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DEPARTMENT OF STATE  
AGENCY FOR INTERNATIONAL DEVELOPMENT  
Washington, D.C. 20523

CARIBBEAN REGIONAL

PROJECT PAPER

ALTERNATIVE ENERGY SYSTEMS

AID/LAC/P-027

Project Number:538-0032

UNCLASSIFIED

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**DEPARTMENT OF STATE**  
**AGENCY FOR INTERNATIONAL DEVELOPMENT**  
WASHINGTON, D. C. 20523

AID/LAC-P-027

**ASSISTANT  
ADMINISTRATOR**

**PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS**

Name of Entities: Caribbean Community Secretariat  
Caribbean Development Bank  
Dominican Republic

Name of Project: Alternative Energy Systems

Project Number: 538-0032

Pursuant to Part I, Chapter 1, Section 106 of the Foreign Assistance Act of 1961, as amended, I hereby authorize a Grant to the Caribbean Community Secretariat ("CARICOM") of not to exceed One Million United States Dollars (\$1,000,000), a Grant to the Caribbean Development Bank ("CDB") of not to exceed One Million United States Dollars (\$1,000,000) and a Grant to the Government of the Dominican Republic ("GODR") of not to exceed Fifty Thousand United States Dollars (\$50,000) (such amounts, which in the aggregate equal \$2,050,000, being called the Authorized Amount), to help in financing certain foreign exchange and local currency costs of goods and services required for the project described in the immediately following sentence. The project consists of the establishment of an institutional capability in the Caribbean region for (i) strengthening national energy planning, including conducting country energy needs assessments, conservation studies and renewable energy resource assessments, and (ii) designing, testing, adapting and disseminating alternative energy technologies (the "Project").

I approve the total level of AID appropriated funding planned for the Project of not to exceed Seven Million Six Hundred Thousand United States Dollars (\$7,600,000) of Grant funding, including the Authorized Amount, during the period FY 1979 through FY 1982. I approve further increments during that period of Grant funding up to \$5,550,000, subject to the availability of funds in accordance with AID allotment procedures, as follows: CARICOM \$2,247,300, CDB \$3,002,700, and GODR \$300,000 (subject to the acceptability of a feasibility study).

I hereby authorize the initiation of negotiation and execution of the Project Agreement or Project Agreements, as the case may be, by the officer to whom such authority has been delegated in accordance with AID regulations and Delegations of Authority, subject to the following essential terms, covenants and major conditions, together with such other terms and conditions as AID may deem appropriate:

A. Source and Origin of Goods and Services

Except for ocean shipping, and except as set forth in Section E below, goods and services financed by AID under the Project shall have their source and origin in the United States or, in the case of the Grant to CARICOM, in member countries of CARICOM, or, in the case of the Grant to the CDB, in the countries in the Caribbean which are members of the CDB and which are included in AID Geographic Code 941, or, in the case of activities to be carried out in Haiti and the Dominican Republic, respectively, in Haiti and in the Dominican Republic, respectively, except as AID may otherwise agree in writing. Ocean shipping financed by AID under the Project shall be procured in the United States, except as AID may otherwise agree in writing.

B. Conditions Precedent to Disbursement (CARICOM, CDB)

Prior to any disbursement, or to the issuance of any commitment documents under the Project Agreement or Project Agreements, to finance activities of the CARICOM Energy Unit or the CDB Energy Group, as the case may be, for other than technical assistance, professional staff salaries and supporting administrative costs, CARICOM or the CDB, as the case may be, shall, except as AID may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(i) evidence that CARICOM or the CDB, as the case may be, has planned for an adequately staffed Energy Unit or Energy Group, as the case may be, and has a detailed plan governing its operation, including permanent staffing arrangements, and a time-phased work plan governing the use of Project funds for the Policy, Training, Communications and Technical Programs; and

(ii) a copy of a signed contract for technical services to provide CARICOM and the CDB with the necessary expertise for program development and implementation.

C. Covenants (CARICOM, CDB)

Except as AID may otherwise agree in writing, CARICOM and the CDB shall each covenant and agree to:

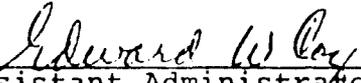
- (i) evaluate the Project using Project funds in the second and fifth years of Project implementation;
- (ii) maximize communications between the CARICOM Energy Unit and the CDB Energy Group through consultations on work plans, subprojects and terms of reference;
- (iii) utilize guidelines developed by the Project Advisory Committee;
- (iv) report periodically to the Project Advisory Committee with respect to Project implementation; and
- (v) use every effort to secure funds from regular budgeting sources to support the continuation of the staffs of the CARICOM Energy Unit or the CDB Energy Group, as the case may be, beginning in the third year of Project Implementation.

D. Covenant (CDB)

Except as AID may otherwise agree in writing, the CDB shall covenant and agree to use its best efforts to procure goods and services from the countries authorized under Section A above prior to procuring goods and services from countries made eligible for source and origin pursuant to Section E below.

E. Waiver

For the reasons set forth in the Action Memorandum to the Assistant Administrator (LAC), attached hereto, goods and services having a cumulative value of not to exceed \$500,000 may be procured from countries included in AID Geographic Code 899.

  
\_\_\_\_\_  
Assistant Administrator  
Bureau for Latin America  
and the Caribbean

  
\_\_\_\_\_  
Date

**Clearances:**

GC/LAC:JKessler	<u>JK/446</u>	Date	<u>8/22/79</u>
LAC/DR:LArmstrong	<u>A</u>	Date	<u>8/22/79</u>
LAC/DR:MBrown	<u>JCB</u>	Date	<u>          </u>
SER/COM:PHagen	<u>          </u>	Date	<u>10/1/79</u>

GC/LAC:GMH            iter:jlo:8/20/79:x29182

AGENCY FOR INTERNATIONAL DEVELOPMENT  <b>PROJECT PAPER FACESHEET</b>		1. TRANSACTION CODE <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-right: 10px;">A</div> A = ADD C = CHANGE D = DELETE	PP  2. DOCUMENT CODE 3
3. COUNTRY/ENTITY CARIBBEAN REGIONAL - RDO/C		4. DOCUMENT REVISION NUMBER <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 100px;">0</div>	
5. PROJECT NUMBER (7 digits) <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">538-0032</div>	6. BUREAU/OFFICE A. SYMBOL LAC	B. CODE <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">05</div>	7. PROJECT TITLE (Maximum 40 characters) <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">ALTERNATIVE ENERGY SYSTEMS</div>
8. ESTIMATED FY OF PROJECT COMPLETION  FY <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">84</div>		9. ESTIMATED DATE OF OBLIGATION A. INITIAL FY <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">79</div> B. QUARTER <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">4</div> C. FINAL FY <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">82</div> (Enter 1, 2, 3, or 4)	

10. ESTIMATED COSTS (\$000 OR EQUIVALENT \$1 - )						
A. FUNDING SOURCE	FIRST FY			LIFE OF PROJECT		
	B. FX	C. L/C	D. TOTAL	E. FX	F. L/C	G. TOTAL
AID APPROPRIATED TOTAL						
(GRANT)	( 503 )	( 1547 )	( 2050 )	( 3004 )	( 4596 )	( 7600 )
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER						
U.S.						
HOST COUNTRY	CARICOM/CDB				500	500
<del>XXXXXXXXXX</del> COUNTRIES					376	376
TOTALS	503	1547	2050	3004	5472	8476

11. PROPOSED BUDGET APPROPRIATED FUNDS (\$000)									
A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE		E. 1ST FY 79		H. 2ND FY 80		K. 3RD FY 81	
		C. GRANT	D. LOAN	F. GRANT	G. LOAN	I. GRANT	J. LOAN	L. GRANT	M. LOAN
(1) SD	740-S	878		2050		2250		3000	
(2)									
(3)									
(4)									
TOTALS									

A. APPROPRIATION	N. 4TH FY 82		O. 5TH FY 83		LIFE OF PROJECT		12. IN-DEPTH EVALUATION SCHEDULED  MM   YY <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">01 88 12</div>
	P. GRANT	Q. LOAN	R. GRANT	S. LOAN	T. GRANT	U. LOAN	
(1) SD	300		-		7600		
(2)							
(3)							
(4)							
TOTALS							

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

1

 1 = NO  
 2 = YES

ORIGINATING OFFICE CLEARANCE SIGNATURE WILLIAM B. <i>William B. Wheeler</i>	18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION  MM   DD   YY <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">07 09 79</div>
TITLE AID REPRESENTATIVE	DATE SIGNED MM   DD   YY <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">17 17 79</div>

ALTERNATIVE ENERGY SYSTEMS  
PROJECT PAPER

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I. SUMMARY AND RECOMMENDATIONS

A. Recommendations

The AID Regional Development Office, Caribbean (RDO/C) recommends grants be authorized to the Caribbean Community Secretariat (CARICOM) and the Caribbean Development Bank (CDB) in the amounts of \$3,272,300 and \$4,027,700 respectively for assistance to carry out an Alternative Energy Systems Project for the region. Further, RDO/C recommends one additional grant of \$300,000 be authorized to the Government of the Dominican Republic for carrying out a technical component of the Regional Alternative Energy Systems Project. Due to the requirements for long-term commitments early in project implementation, RDO/C recommends funding levels of \$2.3 million (\$1 million to CARICOM, \$1 million to CDB and \$50,000 to DR) in FY 1979, \$2½ million in FY 1980, \$3 million in FY 1981 and \$300,000 FY 1982. The total cost of the project is \$7,600,000 to be funded under Section 106, Special Development Problems.

B. Grantees

The grantees and executing agencies for the Project will be CARICOM and the CDB. The participating countries for project activities are Antigua, Barbados, Belize, Dominica, Dominican Republic <sup>1/</sup>, Grenada, Guyana, Haiti <sup>1/</sup>, Jamaica, Montserrat, St. Kitts-Nevis-Anguilla, St. Lucia, St. Vincent. Other countries in the Region will be invited to attend various seminars and will receive various communications developed in the project.

The CARICOM is a regional institution established in 1973 for the coordination of economic activities and policies common to the region. One of its objectives is the achievement of a greater measure of economic independence and effectiveness of its member states in dealing with other states and entities. CARICOM fosters optimum utilization of human and natural resources of the region by supporting programs of various common services and functional cooperation in various social, cultural, educational and technological areas.

The CDB is a regional development finance institution established in 1970 and composed of sixteen member countries in the Caribbean region and Canada and the United Kingdom as non-regional members. Its purpose is to promote the development and integration of its borrowing member countries with special emphasis on its less developed members.

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<sup>1/</sup> - The Dominican Republic and Haiti are not members of the CDB and therefore are not eligible to participate directly in the Technology Program but will participate in all other project activities. Special bilateral funding arrangements have been made to initiate technology projects in the DR., a \$300,000 Grant and in Haiti under the Appropriate Technology project.

### C. Description of Project

The goal of this Project is to develop a capability to utilize renewable energy sources in the Caribbean as alternatives to imported fossil fuels and to encourage energy conservation measures. The purpose of the project is to establish an institutional capability in the Caribbean region for strengthening national energy planning including conducting country energy needs assessments, conservation studies and renewable energy resource assessments and for designing, testing, adapting and disseminating alternative energy technologies.

The project will provide assistance to the Caribbean institutions and governments for the development of regional and national skills and technologies in energy related fields. Project activities have been divided into four programs. Due to the specialized abilities of CARICOM and CDB these programs consist of:

#### CARICOM

- Policy planning and assessments
- Technical and analytical training

#### CDB

- Communication and information network
- Field testing of applied energy technologies

#### 1. Policy Planning and Assessments.

Some \$938,000 of the grant funds will be used to establish and strengthen the regional and national capabilities in energy planning and policy formulation. The CARICOM will negotiate and finance contracts for technical assistance to the region and the countries for development of energy assessments, programs of conservation measures, energy policy review and development. Grant funds will finance contracts with institutions, firms and individuals with experience in energy policy formulation and assessment.

#### 2. Technical and Analytical Training.

Approximately \$1.3 million of grant funds will be used to develop within the Region a cadre of trained personnel in energy planning, assessment, and renewable resource energy technology design, project development and maintenance. The training program includes two training areas (1) policy and (2) technical. CARICOM will fund experienced regional institutions such as the Center for Energy and Environment Research (CEER), University of the West Indies (UWI) to provide both policy and technical training. In areas where no regional expertise exists professionals will be sent outside the region to obtain the training. The program utilizes institutions within the region as much as possible to expand and improve the availability of regional training. Individual candidates will be selected for the program based upon governmental and institutional recommendations to the Training Program coordinator of CARICOM.

The grant funds provide for the training of two energy specialists to work with CARICOM.

### 3. Communication and Information Network.

The communications activities (\$613,000) funded under this grant will be directed at strengthening the existing networks and expanding of capabilities for dissemination of renewable energy information. The communication program supports and will be administered by the CDB Technology Information Unit. Specific activities include country visitation, Alternative Energy Workshops and special communications such as Seminars, Abstracts and a Newsletter.

### 4. Field Testing of Applied Energy Technologies.

Some \$2.6<sup>1/4</sup> million in grant funds will provide field testing of a variety of small scale renewable energy technologies appropriate for community or individual applications. These tests are a key step in the acceptance and commercialization of renewable energy systems in the region. The CDB will contract with various regional institutions and outside contractors for applied design and/or purchase and installation of existing non-conventional energy systems. In each participating country two demonstration sub-projects have been selected which meet criteria considering the country's energy policy, technical and economic situation, possible commercialization, and social and environmental requirements.

The staffs of both the CARICOM and the CDB will be augmented to provide for management of the program. CARICOM is granted \$1 million for some thirty-eight person years of staff and consultant support. Approximately \$1.1 million is provided to the CDB for forty person years of staff and nine person years of consultant services. Both CARICOM and CDB will in most cases utilize other institutions and consultants for implementing project activities.

Tying the project implementation together and providing policy advice to both the CDB and CARICOM will be the Energy Advisory Committee chaired by CARICOM and consisting of representatives of the member countries of CARICOM plus the Bahamas, Dominican Republic, Haiti and the CDB. This committee will function on an ad hoc basis with representatives selected by the participating governments and institutions. Technical support to this committee may be provided by the Commonwealth Science Council or outside consultants as is required. During the projects' initial two years of implementation and to support technical advisory activities, a joint contract for 5 person years of consultant services will be made between CARICOM/CDB and a selected consultant firm.<sup>2/</sup> This joint contract will provide a unitary linkage between CARICOM and CDB for maximizing project coordination and supplying needed technical expertise at start-up.

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<sup>1/</sup> Including \$300,000 direct bilateral grant to GODR.

<sup>2/</sup> This contract period may be extended as required to maximize project implementation. This determination will be made during the second annual review.

D. Summary Financial Plan

The total cost of the project is \$8,476,000. The estimated breakdown of cost of the project is shown in the following table. The CARICOM, CDB and countries are providing \$876,000 of in-kind support. Due to the institution building and testing activities planned, the project will be implemented over five years from the date of signing the Grant Agreements.

Summary Financial Plan

	US. \$000's				
	<u>AID</u>	<u>CARICOM</u>	<u>CDB</u>	<u>COUNTRIES</u>	<u>TOTAL</u>
Policy Program	938				938
Training Program	1,324			56	1,380
Communication Program	613				613
Technical Program	2,626			320	2,946
Institution Building CARICOM	1,010	105			1,115
CDB	<u>1,089</u>	<u>          </u>	<u>395</u>	<u>-</u>	<u>1,484</u>
	7,600	105	395	376	8,476
	=====				

Obligation Levels by Fiscal Year

	(\$ 000)				
Grantee	<u>FY 1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>Total</u>
CARICOM	1,000.0	1,000	1,272.3	-	3,272.3
CDB	1,000.0	1,000	1,627.7	300	4,027.7
Gov't of the Dominican Republic	50.0	250	-	-	300.0
	<u>2,050.0</u>	<u>2,250</u>	<u>3,000</u>	<u>300</u>	<u>7,600.0</u>
	=====				

E. Summary Findings

Based upon the results of intensive review of the proposed project activities, the RDO/C has determined that the project is technically and financially sound and feasible for completion within the proposed disbursement period of five years. The project is acknowledged by the Caribbean Group for Cooperation in Economic Development (CGCED) as being important in development of Alternative Energy sources.

Discussions with officials of governments and regional institutions indicate that a strong demand for this project exists. The project will establish an institutional capability in the Caribbean area for undertaking national energy planning, including country energy needs assessments, energy conservation policy reviews and renewable energy resource assessments, and for designing, testing, adapting, and disseminating various alternative energy technologies. As such, it responds to the desires of the Caribbean governments to reduce their dependency on fossil fuels. This project is a first step toward achieving that goal.

The project is in consonance with a recent World Bank survey on energy needs in the Caribbean area (May, 1979) in that it strengthens the planning, administration and quantitative framework for energy decision making; trains and mobilizes the human resources in the study and implementation of energy accounting, engineering, instruction and policy development; and promotes and tests the adoption of nonconventional energy systems.

#### F. Project Issues

##### Increases in LOP Funding

The original total cost of this project was estimated in the PID at \$2.8 million. The LOP funding was increased because of the added requirements for institution building, energy policy planning and training individuals in technical skills related to alternative energy technologies identified during intensive review. Funds were increased for the implementation of a comprehensive energy training program (\$1.3 million) and for energy policy development and assessments (\$938,000). The training program is especially critical if the project purpose is to be achieved, i.e. the institutionalization of an energy planning and alternative energy technology applied research capability in the region. This level of effort reflects the fact that the project is starting from an almost zero base to build an energy capability in the Caribbean area.

#### G. Conditions and Covenants for CARICOM/CDB Grants

The conditions precedent and covenants described below are proposed in addition to the standard conditions associated with AID Grants.

1. Conditions precedent to disbursement other than for Technical Assistance, professional staff and administrative costs.

Prior to disbursement under each Grant or to issuance by AID of documentation pursuant to which disbursement will be made, for activities of the CARICOM Energy Unit and the CDB Energy Group, the respective Grantee will, except as the Parties may otherwise agree in writing, furnish to AID evidence:

- (a) that the Grantee has planned for an adequately staffed Energy Unit or Group and has a detailed plan governing its operation including permanent staffing arrangements, and time-phased work plan governing the use of project funds for the Policy, Training, Communications and Technical Programs.
- (b) of a joint contract between CARICOM/CDB and a consulting firm for technical services to supply technical expertise and advise in program development and implementation.

## 2. Special Covenants.

The grantees, except as AID shall otherwise agree in writing, shall covenant to:

- (a) evaluate the project using project funds in the second and fifth year of implementation;
- (b) maximize communications between the energy groups in CARICOM and CDB through consultations on work plans and sub-projects terms of reference;
- (c) utilize the project guidelines developed by the project's Advisory Committee;
- (d) report periodically to the Advisory Committee regarding project implementation; and
- (e) use every effort to secure funds from regular budgetary sources to support the continuation of the energy group staffs beginning in the third year of the project.

## H. Source/Origin Waivers for Consultant and Training Services

### 1. Consultant Services.

Several institutions in Great Britain, Canada, and France, for example, Brace Research Institute of McGill University in Montreal, have expertise in renewable energy technologies such as micro-hydropower as well as a French-speaking capability. During project implementation, the CDB and/or the Ministry of Natural Resources and Energy in Haiti and INDOTEC in the Dominican Republic may wish to utilize expertise which exists in AID Geographic Code 935 countries (all Free World). For the new, appropriate technologies being field-tested under this project expertise already exists in England, India and France.

### 2. Training.

The above rationale applies to the training component of this project as well, especially for Haitian participants who may well train at a French institution if US. and Caribbean programs are judged inadequate. In addition, institutions in Latin America - Haiti in Guatemala, for example - may well be more appropriate than a US. setting for training energy specialists from the Dominican Republic.

Due to the experimental nature of the program and the diverse technical skills required, RDO/C hereby requests a source/origin waiver to permit procurement of consultant services and training activities in Code 935 countries not to exceed \$400,000 of total project costs to be used when it is determined that required equipment and services are not available in eligible source countries. The Draft Authorization (Annex I, Exhibit 4) includes language to this effect.

I. Project Committee

RDO/C

Steve Ryner - Project Coordinator - CPDO, RDO/C  
Norma Parker - Finance Officer, LAC/DR-AID/W (TDY)  
Gerald Wein - Program Economist, RDO/C  
Robert Meighan - Regional Legal Advisor, RDO/C  
Dwight Johnson - Deputy AID Representative

Other AID Missions Participating

Charles Blankstein - CRDO USAID/Dominican Republic  
Jerome Hulehan - GDO USAID/Jamaica  
Tibor Nagy - ENG USAID/Haiti  
Nick Mariani - PO USAID/Guyana

Contractors Participating in Project Development

Donovan, Hamester and Rattien Inc.  
AID Contract SOD/PDC-C-0147

Science Applications Inc.  
AID Contract LAC-C-1294-1295-1296

Principal Liaison Persons in Grantee Institutions

CARICOM

Dr. K. King, Secretary General  
A. Moore, Director, Functional Cooperation  
B. Blake, Director, Sectoral Policy and Planning

CDB

Dr. L. Campbell, Director, Projects Department  
B. Gouveia, Deputy Director, Project Design and  
Analysis Division

Approved by

William B. Wheeler, AID Representative, RDO/C

## II. PROJECT BACKGROUND AND RATIONALE

### A. Background

From 1972 to 1977, energy demand in the Caribbean grew at an average annual rate of 6 percent<sup>1/</sup>, approximately two times the rate for the United States, Canada, and Western Europe. This increase is expected to continue. Per capita energy consumption is also rising. In the Caribbean, energy consumption has increased by an average of 35 percent in the last seven years. (See Table A on following page).

Four main development forces have been responsible for the rapid growth in energy consumption in the Caribbean:

- o Industrialization to combat unemployment and balance of payment problems;
- o Infrastructure to support an expanding tourist industry sector;
- o Rising levels of consumer energy use (residential, transportation, etc.);
- o Increased urbanization.

Other factors are presently at work. The agricultural sectors have been in decline in most Caribbean countries which has further contributed to the burden of import dependence. Reversing the decline should, in fact, require more energy intensive infrastructure for greater mechanization and modernization of agricultural production. The end result will be still higher energy consumption. Thus, the Caribbean countries are expected to experience continued rapid growth in energy use.

Known energy resources in the region are small and unevenly distributed. All Caribbean countries, with the exception of Trinidad & Tobago, are net importers of energy, which is almost entirely in the form of petroleum. With fuel bills equal to 15 to 20 percent of GNP in some

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<sup>1/</sup>

Does not include Trinidad & Tobago; Source: IBRD, "Caribbean Energy Survey", May 7, 1979.

## CARIBBEAN REGIONAL ENERGY SURVEY\*

## MACROECONOMIC AND ENERGY INDICATORS, SELECTED CARIBBEAN COUNTRIES, 1977

	GDP at Market Prices	GDP/- Capita	Energy Consumption			Energy Consumption per US\$1 of GDP (BTU)	Electri- city Consump- tion per Capita (KWh)	Consump- tion Increased Since '72 %	Population ( '000)
			Total	Commercial (BTU bn)	Other				
Antigua	55.2	890	1,435.3	1,435.3	18.0	26,328	595	N.A.	72.5
Barbados	438.5	1,760	9,618.9	7,406.3	2,212.6	21,936	899	30	250.0
Belize	89.9	810	5,057.0	2,823.0	2,234.0	56,251	291	32	132.3
Dominica	33.5	410	557.9	501.8	39.4	16,654	164	31	76.9
Dominican Republic	4,466.6	840	..	..	..	..	265	75	5,128.9
Grenada	41.1	480	819.2	758.0	61.2	19,932	185	9	105.8
Guyana	438.0	560	38,595.0	25,443.0	13,152.0	88,116	239	32	812.0
Haiti	1,184.7	230	27,630.0	9,690.0	17,940.0	23,322 <sup>a/</sup>	50	113	4,700.0
Jamaica	2,696.0	1,150	99,179.5	89,409.3	9,770.2	36,788	989 <sup>b/</sup>	20	2,096.6
Montserrat	8.3	745	232.9	211.7	21.2	28,060 <sup>c/</sup>	591 <sup>d/</sup>	-22	12.7
Netherlands Antilles	718.4	2,786	..	..	..	..	..	..	245.2
St. Kitts	25.2	650	..	..	..	..	349	N.A.	49.7
St. Lucia	58.1	580	1,270.1	1,227.4	42.7	21,860	329	53	114.6
St. Vincent	..	330	..	..	..	..	140	10	103.9

<sup>a/</sup> Excluding the bauxite and cement industries, energy consumption per U.S. \$1.- of GDP amounted to 21,415 BTU.

<sup>b/</sup> In 1974, 47,149 BTU/US

<sup>c/</sup> This relatively high energy intensity is due to the large expatriate population.

<sup>d/</sup> 415 KWh of the largest individual consumer is excluded.

\*Derived from IBRD May 1979 Caribbean

Energy Survey, p 27

countries, energy imports have become a critical element in the countries' balance of payments problems. Further price increases in international petroleum markets will exacerbate this situation, and by 1983, energy imports in the region are predicted to preempt approximately 25% of projected foreign earnings.

In the Caribbean, a large amount of imported petroleum products are typically converted into electricity using oil fueled power plants or diesels. The transportation and residential sectors are also responsible for large portions of petroleum consumption in the region (particularly for expensive, premium fuels such as gasoline and propane). In the near future, petroleum-based fuels will necessarily continue to provide the main source of energy to meet these overall demands.

A number of development options must be followed in order to stabilize the regional energy situation. These include, for example, a variety of near-term conservation improvements in existing utilities and industrial facilities, as well as a number of effective conservation policies in the residential and commercial sectors. Over the mid-to-longer term, energy consumption in all economic sectors can be minimized by careful selection of energy efficient equipment and facilities.

Another important alternative lies in the substitution of indigenous energy for imported fuels, or in meeting part of incremental energy demands through the development of alternative energy supply options. The extent of potential energy substitutions depends on the availability of alternative supply options, the adaptability of energy technologies to different energy forms and applications, and the general interest and rate of investment in new options. Non-conventional, indigenous energy resources such as solar, wind, biomass, mini-hydro, and geothermal energy can make a significant contribution to local energy supplies and can thus play a critical role in the economic development of specific communities, target groups and commercial enterprises. In addition, investigation of alternative energy options can form the basis for broader identification and evaluation of resources, initiate the development of a well-coordinated energy program and diversify the energy resource base and increase development options of the region.

A growing understanding of the seriousness of the energy crisis for the Caribbean, coupled with lowered expectations for finding extensive new fossil fuel supplies in the region has led to serious interest in non-conventional or renewable energy resources. It is important to point out, however, that governments in the region generally have not vigorously pursued more basic investigations into energy matters, such as national energy policy and planning, resource assessment, energy use analysis, and conventional energy development. These gaps must be addressed in a coordinated energy program, and will be discussed in latter sections of the project paper describing specific project activities.

On initial inspection, the Caribbean appears well-suited to take advantage of renewable energy resources as a substitute for petroleum. The Caribbean's natural energy resource base consists of high levels of insolation (solar energy), excellent biomass growth rates, trade winds, and geothermal energy potential. In a number of countries, significant hydro power potential exists also. The conversion of these indigenous resources may become cost competitive sooner in some economic sectors in the Caribbean than in industrially advanced countries because of the comparatively higher costs and almost total dependence of the region on imported petroleum fuels. These economic and resource factors, if combined with the necessary technical expertise, managerial skills, financial resources, and government and institutional support to effectively address the energy problem, could allow the Caribbean to be one of the first areas to take advantage of alternative energy options.

Several alternative energy conversion processes are already in use in the region. In a number of Caribbean countries, hydropower is already an important indigenous energy resource and provides electricity in the following proportions of total electricity generation.

Haiti	-	47%
Dominica	-	43%
St. Vincent	-	37%
Dominican Republic	-	13%
Jamaica	-	3%

Hydro potential has been identified in Belize (micro-hydro), Guyana (both large scale and micro) and a number of Eastern Caribbean islands (e.g. Grenada).

Wood and charcoal (biomass fuels) provide significant amounts of energy in heavily rural and/or forested countries (Haiti, Belize, Dominica, Dominican Republic, Grenada, Guyana and St. Lucia). Efforts to increase utilization of these resources must concentrate on production, transport and marketing efficiencies in order to make an additional contribution. These efforts must also be accompanied by integrated reforestation programs to avoid further ecological damage (e.g. Haiti). Other biomass options include the combustion of bagasse (sugar cane wastes) and other plant wastes for electricity and steam cogeneration, the conversion of plant and animal wastes to gaseous fuels through digestion, and the production of liquid (alcohol) and solid fuels from agricultural and timber wastes.

Solar energy has substantial potential throughout the region. Commercial enterprises have begun in hot water heating (Barbados, Dominican Republic, St. Kitts, etc.), water distillation (Trinidad), air conditioning (Barbados) and crop drying (Jamaica, Trinidad, St. Lucia, etc.). Each of these options can be effectively used in a number of residential, commercial and industrial applications, but incentive schemes may be necessary to assist widespread development. Similarly, wind energy potential exists in many Caribbean countries and was, in fact, used throughout the region in the past for water pumping and mechanical power. Wind power for pumping water (e.g. irrigation use) and on-site electricity generation in remote sites are the likely applications for this resource.

Lastly, geothermal energy represents a potential resource in several Caribbean countries (St. Lucia, Dominica, Haiti and St. Vincent). The costs of commercial scale power plants are significantly greater than those of the options discussed above, and thus are outside the scope of this project. However, the feasibility of developing this renewable resource in terms of magnitude of energy supply, and comparative costs and benefits of geothermal development versus other energy sources can be estimated. This study may be funded under the Technical Program (See Project Description, Section B,2.d).

It is important to note, however, that a substantial substitution of conventional energy sources with alternative or renewable sources cannot occur in the near term. This substitution is partially restricted by the lack of energy assessments, trained people and information on systems application. This project addresses these restrictions and will provide a policy and data base upon which expansion and commercialization of non-conventional energy systems can develop for the long term. Furthermore, the immediate

applications of alternative energy technologies do not readily replace petroleum fuels because the demand is heavily based on the need for high quality energy forms, i.e., electricity and liquid fuels for transportation. Nevertheless, wider acceptance and greater market penetration of alternative energy systems can meet incremental energy demands over the mid-term and can begin to displace the need for conventional energy forms.

#### B. Project Rationale: Regional Cooperation

A basic premise for this project is that alternative energy research and development efforts must be cooperative and regional in nature, and must be accompanied by serious efforts in: 1) the development of general as well as alternative energy policy, 2) establishing effective communications networks in energy areas, and 3) developing a skills base through technical, managerial and professional training. These specific efforts will be discussed in detail in the project description.

A regional approach to the development of capabilities in the energy area is important because Caribbean countries share common characteristics which determine their energy position. It is unreasonable to expect that the relatively small developing countries of the region are individually capable of developing renewable energy sources. Regional cooperation in development efforts provides a better base from which to mobilize and utilize limited human, informational and technical resources. Solutions to energy problems must be country-and location-specific, but regional coordination precludes unnecessary and costly duplication of efforts in the solution of recognized common problems.

The small LDCs face particular constraints due to their size and limited capabilities which often prevent the development and utilization of least-cost energy supply options. Addressing energy problems and alternative energy development on a regional level allows the achievement of certain economies of scale by directing development efforts toward wider applications. For example-joint procurement schemes for assistance and equipment required for alternative energy development may well develop out of the project's regional collaborative approach.

### C. Relationship to RDO/C Strategies

Regional cooperation in development initiatives is also a cornerstone of the Mission's Caribbean Regional Development Strategy. Its overall objective is to encourage regional cooperation to overcome the diseconomies of small scale inherent in a strictly national approach by the small countries, and to encourage the development of complementary regional and national policies to strengthen the individual economies. The basic strategy of the Regional Development Office for the Caribbean (RDO/C) is to provide resources to strengthen cooperative initiatives and the institutions which are essential to long-range viability of Caribbean economies. Of the range of activities which are appropriate for regional cooperation, energy is considered important to the economic development of the broader Caribbean and is seen as an area which inherently lends itself to multi-national, region-wide solutions. In particular, the RDO/C strategy identifies the development of alternate energy sources as a key problem area.

The Alternate Energy Systems Project is consistent with both the overall and specific objectives of the RDO/C strategy. As a requirement for effective project implementation, appropriate regional development institutions will be supported and strengthened. Cooperation through educational exchanges and dissemination of technical information and research results will be accomplished through a variety of communications activities. Human resource development will be addressed through expanded as well as new training opportunities in technical, analytical and managerial fields. Lastly, and most importantly, cooperation in national and regional policy development for the energy sector will be sought through a number of integrated policy studies.

### D. International Donor Energy Activities

The large number of multilateral and bilateral international assistance agencies active in the Caribbean Region occasionally include alternative energy development activities in their programs. Annex II-2 presents a list of these organizations with their energy projects in the Caribbean. These various projects represent significant activity in the alternative energy area. However, coordination of these efforts has been generally lacking in the past. To date, no donor organization has sponsored comprehensive country energy resource assessments, focused on the infrastructure needed to consider energy options or encouraged collaborative approaches to the region's energy problems.

The British-based Commonwealth Science Council (CSC) has sought to achieve coordination in renewable energy project planning and implementation through its Caribbean Alternative Energy Program, established in 1977. To date, however, lack of funds and the volunteer nature of project management has impeded progress. Recently (April, 1979) the CSC and the Caribbean Community Secretariat (CARICOM) met to discuss the possibility of establishing an Energy Desk within CARICOM based on CSC's Caribbean Alternative Energy Program. This initiative provides the necessary impetus to the energy development activities of both organizations and was a significant step toward advancing alternative energy in the Caribbean. Although CSC could not provide any funding for the Desk, this concept is funded and expanded by this project.

The Organization of American States (OAS), has provided limited funding for energy projects in the region. While not specifically focused on alternative energy development, the most recent OAS effort assembled over fifty representatives from the Caribbean, with outside participation, for the CSC/OAS Workshop on National Energy Accounting System, Puerto Rico, May 1979. Previous OAS-supported science and technology activities surveyed the energy problems of a number of Caribbean countries in order to assess the potential for non-conventional energy development. OAS has also supported experimental solar research in Jamaica and Trinidad & Tobago. Until the recent energy accounting seminar, however, the OAS has had little success in coordinating Caribbean energy activities.

A number of bilateral assistance projects also include alternative energy development. For example the European Development Fund has supported a solar cooling project for government buildings in Barbados. The German Foundation for International Development has sponsored wind resource surveys and test windmill installations in Haiti. The British Development Division has funded geothermal development feasibility studies in St. Lucia. USAIDs have bilaterally funded an energy analysis project in Jamaica and an appropriate technology project in Haiti.

There are other examples as well, but they serve to illustrate that in few instances have multilateral or bilateral programs sought to involve international cooperation within the region. Nor have energy projects been carried out as part of an integrated, alternative energy initiative.

The World Bank has recently released a report entitled "Caribbean Energy Survey",<sup>1/</sup> which was delivered at the Second Annual Meeting on June 7, 1979, in Washington D.C. of the Caribbean Group for Cooperation in Economic Development, a consortium of international donors and recipient countries active in the region. The consortium agreed that external donors should consider increasing capital flows and technical assistance for energy development and encouraged that assistance include the exploration and production of petroleum and the development of other mineral fuels and alternative energy sources. The USAID program to develop alternate energy sources in the region was acknowledged to be an important one. IDB and the World Bank explained their programs and willingness to consider financing energy development. It was generally agreed that the Technical Assistance Steering Committee could help coordinate the provision of donor technical assistance to the Region. The Energy Survey contained a series of recommendations for the type of activities needed throughout the Region and the role of international donor assistance and coordination in energy areas. The report also contained noteworthy recommendations for the initiation of cooperative efforts in this area. In particular, the World Bank suggested that the Caribbean Development Bank (CDB) play a role in implementing a regional energy development program with an emphasis on renewable and non-conventional energy resources. See Annex II-3.

E. Establishment of a Caribbean Alternative Energy Program

In response to the demand for development of non-conventional energy sources and the need for wider Caribbean cooperation in such endeavors, RDO/C designed this project to:

Assist national and regional energy planning activities;

Promote regional technical cooperation and information transfer among the nations participating in the program;

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<sup>1/</sup> World Bank, "Caribbean Energy Survey", Report No. 2511-CRB Washington D.C. May 7, 1979 p.v.i.

Expand the indigenous technical and analytical skills related to energy management and energy technology development; and

Conduct research and field testing of renewable energy technologies.

Project development began in October 1978, under a contract with Science Applications Inc., to conduct a preliminary survey of renewable energy data and to identify potential demonstration projects. This activity was well received in the region, and served to generate interest for continued participation among the seven East Caribbean countries included in the survey.

The project paper is based on intensive review and analysis provided by a team of consultants from Donavan, Hamester and Rattien (DHR) who surveyed fourteen countries in the wider Caribbean<sup>1/</sup> area in April-May, 1979.

The objectives of the survey were:

to assess current regional activities and needs in renewable energy and to review existing technical, analytical and institutional capabilities in the energy area;

to design and recommend an organizational structure for a regional alternative energy systems project; and

to recommend activities to be performed under the project in policy analysis, training, communications, and technology development and field testing.

In addition to the survey, a two day conference was conducted May 24 and 25, 1979 with representatives from the fourteen participating countries, other donors and regional institutions as well as the Caribbean USAIDS to review the proposed project design and approve the project's goal and purpose. This conference was successful in obtaining a consensus among the fourteen countries for the project objectives and proposed activities. The conference participants also developed a tentative institutional arrangement for project implementation. The organizational structure of the project as described in this Project Paper reflects those recommendations, with the exception that it has been decided that CARICOM rather than the CDB will administer the training component.

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<sup>1/</sup> Antigua, Barbados, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Montserrat, St. Kitts-Nevis-Anguilla, St. Lucia and St. Vincent.

### III. PROJECT DESCRIPTION

#### A. Goals and Purpose

The goal of the project is to develop a capability to utilize renewable energy sources in the Caribbean as alternatives to imported fossil fuels and to encourage energy conservation measures. This goal is achieved by introducing cost effective, renewable energy technologies and conservation programs through energy policy review, training of professionals and technicians, improved communications and testing of applications. The project responds to the desires of the MDCs and LDCs of the region to achieve energy self-sufficiency to alleviate the balance of payments problems all of them, except Trinidad and Tobago, are facing because of rising petroleum prices<sup>1/</sup>.

The purpose of the project is to establish an institutional capability in the Caribbean region for carrying out energy planning, including conducting country energy needs assessments, and for designing, testing, adapting and disseminating alternative energy technologies. See Annex II-1 for Log Frame.

The project supports the development of a regional framework for coordinating national energy planning, training and policy making in the Secretariat of CARICOM. The CARICOM Secretariat will assist each Caribbean country participating in the project to develop or strengthen an energy planning capability and to incorporate energy policy in overall national economic development plans. The project will institutionalize within the CDB a capability, first to design and manage a communications program to promote technical cooperation in energy, including an information clearing-house in the region for exchanging technical information concerning alternative energy applications, and second to finance and evaluate technology field test projects for establishing the commercial feasibility of widespread applications of technologies using renewable energy resources.

Finally, both CARICOM and CDB programs will contribute to the development of a cadre of and experienced energy professionals at various institutions in the region for renewable resource development and for the design, maintenance, and operations of alternative energy systems.

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<sup>1/</sup> All Caribbean countries except Trinidad & Tobago are net importers of energy which is almost entirely in the form of petroleum.

It is anticipated that these capabilities which the project will develop will continue to be utilized after the project terminates by other international donor agencies, regional institutions and the countries themselves to support the financing of continued alternative energy research, planning training, field tests, and commercial applications. The expected country accomplishments are reviewed in Annex II-4.

The project has been designed in order to fully incorporate the participating governments of the Caribbean and to maximize the use of existing institutions, energy expertise, and energy resources available in the Caribbean region. The organizational structure and the role to be played in project implementation by participating institutions were closely analyzed during intensive review and reflect the conclusions of the participants of the Alternative Energy Conference discussed above.

B. Description of Project Activities

1. An Overview of Institutional Activities  
CARICOM and CDB

CARICOM and CDB will be the co-grantees and executing agencies for the project with distinct but coordinated roles in project implementation. To maximize project coordination these two institutions will be coupled together by the Advisory Committee and during the first two years a technical support contractor. This contract period may be extended as required upon evaluation of the second annual project review.

The total cost of the AID-financed activities is \$7.6 million of which it is anticipated that GODR will receive \$300,000 of project funds bilaterally thru USAID/DR.

CARICOM as grantee will receive approximately \$3.3 million to establish an Energy Desk (\$1,010,000) and finance and manage the energy policy program and the training activities. The policy program includes country energy assessments 1/ in the CARICOM member countries and Haiti (e.g. energy accounting demand projections and conservation analysis), general energy policy analysis, and detailed policy analysis for introducing alternative energy technologies (\$937,900). The training program develops technical analytical, management and specialized professional skills in the energy field (\$1,324,400).

The CDB as grantee will receive \$4.0 million to establish an Energy Group (\$1,089,400) within its Project Design and Analysis Division, for implementing the technical and communications program modeled after the Technical Information Unit (TIU) 2/.

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1/- The country energy assessment for the Dominican Republic is being financed in FY 80 with LAC Regional funds in coordination with this project.

2/- The TIU was established as part of a \$1.6 million AID grant for Employment/Investment Promotion Project.

The CDB will finance and manage an energy communications program involving information collection and dissemination, conferences, seminars, workshops, and a public information program for all participating countries (\$612,500) and a technical program including renewable energy resource assessments and field-tests of identified alternative energy technologies (\$2,325,800).

In addition to the technical assistance provided to assist with the planning and implementation of discreet sub-project activities, the project includes provision for a joint CARICOM/CDB technical advisory contract with an experienced U.S. institution or firm for the first two years<sup>1/</sup> of project implementation. Whereas other technical assistance funds are to assist the countries or regional organizations which will receive sub-grants or contracts, this assistance will assist the CDB and CARICOM to fulfill their program management and coordination roles under the project. The need for this assistance reflects the fact that neither of the grantees has appreciable previous experience in alternative energy. Both organizations will need to hire staff to implement the project and this staff will not have had the opportunity to be involved in the project planning or to benefit from extensive contact with the consultants for that purpose. Despite the fact that the institutions will greatly strengthen their capabilities at the outset of the project by hiring additional staff and that the Technical Advisory Committee will bring other perspectives and experience into the program planning and implementation process, the Project Committee believes that the provision of an experienced broad-based U.S. energy consulting institution or firm will add a level of technical ability and experience which does not presently exist in the Caribbean and the creation of which is, in fact, one of the project's principal objectives.

The joint Technical Advisory consulting firm or institution will be contracted jointly by the CDB and CARICOM shortly after the signing of the project agreement. The initial contract is expected to be of two years duration and provide approximately five (5) person years of consulting services. AID funding for this activity, \$250,000 for the CDB and \$250,000 for CARICOM, is provided in the respective budgets. See Annex II- 10 and 13. As advisors to the CDB and CARICOM energy units, the consultants will, for example, assist in the development of final selection criteria for technical sub-projects, institutional grants, contractors, training institutions and participants; assist in assessing the technical and economic soundness of technical proposals; ensure that Grantee personnel are aware of relevant research findings, training opportunities

1/ May be expanded as required for successful project implementation.

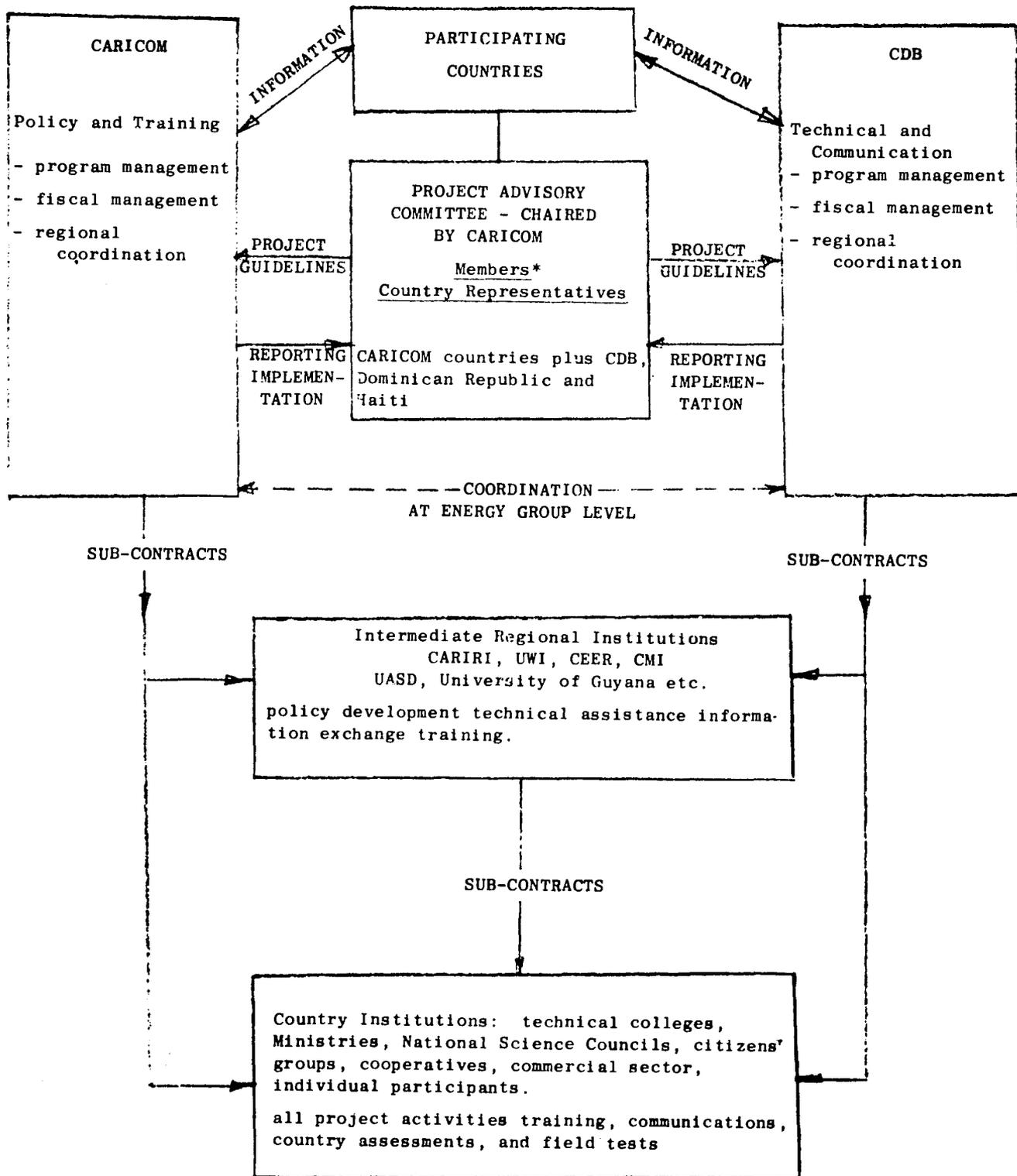
and sources of technical support; assist in the preparation of annual workplans; assist in the development of information feedback systems for monitoring and evaluating; assist in identifying technical assistance needs; and encourage and assist in the development of coordinated and complementary programs by the two Grantees.

Throughout project implementation the CDB and CARICOM will be supported by an Advisory Committee chaired by CARICOM and comprised of the CARICOM member countries plus Bahamas, the Dominican Republic and Haiti. The Advisory Committee will ensure that the project purpose will be accomplished. The Committee will develop general guidelines for project implementation; advise on relative priorities for major program components including budget allocation, and periodically review Project implementation. To provide a greater level of technical expertise this advisory body will incorporate CSC 1/ technical representatives and as required request that CDB contract for specific technical advice with the Grant funds provided to CARICOM and CDB. The CARICOM and CDB will have the day to day management responsibility in their respective areas. Both institutions have been selected for their abilities and experience in coordination and management of the specified areas (see Organizational Structure, Table B. on the following page).

CARICOM Secretariat will establish within its Sectorial and Policy Planning Division an Energy Unit to implement the policy and training programs. The Secretariat's existing staff will be augmented to include a five (5) person staff and will hire consultants to assist countries to undertake various policy and planning studies including country energy assessments. The Energy Unit will be headed by a program manager at the section chief level who will report to the Director of the Sectorial and Planning Division. The staff will include a Section Chief, an Assistant Project Manager and two Energy Specialists (to be trained in advanced energy assessments and policy planning). A training coordinator (for energy), will be added to the newly augmented training staff in the division of functional cooperation to directly support implementation of the energy training program. See Annex II-5 for organization and II-10 for budget. These positions, except for the Energy Specialists, will be gradually funded by CARICOM beginning the third year of project. The training activity will be further supported by the staff provided by the existing CARICOM/AID training grant. Training activities have been integrated within CARICOM to avoid duplication in the previously funded training program.

1/ - Commonwealth Science Council.

PROJECT ORGANIZATIONAL STRUCTURE



\* Governments may wish to include their representatives of the Commonwealth Science Council (CSC) and outside consultants to assure technical inputs and coordination.

CARICOM and CDB will fund US., regional and extra-regional research institutions (CEER, UWI, CARIRI, CMI) and national technical institutes (e.g. St. Kitts Technical College) or other appropriate national organizations (national science councils) for carrying out specific program activities, i.e. assessments, training, communications, and technical research activities.

The CDB will coordinate the activities of the local and regional institutions involved in implementation of individual sub-projects including the provision of technical assistance to the participating organization. The CDB will directly evaluate the technical, economic and social feasibility analyses of demonstration projects to be field tested and develop the selection criteria for future demonstration projects. CDB staff will also evaluate the results of the field tests.

The Project Design and Analysis Division of the CDB will with the assistance to be provided have the capability to carry out its role. The Division has a well qualified staff of professionals with experience in technical assistance, information transfer, project development and implementation. To this staff will be added four full-time professionals to form the Energy Group. This staff will be headed by a Program Manager at the Assistant Director level who will report to the Deputy Director of the Project Design and Analysis Division. The staff will include a Technical Officer, most likely an engineer with experience in environmental analysis, a Communications/Information Officer, and a Financial or Economic Specialist. ( See Annex II-6 for organization and II-13 for budget ). These positions will be gradually absorbed by CDB beginning in the third project year and by the end of the project be fully institutionized and financed by CDB.

Prior to the signing of the Grant Agreements, the Divisions in CARICOM and CDB will assist management in preparation for staff selection and negotiation with the agencies expected to participate in the project and assist in arranging for appropriate agreements with those agencies.

#### Role of Governments

The Caribbean governments will play a primary role in mobilizing the country's resources and interests in energy planning and in alternative energy development. In twelve of the fourteen countries participating in the project an agency or ministry has been designated responsible for coordinating energy activities in-country. This designated listing can be modified as required by the participating governments.

The designated agency generally has broad statutory authority to undertake development activities in public utilities (electricity, water, sewage works) and has a core technical staff with some knowledge of renewable energy resource development. A representative of this Agency may be selected to represent its country on the Projects Advisory Committee. The designated agency may be a Ministry of Public Works and Labor, a National Science Research Council, the Ministry of Finance, or the Ministry of Planning. This Agency coordinates energy activities including alternative energy activities of other public sector organizations (e.g. Ministry of Agriculture, Meteorological Departments etc.). The designated agencies in the participating countries are listed in Annex II-7.

In general, the governments of the Caribbean have very limited experience and expertise in areas of energy policy planning, resource assessment and alternative energy development. The capabilities of each government body designated as lead agency vary considerably, from the sophistication of Jamaica's Ministry of Mining and Natural Resources in overall energy policy planning to the embryonic initiatives in the smaller LDCs.

Most governments will carry out program activities using a combination of the lead ministry and other government agencies. A number of countries have taken steps toward a more directed alternative energy development effort and formed inter-agency or public and private sector commissions concerned specifically with renewable resource development. Examples are the Committee for Alternative Sources of Energy (CASE) in Belize, and the recently organized Energy Commission in the Dominican Republic. These bodies have an advisory role for the government agencies involved in energy areas with varying degrees of influence. They provide the proper focus for information transfer and coordination and could perform an increasingly important governmental function in the Alternative Energy Project.

Another important contribution of participating governments to the project is the commitment of in-kind resources necessary for in-country implementation of project activities. These contributions are in the form of land for project sites, office space and personnel for the policy studies and salaries of participants while attending training courses. This has been quantified in the financial plan at \$376,000. In some cases, this commitment extends to actual site preparation for energy projects (e.g. Antigua Public Utility Authority water pumping sites) and performance of preliminary feasibility analyses (e.g. Belize stream flow data for mini-hydro projects). These resource contributions will be made during the review of potential field tests and will ensure adequate government interest in and attention to project implementation.

### Role of Research Institutions

Because of the desire to strengthen regional institutions in the alternative energy area, it is anticipated that regional institutions such as the UWI, CEER, CARIRI and CMI will be utilized to provide technical assistance to activities in participating countries. These institutions, alone or in combination, could provide a broad range of needed capabilities in energy policy, energy assessments and alternative energy technology applications. These institutions can also contribute to the project's training and communications programs. Annex II-8 describes each institution with its location and areas of specialization.

### Role of Technical Colleges

Technical college activities will consist of conducting technician level training in alternative energy applications, providing logistic support for professional level seminars and conducting limited prototype development. There is a technical college in each participating country. Their capabilities range from basic training in auto mechanics, accounting, etc., to more sophisticated technology development and testing. While these institutes will not, by and large, conduct integrated project activities similar to the research institutions, they fulfill crucial program requirements in skills development at the local or national level. They help to ensure participation of lower income groups in the project in that their clientele are drawn from the lower income group.

Participating colleges and institutes will receive assistance for development, expansion, and/or adaptation of their curricula related to alternative energy applications. The respective governments will be responsible for proposing institutions and programs as a first step in implementing training activities under this component. The CARICOM Energy Unit, assisted as necessary by consultants, will make the final selection of institutions and programs to receive project funds. The institutes presently being considered are as follows:

Antigua	Golden Grove Technical College
Barbados	Unidentified
Belize	Belize Technical College
Dominica	Unidentified
Dom. Republic	Unidentified
Grenada	Unidentified
Guyana	Guyana School of Agriculture
Haiti	Unidentified
Jamaica	College of Arts, Science, & Technology
Montserrat	Montserrat Technical College
St. Kitts-Nevis- Anguilla	St. Kitts Technical College
St. Lucia	Unidentified
St. Vincent	Unidentified

## 2. Program Areas and Activities

- a. Energy Policy Program (\$937,900) CARICOM  
See Annex II-11 for budget.

The purpose of the Policy Program is to establish and strengthen a regional capability in energy planning. The program will improve the data base necessary for energy policy formulation. Improvement in the energy data base and analysis of energy demand, trends, and pricing will be undertaken along with the incorporation of energy planning into national economic planning. An understanding of the implications of economic development on energy demand will also be developed, and energy issues that are best addressed on a regional basis will be identified.

Energy planning studies will provide the basis for the countries' energy technology development plans. Energy assessments, policy review and planning must occur to assure efficient utilization of existing energy systems, as well as to understand the role renewable energy systems can play in the economic development of the participating countries.

CARICOM Secretariat's Energy Group will be responsible for providing broad-based energy policy support to the participating countries. CARICOM's grant funds will be provided for technical assistance for carrying out country assessments and country and regional policy studies. CARICOM's role is that of coordinator and organizer of high level government meetings on policy issues of common importance to the Caribbean region. Because of CARICOM's experience in the Region, the application of policy definition skills to understanding and organizing energy policy issues is a natural role for CARICOM to play in the Alternative Energy Systems Project.

The Policy Program will focus on two major objectives: (1) efficient utilization and conservation of existing energy in each country and (2) the development and promotion of renewable energy resources. Assistance and resources will be provided through the program to governments for supporting their efforts in country energy assessments, policy studies and in identification of regional policy issues.

### Country Energy Assessments

A major portion of the policy program will involve country energy assessments which will provide energy data upon which rational energy planning and policy development can be based. These assessments will use the country energy

assessment methodology developed by Jamaica. See Annex II-9.

Use of the Jamaican methodology will greatly reduce the time, expense, and manpower requirements for carrying out the assessments. The basic areas to be studied in a country energy study will include: country energy demand analysis; petroleum demand and end-use analysis; utility systems and their composition, expansion plans and rate structures; and energy growth and demand projections. Country energy assessments assist a country to comprehend its current energy situation and to begin developing a plan to deal with its future energy problems. CARICOM will provide technical assistance in carrying out country energy assessments. Two energy specialists assigned to CARICOM, Secretariat's Energy Unit, after completion of long term training, will assist participating countries to carry out their assessments. The varying size and energy-use patterns in the participating countries requires that the approach and degree of details needed will be country specific.

#### Country Policy Studies

Country policy studies will be undertaken to assist governments to evaluate various energy policy and strategy options. As indicated below, where the energy problems and prospects are similar across several countries, joint or sub-regional studies may be undertaken.

The country policy studies will assist countries in developing an overall policy framework and analytical methods. This institutional capability will be strengthened by the participants coming out of the training program who will provide the major in-country analytical and policy experience. Coordination of country policy studies with studies already underway, and the selection of participants for the training program, will be the responsibility of CARICOM. Country policy study requests will be evaluated on the basis of their potential usefulness to other countries, estimated cost, and impact on the country's energy problem.

Country policy studies will cover a wide range of relevant energy issues such as:

- (1) Studies of energy conservation policies and existing opportunities.

- (2) Studies on subsidization of the existing energy price structure and how prices can change to reflect the international energy market and promote social equity.
- (3) Studies on less energy-intensive industries for economic development and utilization of more efficient end-use technologies.
- (4) Studies to encourage development of markets for indigenous energy resources.
- (5) Studies on the role and integration of renewable energy resource technologies with existing conventional energy systems.
- (6) Studies on factors influencing energy demand.

#### Regional Policy Studies

Regional energy policy studies will play a major role in the wide-spread application of renewable energy resource technologies. The understanding of energy issues which can best be confronted on a regional level will aid the participating countries in developing their own energy policies. Examples of issues and policies which might be studied on a regional level include a study of regional approaches to manpower and technical resource mobilization and coordination for addressing the Caribbean energy problem; studies on common regional energy services; development of possible petroleum import strategies; development of tariffs and inter-country trade agreements on renewable energy equipment; and studies that deal with energy production facilities that are larger than the host country's demands for a particular energy product (i.e. alcohol in Guyana, solar collector manufacturers in Barbados). Regional energy policy studies can provide guidance for country specific energy policies, as well as aid in directing efforts towards finding regional solutions to the Caribbean energy problem. CARICOM will have responsibility for designing and financing these studies.

Energy policy development is a key component of the alternative energy program and will be supported by and supportive of the other program components. For example, one

of the major goals of the training program is to provide a regional cadre of personnel to do energy accounting and management, energy policy analysis, and energy planning. Trained individuals in these areas will play the major role in organizing and implementing country energy policies. The communication program will provide major information inputs into the policy making process. Inter-regional information links will be established through the communications program to provide effective exchange mechanisms for people working in energy policy development. Seminars on energy policy issues will also provide an effective means for transferring information and ideas on common regional energy problems.

The technical program component will also be closely coordinated with and, in fact, partially influenced by the energy policy component. The result of energy policy planning will, in part, determine the type of energy technologies required to fulfill these needs and goals. As work in the policy area begins to define the needs, constraints, and opportunities of the Caribbean energy situation, much of the work in the communication, technical and training areas will be directed to address these issues.

- b. Training Program (\$1,324,000) CARICOM  
See Annex II-12 for budget.

The objective of this program is to train the skilled personnel necessary for the development of a Caribbean capability in energy policy and planning, country energy and resource assessments, and renewable energy resource technology design and implementation. A comprehensive training program will strengthen the institutional capabilities of the region to address the problem of developing nonconventional energy resources and managing conventional energy resources. Skilled manpower will be needed on a wide range of levels - from technicians who will operate and maintain energy systems through government policy makers.

Within the Caribbean region there are currently few trained people who could contribute significantly to the accomplishment of the overall project goals. With the exception of the CSC/OAS energy accounting seminars and short programs at CEER of the University of Puerto Rico, there exist no regional energy training programs. There are, however, institutions that have a capacity for training and need only to have this capacity developed in energy related areas.

The training program is directly linked with the policy, communication, and technical components of the Alternative Energy Project. Many of the people who will ultimately be developing national energy policies will have participated in policy-related training courses. Individuals participating in country energy or energy resource assessment training will provide key inputs into the national energy planning process of their countries. The training program will provide governments with personnel who have the analytical skills that will be required in evaluating energy policy options and overall energy strategies.

Activities under the training program will represent a major information transfer mechanism in the Caribbean Alternative Energy Project. To ensure the trainees return to the Caribbean the contract/service system utilized in the CARICOM/AID Training Grant<sup>1</sup> will also apply to this project. Training program participants upon return to their countries will pass on their new skills and knowledge. Additionally, important information contacts will be formed by the participants through the training programs, resulting in the establishment of effective intra- and extra-regional information transfer networks.

The training program will support the development of the technical program by providing much of the technical

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<sup>1</sup>/ See Annex II-17.

expertise that will be required for widespread implementation of renewable energy resource technologies. Technical skill development will range from engineers with advanced training in design and implementation to technicians for operations and maintenance of renewable energy resource systems.

The training program is directed toward three broad areas of skills development. Applied or operational training will develop technical expertise in all phases of renewable energy technology. This component of the training program involves technician training for the construction, operation and maintenance of different technology applications. The second area involves training in energy policy and planning, energy country assessments, and general analytical techniques for national energy policy information. The third area, professional training, will include members of the engineering, architectural, construction and other professional communities in studying use of renewable resources, energy conservation, energy efficient building design, and other aspects of commercializing renewable energy systems. Within these three training components, institutes as well as individuals will be supported.

The following TABLE C lists the program components and describes how participants are to be chosen, where they will be trained, where they will go after training, and what they are likely to do after training. The kinds and number of people to be trained are detailed in TABLE D, Illustrative Training Program Output Matrix.

TABLE C  
Training Program Process  
and Results

Function Training Program Component	Participant Selection Process	Training Institute and Location	Post-training Employment & Location	Impact on Region or country
Regional Energy Specialists	Selected by CARICOM	Institutes both regional and extra regional with help from outside experts	Specialists headquartered at CARICOM, will aid countries in energy assessments and policy analysis and development.	Will assist countries in national energy assessments and policy analysis, be a major resource for CARICOM's policy study work
Country Energy Generalists	Selected and salaried by governments	Institutes in region with outside expert help	Return to governments as major focus for energy policy and planning activities	Will provide major focus for national efforts in energy assessment and policy analysis
Engineer/Designers	Competitive scholarship, evaluation by regional technical experts selected by CARICOM	Technical universities in region and U.S., technical experts brought in to teach students & faculty	Return to major R&D institutes in country doing technical work, or government agencies in home country	Expertise for adapting technologies to Caribbean region major design and implementation responsibilities
Professionals	Voluntary participation program sponsor and content evaluated by CARICOM	Venue is the local technical colleges, with training to be done by experts.	Short workshops will improve professional capabilities.	Accelerate use of conservation and alternative technologies into economies, commercialization of new concepts and technologies
Technicians	Program and institutions selected by CARICOM; students selected by technical colleges	Program designed by instructors, taught at technical colleges as part of existing coursework	Absorbed into local craftsman market in home country; available to work on alternative energy technologies, some to become entrepreneurs	Provide technician level skills in the operation & maintenance, and installation of alternative energy technologies.

TABLE D  
ILLUSTRATIVE TRAINING PROGRAM OUTPUT MATRIX

The following matrix describes the numbers, types and availability of participants in the proposed training programs. The matrix is broken into two main training areas, Policy and Technical, with the expected numbers of participants in each category and when they may be available. The proposed training program addresses a wide range of skills development components with greatly varying lengths of time spent in actual training.

Type & Level	APPROXIMATE NUMBER OF TRAINEES					
	FY80	81	82	83	84	TOTAL
<u>Energy Policy Training</u>						
Regional Energy Specialists - energy assessments, accounting and policy analysis	1	1				2
Country energy generalists -	14		14			28
<u>Technical Training</u>						
Engineers/Designers - specialized technology training		10		10		20
Professionals - continuing education	70	140	190	190	190	780
Technicians - installation and maintenance training	42	84	112	168	168	574
Other Technical Training (Funds available in CARICOM/AID Project 538-0014)						
TOTAL	127	235	316	368	362	1404

The following section describes the components which will make up the training activities in the Alternative Energy Project. These program elements will be under the direction of the training officer who will be located within the CARICOM Energy Unit. Evaluation of program proposals and scholarship applications will be under the responsibility of the Training Officer, and may be performed by an evaluation committee within CARICOM or by outside experts. Outside training experts can be recruited through personnel networks at VITA, ATI, or the Universities listed in Annex II-16.

### Energy Policy Training

#### - Regional Energy Specialists Scholarships.

Two persons from the region will be eligible to participate in a twelve month program of training at institutes in both the Caribbean and the U.S. The people will be trained intensively in performing energy assessments, energy accounting, and policy analysis. After training, they will be headquartered at CARICOM as the key resource people to assist countries in organizing, implementing, and analyzing the results of the individual country assessments. They will be assisted in each country by individuals who have participated in a more generalized energy training program. In the larger nations the energy specialists will act to assist the efforts that may be underway, whereas in the smaller nations they will take the lead role in performing country energy assessments. The estimated cost of this training is \$28,000.

The training for these two specialists will involve study at CEER in Puerto Rico, UWI, State University of New York at Stony Brook, and various specialized short courses on planning and implementing country energy and resource assessments. (See Annex II-16). The final training program will reflect the previous training and experience of the candidates.

The two Regional Energy Specialists will be fully salaried during their training period and for the four years thereafter with project funds. (See Training Budget Annex II-12) Selection of candidates will be based upon previous relevant experience and be advertised through normal regional channels for jobs of this nature. In addition, governments and institutions may be asked for recommendations. Selection will be made by CARICOM.

## Country Energy Generalists

At least one person selected by each government will participate in a four-six month training program in energy policy and planning. The training will give participants an exposure to the basics of energy assessments, policy analysis, and energy management. The major purpose of this training component, costing an estimated \$212,200, is to introduce into the governments as quickly as possible a capability and familiarity with a wide range of energy policy and planning issues.

Training may consist of a specially designed program at the UWI or at a U.S. institution. (See Annex II-16). Those trained will in many cases become their government's coordinator for energy policy and planning activities. Their familiarity with energy and resource assessments will also make them key contacts in each country for the two regional energy specialists. Some countries may require their representative to specialize in a particular area and, funds permitting, may send more than one participant. It is anticipated that the training program utilized would train about fourteen participants in 1980 and a similar number in 1982 at a cost of approximately \$7,500/participant. Travel and expenses will be provided by the program, while government will continue to pay the participant's regular salary.

### Technical Training

#### - Engineers/Designers

This program component will permit approximately twenty engineers to pursue post-graduate training of up to one year in a specialized energy technology. This training component, for example, could sponsor a utility engineer who wished to study the integration of wind-generated power into conventionally-generated power systems. Scholarships will not necessarily lead to formal degrees, but can be used for an intensive summer or semester of study. Training will be made available to technically qualified persons who could become regionally available experts on a single or set of related energy technologies.

The Training under the component will, as appropriate, be provided through existing Caribbean or US. programs or by augmenting the capabilities of a Caribbean institution. CARJCOM will determine the appropriate training vehicle based on the number of trainees for a given course, the adequacy of existing Caribbean programs and related financial and technical considerations. A total of \$265,200 is presently earmarked for this program activity.

#### - Professional Training

Some \$402,700 in Grant funds will fund specialized short courses for local contractors, architects, engineers, industrial managers and relevant experienced professionals on uses and applications of renewable energy resources and energy conservation technologies. These courses will permit the disseminating of these technologies to the professionals and entrepreneurs who are in a position to utilize and commercialize these technologies.

CARICOM will contract with consultants to develop, schedule, and present such courses on each island or regionally, as appropriate. Two to three seminars per year per country would permit the involvement of about 780 professional participants, over the life of the project, and would greatly accelerate the rate at which renewable energy resource and energy conservation technologies will be adapted to commercial use.

- Technicians

The project will support technical schools and colleges by expanding their existing courses to include instruction in renewable energy technologies and energy conservation. Existing coursework will be expanded through use of some \$416,300 of Grant funds to train technicians for example, in plumbing courses, on installation and maintenance of solar hot water systems, mechanics on wind turbine operation and maintenance, refrigeration technicians on alternate-fuel refrigeration systems and energy conservation, etc. The funds will be utilized for purchase of alternative energy equipment and materials, for partial payment of instructor salaries, and for short-term courses (these could be funded by the communications program). This energy technician program will develop a pool of some 574 skilled personnel capable of making a living in the traditional trades together with a working knowledge of Alternative Energy Systems Applications and installation.

The region's technical colleges have expressed great interest in developing a training capability in renewable resource and energy conservation technologies. For example, St. Kitts Technical College has designed curricula to develop alternative energy training capabilities requiring approximately \$7,000 per year to purchase equipment and pay salaries to implement this program. While technical colleges provide an effective mechanism for both training and information dissemination not all technical colleges in the region possess equal capabilities. Thus CARICOM will be responsible for evaluating programs put forth by the technical colleges and the colleges' abilities to carry out the proposed training activities. This evaluation may be assisted by outside experts using a portion of CARICOM's consulting support funds.

As indicated below, the technical colleges may also participate in appropriate field-test projects where the technical college has the expertise required. The technical colleges will apply to CDB for these projects like any other contractor. In this way students would receive "hands-on" training and local renewable energy resource training efforts would be further expanded.

- Other Technical Training - Small Grants Program (suggested for funding under CARICOM/AID Regional Training Project. See Annex II-17 for description of this project).

This suggested training activity utilizes funds available under the CARICOM/USAID training grant to which application can be made for scholarships and seminars not specifically identified nor addressed under this project. Under this program individual training initiatives could be funded in areas such as short-term "hands-on" training for participants in field testing of renewable resource energy technologies, a series of visits to energy related

workshops or seminars by government or university personnel, or the visitation of a researcher or government official to a number of energy technology or energy policy centers in the U.S. for short-term, specialized training sessions. This grant fund will be administered by the CARICOM and used to fund innovative training ideas or projects.

- c. Communications Program (\$612,510) CDB  
See Annex II-14 for budget.

A key component of the Alternative Energy Systems Project will be expansion of the communication capabilities of the region to handle technical and general interest in renewable energy information. The CDB's Technology Information Unit (T.I.U.) will be the base for implementation of the communications program. See Annex II-18.

The Communications Program will (1) identify the various interested groups such as researchers, professionals, policy makers, technicians and community outreach organizations, and respond to their particular technical informational needs; (2) identify information gaps in energy problem areas, technology R & D, field testing, policy issues and training; and, (3) establish a technical information exchange network in alternative energy development. The communications network is simply a mechanism for information transfer. Its function is to make useful linkages between organizations and individuals working in the alternative energy field both within and outside the Caribbean region.

Existing energy information transfer mechanisms are currently limited to informal networks between researchers and teachers both within and outside of the region. These networks have been established in a random non-coordinated fashion and are limited in scope.<sup>1/</sup> Through the institutionalization of more structured information transfer mechanisms, the communication program will be able to meet a full range of energy information demands in an effective manner. Utilizing existing non-energy information networks (i.e. CDB's TIU, CARDI newsletter etc.) as well as meeting needs previously unfulfilled the communications program will be able to make a significant impact early in the project. By the end of the project the communications program will be fulfilling a major coordination role both between the project components and for energy-related issues within the Caribbean.

Intra-regional communication is a major problem in the Caribbean. The lines of communication are often indirect and in many cases it is easier to go directly to the industrialized nations for information even though it may exist within the region or even the country. Specific activities financed under the Communications Program are as follows:

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<sup>1/</sup> See ANNEX I-19 for a listing of existing networks.

### Alternative Energy Workshops & Seminars

This project will fund four regional or national workshops and seminars on specialized topics relevant to alternative energy technologies and policies. These workshops and seminars will focus on a technology such as wind, solar or biomass, or on problems facing governments in regard to energy policy issues or alternative energy technology applications. Topics that might be addressed include:

- Availability of resources and skilled labor,
- Economic policies
- Rural electrification
- Delivery of basic services
- Effective use of country energy assessments
- Long-range national energy planning
- Grid-connected wind energy conversion systems: financing and operating problems
- Alcohol fuels for the Caribbean: problems and prospects
- Tropical country alternative energy projects: The Hawaiian and Philippine experience.

Workshops and seminars will be both important information transfer and training mechanisms. Information will be exchanged during seminars at the same time information networks are being established by the participants. The objective of a workshop format is to encourage active participation and information exchange through small group meetings. Experts can then address the problems specific to a particular issue or project.

Seminars and workshops will be organized by the communications officer with input from professionals, institutes and governments in the region. These funds can also be used to send regional participants to seminars inside and outside the region.

### Abstract and Translation Services

Some \$44,000 of grant funds are available to contract for the translation of all relevant information on energy resource assessment, energy and development issues, and alternative energy applications in English, Spanish and French as required. These funds would also be used to contract for the preparation of conference and seminar abstracts.

### Alternative Energy Information Clearinghouse

Energy library in CDB's T.I.U. will be the center for collection, storage, and dissemination of information relevant to alternative energy applications for the region. CDB's Technology Information Unit provides established linkages to one of the largest information centers in the world, the U.S. National Technical Information Service (NTIS). This

operation is being expanded to tap into other international information centers (e.g. the Intermediate Technology Development Group (ITDG), the Brace Research Institute, Volunteers in Technical Assistance (VITA) and TRANET. Many of these organizations have collected a considerable number of studies on the potential for alternative energy technologies in developing countries. The TIU will collect this kind of information and selectively evaluate those R & D activities that are most relevant to the Caribbean. Through an extensive outreach program, participating countries including the Dominican Republic and Haiti will be encouraged to use the T.I.U. either through contact with the visiting CDB Communications Officer, or by sending in direct requests for information. The T.I.U. will acquire various R & D reports, professional journals and periodicals and provide educational materials and audiovisual equipment coupled with the T.I.U. will be \$31,650 of Grant funds to provide countries with books, journals and audiovisual equipment. The materials will be sent by the CDB Energy Unit to country information centers established in conjunction with either country energy centers, UWI, Extra Mural Centers, or the technical colleges.

#### Special Communications Project

1. Travel funds are Grant funded for the CDB Communications Officer to visit each country including Haiti and the Dominican Republic and make local contacts for the purposes of: (1) identifying sociological, economic, and technological aspects of energy problems, (2) determining the informational and technical needs relevant to alternative energy that will address these needs, (3) making people aware that the program exists and that information and resources are available, (4) delivering information and technical assistance in a form most useful to the user; and (5) collecting and disseminating information at various project sites.

2. Periodic (Bimonthly or Quarterly) Technology Newsletter financed under the Employment/Investment Promotion Grant will have a special section on energy technology, energy projects works, training programs, scholarships resources available through CARICOM CDB, AID and other donor agencies.

3. Information supplied to existing newsletters (e.g., CARDI, CSC, CADEC, UWI, CARIRI, etc.) on alternative energy developments relevant to the particular audience.

4. One of the functions of the communication officer is to strengthen the communications between private voluntary organizations, community groups, private entrepreneurs, and Peace Corps volunteers. The communication

Officer will establish contact with these organizations to allow their staffs: (1) to learn from the community (and vice versa) about on-going activities and informational and technical needs; and (2) to link available volunteers with community-based organizations in need of technical assistance and training. This activity and increased communication could help PVO's identify potential projects and identify avenues of need, local training or technical assistance.

d. Technical Program (\$2,625,800) CDB  
See Annex II-15 for budget

The fourth project activity is the Technical Program. The major objective of this program is to provide field testing of a variety of renewable energy technologies, including wind power, biomass utilization, micro-hydro power facilities and direct solar utilization appropriate for community or individual applications, Geothermal power and advanced energy systems such as photovoltaics represent two other areas of interest in the technical program, but field tests are not contemplated for these technologies due to the major cost of application.

The DHR consultant team during intensive review surveyed fourteen Caribbean nations and identified some \$2.3 million<sup>1/</sup> of sub-projects for field testing considered to be of greatest interest and most needed in each country. The country by country field tests list developed during this survey is reproduced in TABLE E which follows. Using the DHR consultant team findings project proposals will be developed in each country and submitted to the Energy Unit of the CDB. These proposals will be evaluated and if suitable will be funded under the project, except in the case of Dominican Republic and Haiti where all field tests will be bi-laterally financed. Because of the rapid changes taking place in this field, \$516,800 has been earmarked for technical projects that will be identified during project implementation. Implementing institutions have been tentatively identified in each country. If necessary technical assistance for proposal formulation and implementation will be obtained from private consultants, UWI, University of Guyana, INDOTEC, CEER and other extra regional and regional research organizations.

The Technical Program consists of four activities. These include Renewable Energy Resource Assessments, Analytic Support, Applied R & D and field testing. These activities are discussed below and detailed in TABLE F.

Renewable Energy Resource Assessments will be necessary to identify the prime sites for technology field tests and commercial deployment, especially for wind power and hydro-power opportunities. These technologies require site-specific evaluations of available resources such as wind-power, biomass production rates, hydro potential and direct solar radiation incidence. Evaluations such as these are necessary to determine ultimate resource availabilities.

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<sup>1/</sup> Does not include field tests Haiti or the Dominican Republic as these sub-projects will be funded under AID's bilateral program.

The Analytic Support activities, will involve technical applications and extent-of-resource studies. These analytic efforts will determine where the areas of technological opportunity are greatest for renewable energy resource utilization.

The Applied R & D activity will draw on the initial results of the field tests to determine what changes or modifications to the existing technology are required to increase its cost effectiveness. Local Caribbean conditions will influence the technologies utilized; this program component will provide the technological adaptation.

The Field Tests represent a necessary step towards the commercial applications of renewable energy technologies on a significant scale. It is only through the actual testing of devices that decisions can be made for further investments.

TABLE E  
ILLUSTRATIVE COUNTRY-BY-COUNTRY RECOMMENDED PROJECT  
LIST AND PERFORMING GROUPS

COUNTRY	PROJECT (Commercial Usage)	PERFORMING GROUP
Antigua	1) Wind Water Pumping (Irrigation) 2) Biogas (cooking)	Golden Grove Technical College Golden Grove Technical College
Barbados	1) Grid-Connected Windmill 2) Solar Stills (water)	Barbados Light and Power CADEC
Belize	1) Mini-Hydro (village electrification) 2) Wind Water Pumping (irrigation)	Ministry of Energy & Communications Ministry of Energy & Communications
Dominica	1) Charcoal (cooking and export) 2) Mini-Hydro (grid-connected)	Forestry Department Dominica Electricity Services
Dominican Republic	1) Wind Water Pumping (irrigation) 2) Crop Drying (crops) 3) Bagasse Drying with Solar Energy	Indotec, INAPA Indotec, Indotec,
Grenada	1) Biogas (cooking) 2) Wind Water Pumping (irrigation)	National Science Council National Science Council
Guyana	1) Charcoal (cooking & export) 2) Mini-Hydro (grid-connected)	University of Guyana Ministry of Guyana
Haiti	1) Charcoal (cooking) 2) Wind Water Pumping (irrigation)	Ministry of Natural Resources and Energy HACHO
Jamaica	1) Biogas (diesel option) (electricity for on-farm use) 2) Charcoal (cooking)	Ministry of Mining and Natural Resources Forestry Department
Montserrat	1) Grid-Connected Windmill 2) Biogas (cooking)	Montserrat Electricity Services Montserrat Technical College
St. Kitts/ Nevis/ Anguilla	1) Solar Hot Water (hospital) 2) Small Wind Electric (grid-connected) 3) Wind Water Pumping (irrigation) 4) Crop Drying (crops) 5) Solar Stills (water) 6) Crop Dryers (crops)	St. Kitts Technical College St. Kitts Technical College
St. Lucia	1) Solar Hot Water (hospital) 2) Crop Drying (crops)	St. Lucia Technical College WINBAN
St. Vincent	1) Crop Drying (crops) 2) Biogas (cooking)	St. Vincent Technical College St. Vincent Technical College

TABLE F  
TECHNICAL PROGRAM - ACTIVITY AREAS

TECHNOLOGY	RENEWABLE ENERGY RESOURCE ASSESSMENT	ANALYTIC SUPPORT	APPLIED R & D	FIELD TEST	
WIND	Status of Data Survey	Applications study	Corrosion Test- ing	Site selection	Water Pumping
	Identify necessary Tasks and available data	Field Test Feas- ibility studies	Maintenance Procedure Development	Procurement and installation	Battery Systems
	Carry out surveys in areas with large potential	Corrosion Pro- tection  Maintenance Design	Results of Field Tests	Start-up operation	Grid Connected System
BIOMASS (Direct burn) (Biogas) (Charcoal) (Alcohol)	Assess status of current data	Applications Study	Design of bagasse handling systems	"	Charcoal
	Identify necessary tasks		Biomass systems		
	Carry out surveys in areas with large potential	Concentrate on methanol feas- ibility study	Charcoal product analyses	"	Small, medium and large scale methane digesters
HYDRO	Assess status of current data	Applications Study	Maintenance Pro- cedure Develop- ment	"	Grid-connected micro-hydro
	Identify necessary tasks	Corrosion Protection	Control system development	"	
	Carry out surveys in areas with large potential	Maintenance Design	Power condition- ing equipment	"	Autonomomus micro-hydro

DIRECT SOLAR (waterheating)	Assess Status of Current Data	Applications Study	Local materials	"	Hot water Installation
(crop drying)	Identify Necessary Tasks	Field Test Feasibility studies	Water corrosion inhibitors	"	Crop dryers
(solar stills)	Continue surveys	Corrosion Protection	Adaptation of Crops Dryers to Region's crops		Solar stills
<hr/>					
GEOTHERMAL	Assess Status of current data	Applications Study	Corrosion Analysis of thermal sources	"	Identify on-going assessments
	Identify necessary tasks	Field Test Feasibility studies	Development of special parts by small scale systems	"	Participate as appropriate
	Co-ordinate survey activities	Corrosion Protection			
<hr/>					
ADVANCED SYSTEMS	Assess Status of current data	Applications study	"	"	"
	Identify necessary tasks				
<hr/>					

After the establishment of the CDB Energy Group and hiring of the Technical Officer, technical program activities will begin with the recommended field test projects listed in TABLE A.

Technical Program activities approved by the CDB will be carried out by appropriate national regional and extra-regional institutions. CDB will have responsibility for supervision, reviewing, evaluating and approving technical program sub-projects. In some cases, governments may have a sub-project identified but be unable (due to shortage of skills or lack of experience) to submit the required quality contracting of proposal. In such cases, CDB Energy Group Staff will use normal CDB procedures to provide technical support and expertise countries to assist them in proposal definition and preparation.

The two stage project review process would work as follows:

- 1) Proposing country submits a Proposal Definition Letter. In this letter, details are provided as to;
  - Project description and rationale
  - Performing groups identified and qualifications
  - An estimated time-line
  - Description of costs and available resources
  - Need for technical assistance
  
- 2) CDB Energy Group reviews the Proposal Definition letter and either:
  - Returns a critiqued copy noting further requirements for final proposal submission (a more detailed version of the letter)
  
  - Returns a critiqued copy noting available technical resource to be consulted for final proposal definition and drafting. The Energy Group would provide funding to support the final proposal formulation.

Projects in the Technical Program will not be funded unless they meet the agreed criteria. A draft set of criteria were generated at the Caribbean Alternative Energy Systems Conference in May; they are as follows:

### Criteria for Projects

1. Country must have undertaken a preliminary assessment of its energy problems and needs.<sup>1/</sup> (Can receive assistance under the project for this).
2. Project must fit within the general energy policy, plan and program of the country.<sup>1/</sup> (If no plan, can receive assistance under the project for development of a plan).
3. Project must be technically and economically feasible. (Preliminary technical study to be done by CDB or contracted).
4. Project must have Government approval.
5. Project should not duplicate other efforts (in country).
6. Commercial aspects of projects should be considered.
7. Project should contribute to reduction of dependence on imported energy.

The final set of criteria will incorporate additional considerations such as:

- impact on the poor
- demonstrated ability of implementing group to carry out the project
- small scale projects are culturally acceptable (social feasibility)
- projects are environmentally acceptable
- projects provide high visibility and educational value
- net value fossil fuel consumptive effects, including consideration of technology, manufacture and transport, are beneficial.
- capability of employment generation.

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<sup>1/</sup> The need for a national energy assessment and, general energy plan before project implementation will vary depending upon the type of project to be undertaken as well as the complexity of the countries energy economy. Energy projects which do not tie into the national electricity grid or satisfy an energy demand previously unsatisfied (such as small solar water heaters, solar stills, crop dryers or wind water pumping systems) will not have to wait for country energy analysis to be complete before implementation. However, large grid-connected or major commercial fuel displacing projects, (such as large wind-electric systems are biogas digestors) design and implementation should be a result of a country's identified needs and national policy planning process. The complexity of a country's energy economy will also be a factor in determining the need for an energy assessment before project implementation. The energy needs of the simpler energy economies and the appropriate alternatives are more quickly and easily identified than in the more complex economies.

A quarterly review of ongoing technical projects, as specified in the Implementation Plan, will be performed by CDB Energy staff. This will provide an assessment of progress towards objectives, will flag poorly performing or failing projects and monitor cost/accounting and budget detail

#### Technical Program Budget Summary

Annex II-15 presents the Technical Program Budget Summary. Budget estimates were derived from an analysis of the operational needs and objectives of the program. These objectives took into consideration ultimate resource availability in the Caribbean region and the economic feasibility and current commercial status of each technology. A detailed budget for each technology is on file at RDO/C and will be provided upon request.

Windpower receives the largest portion of the 5 year budget some \$680,000. This reflects its general availability throughout the region and the need for extensive site specific resource assessments for its utilization.

Biomass, as a widely available resource (and as a potential source of alcohol fuels in the future) receives the next largest amount of funding approximately \$490,000. Although biomass resource assessments can be inexpensive, a great deal of analytic support and applied R&D will be required to develop an alcohol fuels industry, for example. Also, these technologies can be large in size and, therefore, expensive to demonstrate.

Hydropower is the next largest budget item, about \$380,000, not because it is less desirable, but because it has a limited number of productive sites. Windpower is also restricted to specific sites, but there are more of them throughout the region.

Direct solar energy utilization receives fewer funds (\$265,000) because of its commercial status. Solar crop dryers, solar stills and solar water heaters are all produced commercially in the Caribbean. A large portion of this budget, in fact, is devoted to solar radiation resource surveys which are needed throughout the islands. Technical program funds may also be directed to solar cooling, solar photovoltaic systems and other advanced systems, when it appears that they will be reasonably cost effective. The ongoing work at UWI, St. Augustine, Trinidad, in solar cooling could be supported by the program.

A brief description of each technology area and a review of the Technical Program is included in the Technical Analysis, Section IV. B. and Annex II-20.

#### IV. PROJECT ANALYSIS

##### A. Institutional Analysis

###### 1. Background.

A major purpose of the project is to establish and strengthen the institutional framework in the region for designing and carrying out country energy assessments, developing energy policy, conducting coordinated energy-related training and communications and activities, and testing alternative energy technology applications. Other major purposes in the institutional development under this Project are to:

- build upon existing technical, managerial, communications and training expertise in the region;
- further develop the technical capabilities of participating institutions in energy areas;
- achieve regional institutional cooperation in implementing the four program areas of the Project.

At present an indigenous institutional capability does not exist in the region to conduct the necessary analysis, planning, and applied research required to develop alternative energy programs. Technical expertise is limited and dispersed among many regional and national institutions, and the coordination of alternative energy development efforts in the Caribbean is in an embryonic stage. Institution building aspects of this project must address these problems as well as consider basic development needs such as labor availability, management systems and organizational structure.

The institutional organization of the program consists of an Advisory Committee chaired by CARICOM and responsible for project guidance, two grantees and executing agencies, the CDB and CARICOM, a number of implementing agencies such as major research institutes within the region like CEER and UWI, and a larger number of training and specialized research organizations. To assist CARICOM/CDB during the first two years of project implementation, a consultant advisory group is provided to strengthen the organizations' capabilities to plan and implement the program. The criteria upon which institutions were included in the project and an analysis of their current capabilities and deficiencies are presented below.

###### 2. Advisory Committee

CARICOM will chair an Advisory Committee composed of representatives of fourteen participating countries including Haiti and Dominican Republic as voting members, and representatives from the CDB and participating institutions, such as UWI, CSC and CEER, as invited observers. This committee will meet on an Ad Hoc basis twice yearly at first and then annually to carry out a number of policy review and project evaluation functions related to the implementation of the Alternative Energy Systems project. Specifically its tasks will be:

- to set broad guidelines for program direction;
- to establish relative priorities for program components including initial budget allocations;
- to periodically review progress in project implementation;
- to resolve major policy conflicts arising during project implementation.

Project management staff within the CDB and CARICOM will report to the Advisory Committee on the implementation of project activities and will carry out committee recommendations concerning policy, budgetary allocations and criteria concerning demonstration project selection.

CARICOM is the primary political organization in the Caribbean for inter-governmental cooperation and coordination. CARICOM sponsors and conducts the Heads of Government Conference as well as ministerial level meetings which seek regional coordination in policy matters related to economic development. With its political base, purpose and operational background, CARICOM is selected to chair the Alternative Energy Program Advisory Committee. The Committee will decide the locale for its meetings during its first session shortly following PP approval and signing of the grant agreements.

### 3. Executing Agencies (CDB & CARICOM)

#### a. Selection Methodology and Evaluation.

The CDB will have management responsibility for the Communications and Technical Programs of the Alternative Energy Project; CARICOM will manage the Policy and Training Programs. Initially it was felt that designating a single institution as the executing agency would provide the best means for overall implementation and integration of Project activities. A detailed set of selection criteria were developed (Annex II-21) and the capabilities of eleven regional institutions were evaluated with respect to specific programmatic requirements of the executing agency role. The assessment involved meetings held with representatives from:

- all participating governments;
- research and development institutions;
- regional and national development organizations;
- international donor groups and private volunteer organizations;
- universities, colleges and technical (training) institutes;
- interested private sector groups; and
- USAIDs in the Caribbean region.

Based on this extensive review it was determined that designating both the CDB and CARICOM as grantees and executing agencies will most effectively serve the purposes of the project.

CDB's administration of the Technical and Communications Programs links closely with its established roles in technical assistance, project development and implementation, and information transfer. Specifically the Technology Information Unit and Technology Research Fund (see Annex II-18) recently established under the Employment/Investment Promotion project, provide mechanisms within CDB which directly lend themselves to Communications and Technical Program activities. See Annex II-6 for CDB Organization Chart.

Other attributes of the CDB which are considered important for its selection as an executing agency are that it:

- has an established reputation and broad experience in regional economic development activities;
- has experience in management and administration of integrated development projects of similar size and type;
- emphasizes development projects with commercial potential and region-wide replicability;

- has established programmatic ties and close working relationship with AID in similar technical assistance areas;
- has links with international development and donor agencies, to promote coordination of alternative energy activities and avoid duplication of efforts in region;
- has an extensive on-board technical staff with experience in conventional energy projects;
- has the capability to identify and hire development professionals in specialized fields;
- can become the mechanism to loan finance commercial ventures in renewable energy technologies and become the recipient of other donor financing to make additional resources available in the alternative energy field.

CARICOM's management of the policy and training programs is also a logical extension of its traditional roles and ongoing activities as a Caribbean regional institution. As discussed in the Advisory Committee section, CARICOM is the principal political organization in the Caribbean. Its three main areas of endeavor involve sectoral policy and planning, regional Trade and Statistics and Functional Cooperation. The Divisions of Sectoral Policy and Planning and Functional cooperation will be responsible for implementation of the policy and training programs respectively. See Annex II-5 for organization chart.

CARICOM's membership includes the twelve English-speaking countries in the project. Other countries, including Haiti, the Dominican Republic and Surinam, have expressed an interest in joining CARICOM, and it has provisions for associate memberships and both observer and liaison status.

CARICOM has mechanisms for the coordination of economic policies, including a common external tariff, a common protectionist policy, humanization of tax systems, a common exchange rate and monetary policy, and joint action in relation to industrial development programs. Members also attempt to coordinate their political policies in a number of international forums. CARICOM has established lines of communication with Ministers in the individual countries and works primarily as a coordinator in regional cooperation for problem areas common to the region. It is gaining an increasing role in regional policy development and coordination. Because of these attributes, CARICOM is the most appropriate body to manage policy program activities.

Similarly, in training, CARICOM has recently signed a grant agreement with AID to implement the Caribbean Regional Training Project (See Annex II-17). The open nature of eligible technical training activities under that project and CARICOM's similar administrative role are strong reasons for designating CARICOM to manage the training activities under the Alternative Energy Project. It will be CARICOM's responsibility to ensure that these two projects operate consistently and that duplications do not occur.

CARICOM admittedly does not possess the strong management and organizational skills of the CDB. Training is a less familiar area to the CDB, however, and provisions are made under the project to support CARICOM with the necessary funding and manpower it requires to effectively implement the policy and training programs. Likewise, the CDB will be required to obtain additional personnel to implement the communications and technical programs. The staffing responsibilities and qualifications of both CARICOM and CDB Energy Group personnel are contained in Annex II-22. It will be incumbent on both the CDB and CARICOM to maintain effective communications in order to ensure proper coordination among the four program areas.

## B. Technical Analysis

### 1. Summary of Technical Feasibility

All of the technologies considered in the four major technology areas have been demonstrated on a technical basis; all are commercially available (charcoal units, methane digesters, solar stills, crop dryers and hot water heaters are amenable to small business production activities throughout the region). However, it is important to note that although these technologies are purchasable and will operate as designed, their integration with the existing energy system of the region is constrained. Utilities, for example, need to develop operational experience with grid-connected renewable energy supply systems. The development of this experience will be a major goal of the field test and feasibility study activities.

Current economic feasibility is varied among the various technologies. Direct solar applications are fully economical today (see Solar Hot Water analysis in Annex II-23c) and hydro-power facilities should prove economical at the appropriate site. The charcoal production facilities increase productivity significantly and have been shown to be economical in Jamaica and Guyana.

Wind-power applications should be economical at favorable sites; a cost-benefit analysis is provided in Annex II-23a

Biogas fueled diesel generators are also favorable at sites with large concentrated plant or animal waste material resources; a cost-benefit analysis is provided in Annex II-23b

The following alternative energy sources are seen as having possible long-term potential for the Caribbean region, and the program should ensure that adequate preliminary examination is made in these areas, and that technical progress elsewhere is monitored. (For additional review see Annex II-20)

1. Photovoltaics
2. Ocean Thermal (OTEC)
3. Solar Thermal Electricity
4. Solar Cooling (mechanical or absorp)
5. Ocean farming (kelp)
6. Photochemical

## 2. Country by Country Project List (Performing Groups)

Table B in section III B Project Description lists the technologies considered for the initial phase of field test applications under this program. Brief descriptions of possible configurations of the nine different technologies are provided below.

i) Wind Water Pumping - a 15 KWe windmill which drives an attached water pump. In emergencies the water pump can be driven with grid electricity.

ii) Battery Power Supply System - a 15 KWe windmill supplies a 40 KWHr battery storage system. Power is available from the battery bank as high voltage DC (resistive loads) or as 60 cycle AC (for communications and appliances).

iii) Grid Connected System - a 50 KWe windmill supplies fully conditioned electrical power to the national grid via a grid-excited synchronous inverter.

iv) Charcoal Project - an integrated program involving a reforestation study, the efficient production of charcoal via modern kilns and the efficient combustion of charcoal using efficient stoves.

v) Biogas Project - the anaerobic digestion of plant and animal waste materials at three possible scales; small or family size, farm size, large size (up to 800 head of cattle). The smaller systems produce methane gas for cooking, lighting or refrigeration; while the large system is designed to generate electricity for grid-connected operation.

vi) Micro-hydro Power - a 15 KWe turbine with supplies the grid with electricity.

vii) Solar Hot Water Heating - demonstrations involve a medium-size system (St. Kitts slaughter stalls at the marketplace) and a large-scale system (hot water for St. Lucia's Victoria Hospital).

viii) Solar Crop (lumber) Drying - small, medium and large size hot air solar collection devices used to dry agricultural products.

ix) Solar Stills - small systems designed to provide distilled water for chemical analyses, battery maintenance or, in some cases, potable water.

The above listed demonstrations have been apportioned among the participating nations according to the stated preferences of individuals and groups in each country as seen in Table E, Section II, B showing the country, the technology, and the performing group. During project implementation these projects may be modified as required for utilization of technologies and economic conditions.

C. Financial Analysis and Plan

1. Financial Analysis.

The Alternative Energy Systems Project consists of a grant which will finance institution building, data collection, studies, training and the dissemination of information; hence there will be no revenue producing activities. Although financial returns are not expected sample cost/benefit analyses have been conducted on the technologies to be employed demonstrating their economic viability (see Economic Analysis Annexes II-23 a to c).

The grant will also finance applied research related to non-conventional energy technologies. The program is by definition experimental; therefore, one of the desired outputs is accurate cost data allowing for meaningful financial analyses. This data which will enable the Caribbean Governments to determine the financial feasibility of developing non-conventional energy resources on a broader scale.

Technically, sufficient power or fuels could be generated under several of the sub-projects to warrant marketing the energy produced during the field-testing program. In making the implementation arrangements for these sub-projects, CDB will often negotiate agreements with the governments and implementing agencies for marketing these outputs. As planned, revenue generated will be utilized to finance operating and maintenance costs of the non-conventional systems. For other subprojects, operation and maintenance will be financed directly from project funds.

2. Financial Plan.

The summary Grant levels are as follows:

<u>USAID Grant Funds</u>			
US. \$000			
<u>CARICOM</u>		<u>CDB</u>	
Energy Unit	1010.0	Energy Group	1,089.4
Policy Program	937.9	Communication	612.5
Training Program	1324.4	Technical Program	2325.8
	<u>3272.3</u>		<u>4027.7</u>
			<u>Total - 7,300.0</u> <sup>1/</sup>

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<sup>1/</sup> - Excludes a \$300,000 bilateral grant between the GODR and USAID/DR.

Table G. is a summary of the major project components as well as a summary of the CDB, CARICOM, and Caribbean Governmental counterpart contributions. Additional explanation of the sources of these planned expenditures are in Annexes II-10 to 15.

Table G.

Illustrative Source and Use of Funds

( \$ 000's )

	<u>AID</u>	<u>CARICOM/CDB COUNTRIES</u>	<u>TOTAL</u>
<u>CARICOM ENERGY UNIT</u>	<u>1010</u>	<u>105</u>	<u>1105</u>
Staff and Consultants	876	105 (CARICOM)	981
Travel and Per Diem	106	-	106
Communications	28	-	28
<u>POLICY PROGRAM</u>	<u>938</u>	<u>-</u>	<u>938</u>
Tech. Assistance	250	-	250
Studies	688	-	688
<u>TRAINING PROGRAM</u>	<u>1324</u>	<u>56 (COUNTRIES)</u>	<u>1380</u>
Policy	240	-	240
Technical	1084	56	1084
<u>CDB ENERGY GROUP</u>	<u>1089</u>	<u>395 (CDB)</u>	<u>1484</u>
Staff and Consultants	1017	328	1345
Travel & Per Diem	48	45	93
Communications	24	22	46
<u>COMMUNICATIONS PROGRAM</u>	<u>613</u>	<u>-</u>	<u>613</u>
Tech. Assistance	156	-	156
Travel & Per Diem	262	-	262
Reproduction & Supplies	123	-	123
Communications	72	-	72
<u>TECHNICAL PROGRAM</u>	<u>2626</u> <sup>1/</sup>	<u>320 (COUNTRIES)</u>	<u>2946</u>
Field Testing and Assessments	861	-	861
Analytic Support	163	-	163
Applied R&D	192	-	192
Field Tests	<u>1410</u>	<u>320</u>	<u>1730</u>
<b>TOTAL PROJECT</b>	<b>7600</b>	<b>876</b>	<b>8476</b>

1/ - Includes \$300,000 for a solar bagasse dryer in the D.R.

## D. Economic Analysis

### 1. Overview

The Project will assist countries in the Caribbean region in broad development of capabilities and institutions building and applied research and development effort. In particular, the project focuses on the needs and potential of renewable energy resource development and its ability to assist in economic development.

The obvious difficulties of projecting the benefits of policy studies, applied research and demonstration activities, communications programs and training prevent carrying out a standard economic analysis of this project. Yet, economic analysis will be important to the project since one of its major objectives is to determine the potential role of alternative energy sources and technologies in the process of economic development. For this reason, an economist has been included in the core CDB energy group staffing.

An important project objective for which the economist will have responsibility is to determine which alternative energy technologies are most promising from the standpoint of cost-effectiveness. The program will finance a number of technology field tests for purposes of demonstrating commercial and technical feasibility. Preliminary cost analyses have been performed and comparisons of delivered energy cost are drawn between conventional and alternative energy sources; this is done for wind generated electricity vs. diesel electricity, biogas versus distillate oil fired diesel generator sets, and solar hot water versus conventional water heating. The results of the cost comparisons and B/C ratio show all three technologies to be competitive under conditions which currently exist within parts of the Caribbean. (For Analyses see Annex II-23.a to c.).

In the case of many alternative energy devices, however, it is important to recognize that considerable research and development work is necessary before wide-spread application would be clearly economic. These field tests will be designed to generate accurate capital, maintenance and operating cost data which will enable Caribbean governments, institutions and other interested groups to determine their applicability on a broader scale. Thus, it is expected that significant insight into economic feasibility of alternative energy development will be gained from the project.

## 2. Macroeconomic Issues

All countries in the project are heavily dependent on imported energy sources, almost entirely in the form of petroleum fuels. Prior to 1973, low international energy prices allowed Caribbean economies to grow rapidly. Much of this growth occurred in relatively energy-intensive sectors such as mineral extraction and processing (e.g. Bauxite industry in Jamaica), manufacturing and tourism (throughout the region). Per capita energy consumption also grew at a fast pace as incomes rose and consumers purchased products with higher energy intensity levels. This growth entailed progressive fuel replacement from traditional fuels such as charcoal and kerosene to fossil-based energy forms such as electricity, liquid petroleum gas and natural gas.

There are differences in the economies of the region based on the structures and stages of economic development and their associated energy intensity. These differences have distinguishable impacts on the pattern of energy demand in the different countries. But the economies of the region are marked more by similarities than differences in their energy position. The important similarities are:

- heavy import dependence and rapid growth in energy use;
- size of economies and energy systems;
- scarcity of indigenous commercial energy sources.

The dramatic international oil price increases since 1973, combined with the above factors, have had a crippling effect on Caribbean economies. Consumption and imports have been growing faster than GDP, creating serious balance of payments problems. These impacts were softened somewhat in the region by increased earnings from high sugar prices in 1974-75, but increased again as sugar prices fell and petroleum prices continued to escalate. The cost of petroleum imports to the Caribbean more than quadrupled during the period 1972-1977, from US.\$150 million to about US.\$620 million. This raised petroleum's share of imports from under 9% to more than 20% in the region. Recent and projected price increases will exacerbate the problem so that by 1983, the World Bank reports that energy imports might preempt 25% of projected foreign exchange earnings. <sup>1/</sup>

In summary, energy import dependence of the countries in the Caribbean has become a critical element in their worsening foreign exchange problems. The economic burden of this dependence has severely hampered economic development efforts throughout the region. On a more micro level, rising costs of energy have adversely affected those in all consuming sectors. For example, commercial and industrial enterprises devote greater resources to energy inputs, leaving less for essential capital and efficiency improvements. Home-owners and consumers pay larger shares of income for the energy they use (transportation, electricity, cooking, hot water, etc.), or cut back consumption of often essential energy uses (i.e. cooking fuel). Rising energy prices have hit the rural and urban poor particularly hard reducing both disposable income and general economic opportunities.

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<sup>1/</sup> - World Bank "Caribbean Energy Survey", Report No. 2511-CRB, May 7, 1979, Washington, D.C.

In order to combat the serious problem of increasing energy import requirements and associated economic dislocations, the countries of the region will have to utilize a combination of strategies. They will have to both restrict future demand growth through more efficient energy use as well as development of less-energy intensive economies and seek alternative sources of supply through the development of indigenous energy resources. This project will directly assist the region in these efforts. The four program component areas are designed for overall regional development of capabilities in general energy areas, and in specific aspects of energy economic analysis.

The Policy Program, in particular, is addressed to the study of macroeconomic issues related to energy problems. It is recommended, for example, that in country energy policy formation and regional policy coordination efforts a comprehensive approach to energy pricing be developed. Most countries have held growth in domestic petroleum product prices and electricity tariffs below the rates of increase in international petroleum prices. This subsidization has caused energy consumption to continue growing despite absolute declines in GDP. A rational pricing structure would, by reflecting the marginal cost of energy, help contain energy growth as well as stimulate development of indigenous energy sources.

The training and communications programs will complement these aspects of the policy program. One training mechanism, for example, supports the development of energy management and accounting skills for government professionals in the region. The communications program will, among other activities, help to coordinate policy and economic studies with related work on-going or planned by other donor organizations (World Bank). Additionally, seminars on energy resource technologies and related areas have been proposed. Activities of this nature will act to ensure that technologies and policies are developed in full light of required economic analysis and criteria. In summary, improvements in the institutional infrastructure and technical base sought by this project in energy analysis and planning will make a significant contribution to understanding overall energy/economic issues.

### 3. The Issue of Size/Regional Coordination

The regional approach emphasized in the Alternative Energy Project takes cognizance of the problem of limited technical resources and the development difficulties posed by the small size of economies and energy systems in the Caribbean. Most countries participating in the project are of sub-critical size for development of efficient, least-cost per unit energy systems: Refineries are comparatively small and inefficient with high transport costs and processing efficiency losses. Electricity generating and transmission systems are generally small as well, utilizing 1 to 5 MWe diesel units. These constraints preclude the economies of scale possible with larger systems.

Increased energy economy is required in all energy using sectors. This implies a shift toward development of indigenous energy resources (solar, wind, hydro, biomass) which may substitute for some incremental conventional energy supply. Additionally, many of the contemplated technology applications are for on-site resource development and application (e.g. solar hot water for residences) thereby reducing many transmission and distribution losses and fuel costs associated with conventional systems. While specific conservation initiatives are not planned, the project will also be concerned with the study of overall approaches in the region for increased energy use efficiency.

The regional approach allows for effective mobilization and channeling of limited available technical and human resources in the Caribbean. Individual countries are not solely capable of developing numerous energy skills or indigenous resources. Regional cooperation can make a broader spectrum and larger pool of resources available for specific problem solving. A regional approach allows for the study and implementation of least-cost solutions to energy development needs common on regional and sub-regional levels. Lastly, a regional network provides a more integrated mechanism for obtaining and disbursing the external assistance necessary for overall energy development.

## E. Social Analysis

### 1. Social Setting

The countries constituting the Commonwealth Caribbean are presently experiencing a state of rapid social change. Today's conditions reflect a curious blend of a fading colonial plantation system and an emerging society which increasingly is becoming drawn into the modern world economy. Continuity of the old and arrival of the new finds expression at all levels of society from the family to the nation. The manner in which social classes relate to each other perhaps best reflect the full significance of recent Caribbean social development. Since independence, the power of the European planter class has declined, although their economic control in all sectors is still significant. Simultaneously, there has been an upward advancement of non-white professionals, businessmen, politicians, and an expansion of the middle class. Ethnically Caribbean Societies reflect a complex patterning of parallel hierarchies of African, Asian, and European heritage, each with their own upper, middle and lower class. However, the bulk of the Caribbean population is still composed of a large segment (50% of the total population) of native small "peasant" farmers, landless agrarian laborers, urban workers, and the unemployed. Compared to the rest of society, they are characterized by low per capita incomes, poor health, inadequate housing, and high rates of unemployment and underemployment.

The impact of the energy crisis on this group has not yet been fully analyzed. However, it is clear that they are "feeling the pinch".

In countries such as Barbados, Antigua, St. Lucia and St. Kitts low income families do their cooking with bottled gas. These families are caught in the spiral of rising petroleum prices and reduced availability, making the purchase of cooking gas almost impossible for many. Programs introducing biogas and charcoal for cooking fuel will serve a felt need in a timely way. More efficient kilns using charcoal will reduce energy input by half, resulting in a 30% increase in efficiency, and substitute for the more costly conventional energy.

In rural areas of the Caribbean most low income families don't use commercial energy, either because it is not available to them (e.g. because their farms are not served by electric lines), or because it is too expensive. In some countries like Haiti, wood is the principal fuel for cooking and productive activities. The cost of kerosene and gas is much more expensive in rural areas than in

urban areas due to transportation costs. Lack of affordable energy limits earning potential among low income residents in rural areas. For example, perishable products must be sold immediately, often at low prices, and storables are difficult to dry to meet market requirements in the Caribbean's hot and humid climate. Fish and seafood must be sold or consumed immediately thereby limiting potential commercial activity in this area.

In urban areas, high energy costs are resulting in decreasing disposable incomes for low income families. The costs of bus transportation and electricity have risen substantially in recent years. Thus higher energy costs are contributing to a general decline in living standards, and their effects are felt most strongly by low income families.

## 2. Project Beneficiaries

### a. Ultimate Beneficiaries

The low income inhabitants of the rural and urban areas of the twelve Caribbean countries participating in this project will be the indirect beneficiaries of this project through the utilization of more cost effective renewable energy resources. For example, the small-scale generation of electricity (50-100kw) using micro-hydro technology will provide electric power for the first time to small rural communities unconnected to the national grid. This will be power for residential, commercial, and agricultural uses. The social impact of rural electrification has been well documented in the Philippines and in other AID financed evaluation studies. As energy from renewable sources becomes cost effective and available, the Caribbean countries will be able to provide increasing amounts of relatively inexpensive energy to a large majority of their populations.

Although a small number of families will be provided usable energy from the field tests, the demonstration projects are an applied research activity and as such will not have a broad social impact. If, however, viable energy producing systems are developed, then in-depth socio-cultural analyses will be undertaken to ensure successful broad-scale field applications. The CDB with existing staff will take social considerations into account during the sub-project design process to ensure that cultural sensitivity will be a component of the field testing program. Social and cultural feasibility analyses will be carried out concurrently with the engineering analyses for each site-specific field test. Firm cost estimates will be derived, along with

indications of the social acceptability of the alternative energy technology prior to the financing of the demonstration project. In addition, the criteria for the selection of demonstration projects to be field tested which will be established will encourage selection of projects which utilize alternative energy technology (i.e. wind, biomass, hydro) that can be used in productive activities that are undertaken by AID's target group in the Caribbean area. For example, wind conversion technologies will be used for water pumping for both home consumption and agricultural irrigation of small farmer crops. Both applications will directly impact on the lower income groups who lack access to sufficient quantities of water for hygiene and for crop irrigation. Biomass conversion such as charcoal and biogas for cooking fuel to replace high cost petroleum fuels will assist AID's target group to reduce household expenditures for energy, thereby increasing the dispensable income.

b. Direct Beneficiaries

The direct beneficiaries of this project will be the individual participants trained in technical disciplines related to energy planning and alternative energy applications, and the regional and national institutions, technical colleges and organizations, and ministries which will receive information about the technologies tested under the project. Institutions such as CEER (Center for Energy and Environment Research), CMI (Caribbean Meteorological Institute), CARDI (Caribbean Agricultural Research and Development Institute), UWI (University of the West Indies) and Ministries of Energy and Communications and Agriculture will receive funds for technology research and development for solar crops dryers, biogas plants and charcoal kilns, as well as funds for training and expansion of information systems.

A more specific result of the technical program will be the attempt to apply the new technologies to commercial uses. Engineers will be trained in the design of commercial scale systems for solar water heating and technicians will be trained in their installations so that an infrastructure will exist for commercialization of solar heating throughout the region. This is one of the more significant impacts resulting from the program in terms of substitution for petroleum consumption. The numerous hotels and restaurants throughout the region, not to mention hospitals and other institutions, offer a ready market for this application of solar technology. Another expected consequence is the creation of an awareness of these new technologies among administrators and policy-makers gained through demonstration projects. Individuals at this level will have heard of solar, wind, or biogas, and be vaguely aware that there is some potential, for their develop-

ment in the region; but they will not be able to consider them while making policy decisions (for example, tax incentives for solar water heaters), in the absence of viable demonstration projects which provide hard data and illustrate their uses. The mere existence of such units should greatly stimulate the acceptance of new technology at the administrative and policy levels among the governments of the Caribbean.

Many of the research and technical organizations participating in the project have extension programs or outreach activities to local communities. Various local groups in individual countries may receive funding under the project for specific alternative energy demonstration projects. Groups such as CEMAT (the Appropriate Technology Study Group for Meso America headquartered in Guatemala), HACHO (Community Development Organization in Haiti), and perhaps PVOs such as CADEC (Christian Action for Development of the Eastern Caribbean) and other church groups will receive funds for technical assistance activities and community organizing efforts required to introduce a renewable energy technology and to maintain it at the village level.

#### c. Long Term Impacts

The major long term social impact of this project will occur if certain alternate energy systems are developed on a large scale. For example, biomass conversion for alcohol production offers a large scale, long term development prospect. Two alternatives, methanol and ethanol, exist for such development. Except in Guyana, production of ethanol will come about by diverting the existing sugar industry to a new end product. This development is unlikely in the near future as long as a market exists for sugar. In the near future it is demonstrably more profitable to export sugar than to consume its alcohol equivalent as fuel considering the high capital cost of equipment and technologies required to produce this equivalent. In Guyana the potential exists for large scale tree farming to produce methanol. This would also be a large project with major social implications. In general any large scale applications of biomass technologies, because of the land and manpower requirements, will have far reaching social implications which will require careful analysis and planning.

#### 3. Social/Cultural Constraints

Constraints to accepting new alternative energy technologies in local areas will be identified in the feasibility studies conducted prior to financing field tests for various technologies. They will be considered further during the evaluation of each field-tested project. The

social feasibility of alternative energy applications will be part of the information stored in the clearing-house and disseminated through the region under the communications program.

#### 4. Role of Women

The professional training funded by this project provides a unique opportunity for exposure both men and women to technological expertise. Although participation of women in technical professions in the Caribbean is limited, the increased contact through improved communications and with female professionals brought in as advisors services to encourage others to strive for greater opportunities.

Many of the alternative energy demonstration projects will substitute renewable energy sources for conventional energy which women are now using, such as fuel for cooking. Other conversion technologies will make energy available where it did not exist before, such as grid-connected windmills or mini-hydro power for rural electrification. The provision of electricity to reduce household drudgery and to increase time available for women to engage in other productive tasks, such as artisan activity or education, has been mentioned in previous AID-financed rural electrification projects (e.g. Philippines, Guatemala, Indonesia). Conversion technologies resulting in increased water pumping and, therefore, availability directly affect women concerned with family hygiene and health conditions. Water pumping for crop irrigation directly affects productivity and household incomes. Widespread replication of the alternative energy demonstration projects may need to take into account impact on women and women's roles in the home and agricultural production. These factors will be identified during the feasibility studies and project evaluations of individual applications and be disseminated to the Caribbean countries along with other information pertaining to the field testing program.

#### F. Environmental Analysis

The Initial Environmental Examination (IEE) for this project was approved May 10, 1979, and a negative declaration was recommended. It was requested, however, that an expanded environmental analysis be performed which examines specific environmental issues related to alternative energy development and sets applicable project criteria. This analysis is found in Annex I-4.

V. IMPLEMENTATION PLAN

The schedule for project implementation is set forth below. The following implementation arrangements and conditions will be established for carrying out the project in accordance with the schedule.

A. Summary Plan

Implementation of the Caribbean Alternative Energy Project will proceed in two phases. The first phase involves establishing the contractual arrangements, and the second involves project implementation.

Grantee of contractual arrangements (Phase I) will be pursued immediately following authorization. They are designed to set up the organizational structure described in the project description, and involve two major regional institutions: CDB and CARICOM. An AID grant will be made by USAID/DR to GODR <sup>1/</sup> for the development of a solar bagasse dryer.

Phase II of project implementation will proceed as the contractual arrangements are finalized and as new staff are hired. Implementation steps are described below for activities in all four program areas: Policy, Training, Communications and Technical.

B. Contractual Grant Arrangements (Phase I)

1. Steps must be taken to establish the Project's Advisory Committee, the Energy Group of CDB, the Energy Unit at CARICOM, and negotiate a joint contract between CARICOM/CDB and a consulting firm to provide technical support for the first two years of project implementation. This support will provide the needed expertise for developing implementation plans, scopes of work and technical advice.

2. The Advisory Committee members will be selected by the CARICOM countries, CDB and representatives from D.R. and Haiti shortly after the grants are signed. They will hold their first meeting within three months after the signing of the Grant Agreements and meet semi-annually thereafter for the first two years of the project and annually thereafter. Members will serve without fee. It is anticipated that their travel and per diem will be paid by the host country, government or institution they represent in-kind support to the project.

3. The CDB Energy Group will be a division of the Energy and Technology Unit (TIU) of the Project Design and Analysis Division having the same Assistant Director who will also manage the Caribbean Alternative Energy Systems Project. The division will have its own clerical staff. In addition, project funds will be used to hire consultants on personal services contract for the associated project activities throughout the five years of project implementation. Creating and operating the Energy Group within the CDB will involve the recruitment of four full time professionals. The CDB is expected to begin financing two of the four positions in the 3rd year of the project so that by the fifth year project funds will finance only consultant costs.

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<sup>1/</sup> - Additional bilateral grants in future years programs will be made to the extent necessary for technical projects in Haiti and Dominican Republic.

4. CARICOM will establish an Energy Unit. The Training Section has previously been established under the Regional Training project.

The unit will be supported with five full time professionals (Director, Assistant Director, a Training Coordinator and two Energy Specialists) for the five years. In the third, fourth and fifth year, CARICOM will begin to fund these positions. Consultants will also be hired as required to provide supplemental assistance. Project Funds will be used to finance all operating costs of the unit for five years.

5. If necessary USAID/D\* will sign grant agreements with INDOTEC, (D.R.) for the field test programs NLT September 30, 1979, using regional RDO/C funds allotted to them. In Haiti under the existing Appropriate Technology Program the Ministry will most likely use CEER under a host country contract to provide technical assistance for their field testing activities and not fund them under this Energy Project.

6. Responsibilities and requirements among institutions and between institutions and sub-grantees will be defined in the sub-project agreements. These will define: 1) roles, 2) expected tasks and schedules, 3) estimated disbursements, and 4) evaluation and reporting requirements.

7. Contracting under the Program will operate in three basic ways:

- CARICOM/CDB will grant project funds directly to national organizations (such as the designated government ministry) to carry out specific project activities. These national organizations can as necessary sub-contract for technical assistance from research institutions participating in the Program (such as UWI, CEER, CMI).

- CDB will contract directly with an institution (such as CEER or UWI) to carry out demonstration project activity in one or more countries.

- CARICOM will fund other institutions, such as UWI, or other regional or extra regional institutions as required, for technical assistance to undertake individual country assessments, policy studies and training activities. CARICOM will also hire consultants to assist its direct hire staff to carry out the policy studies.

C. Project Implementation (Phase II)

1. Project activities involve policy, training, communication, and technical demonstration projects.

2. Program implementation will pursue the following goals:

- a. Efforts will be made to produce country energy assessments and renewable energy resource assessments in the first two years of the project.

- b. Priority development of the communications network to increase information flow and permit coordination.
- c. Immediate initiation of training program to identify participants.
- d. Phased implementation of field test projects according to availability of skilled workers and to gain experience initially with smaller projects.
- e. Continuing development of Planning and Policy framework to promote effective energy pricing and conservation policies in the region and to prepare for incorporation of renewable energy technologies.

3. The following table outlines specific major project implementation steps and the responsible institution. Other day to day activities such as the newsletter, conferences and analytic studies are not detailed here but are expected to be conscientiously pursued by the CARICOM/CDB Energy Staffs.

<u>Major Tasks</u>	<u>Institution</u>
- Negotiate Technical Support Contract	CARICOM/CDB
- Establish Communications Network	CDB
- Initiate Country Energy Assessments	CARICOM
- Initiate Renewable Energy Resource Assessments	CARICOM
- Initiate Analytic Support Studies	CARICOM
- Initiate Training Program	CARICOM
- Initiate Equipment Procurement System	CDB
- Initiate Field Test Proposals	CDB
- Initiate Contract Review and Evaluation System	CARICOM/CDB
- Establish Training Program	CARICOM
- Award Field Test Contracts	CDB
- Initiate Unidentified Proposal System	CDB

4. Evaluation of Program Area performance will occur on several levels, beginning with self-evaluation by professional staff.

The Assistant Directors for both Energy Groups will be expected to evaluate the integrated program periodically for review by the Advisory Committee.

#### D. Implementation Schedule

The overall implementation Schedule for the proposed project is in Annex II-24.

## E. Reports

Reports will be submitted by CARICOM and CDB to RDO/C on a semi-annual basis. The first report will be submitted six months after the project agreement has been signed with RDO/C. The semi-annual reports will also be provided to the Advisory Committee Board for use in reviewing the progress of the Alternate Energy Systems Program.

The semi-annual reports will consist of the following basic information:

### CARICOM/CDB Program Activities

- Staffing levels
- Budgetary reports
- Overall Alternative Energy Project Implementation Progress
- Program review of goals and objectives
- Status of variances from expected achievements
- Status of integration of program component activities

### Policy Program

- Overall project status
- Status reports on sub-program components
- Funding levels and budgetary status
- Country participation in and utilization of outputs
- Status of research
- Status of policy program achievement

### Training Program

- Overall training program status
- Number and countries of participants
- Funding levels and budgetary status
- Status of training program achievement
- Status reports on sub-program components
- Output level of trained personnel

### Communications Program

- Overall training program status
- Frequency of information system usage
- Funding levels and budgetary status
- Status of communication program achievement
- Status report on sub-program components
- Country usage and participation

### Technical Program

- Overall technical program status
- Funding levels for projects and overall budgetary status
- Status of research and field-tests
- Status of technical program achievement
- New project development
- Status of project completed

CARICOM/CDB will also be responsible for integrating the activities of the various research, training, and implementing institutions in the annual reports.

These reports will form the basis for the annual project evaluations.

#### F. Evaluation Plan

The project impact on the region will be jointly evaluated by CARICOM, CDB and AID on an annual basis during the project's five year life. All evaluation activities will include the D.R. and Haiti program components. This yearly evaluation will be concurrent with the Advisory Committee's annual meeting to review the program's operating policies and goals. The Advisory Committee may make use of the project evaluation in their deliberations and review of the project. RDO/C will have major program evaluation responsibilities which will be funded by project funds.

The major program evaluations will be performed by an outside group in the second and fifth years of the project. The first evaluation will provide RDO/C with a report on the appropriateness and effectiveness of the project relative to the stated goals and objectives, as well as to focus on the administrative aspects of the program to permit early identification and resolution of any implementation problems. In addition, this evaluation will review and make recommendations for the ongoing institutionalization of energy activities at the national and/or regional levels. This review will include studies of the forms of institutionalization, requirements for formation, methodology for implementation, estimated costs of establishment and identification, if possible of which institution(s) be used to achieve this ongoing role.

At the time of the second year evaluation it is expected that research projects and technical assistance support will have generated significant results for evaluation of the project's outputs and purpose. The second evaluation will be based on the following general parameters.

The contribution to the project's goal will be examined in terms of the specific contributions which each program area is making towards achieving widespread utilization of renewable energy resource technologies. For this purpose the CARICOM/CDB project reports will provide the necessary baseline data for the individual program, as well as overall project evaluations. Specific areas and data to be included in the evaluation are as follows:

- the efficacy of CARICOM/CDB administration and management in overall project implementation
- success in developing projects as scheduled
- adequacy of the programs to effectively expand the usage of regional resources, capabilities and institutions
- participation of other public and private entities in testing, expanding and integrating successful technologies
- the problems or efficiencies generated by information dissemination
- competence and effectiveness of management and technical personnel provided
- success in transferring technical and administrative skills to the region
- success in producing prototypes on pilot operations which meet the appropriate criteria, i.e. can be reproduced easily and quickly, are socially, economically and environmentally feasible, use local materials, provide alternative sources of fuel or a reduction in fuel requirement
- the probability on activity of the industrial sector utilizing the technologies developed.

The evaluations will also include specific areas of problems of interest to RDO/C. The funds for these two special evaluations in the second and fifth years will be from the project budget. RDO/C will be responsible for selection of the evaluation contractor.

#### G. Procurement Plan

The CARICOM and the CDB will use existing accounting and procurement procedures as are utilized in existing AID Regional projects thereby insuring efficient and timely procurement of equipment and materials for the Technical Program.

Nearly one-third of the funds expended under this project will purchase laboratory, field test and renewable resource assessment equipment and materials. Many of the countries and organizations participating in the project would spend a great deal of time trying to procure such equipment individually. The TIU will be utilized as required by every group to facilitate the identification and purchase of equipment needed for the technical program. The CDB can utilize funds from this Grant for retaining contractors on a part-time basis as necessary.

The following procurement schedule is recommended:

The schedule provides for capital equipment, construction materials, and measuring equipment for the Technical Program, including Renewable Resource Assessments, Analytic Support, Applied R&D and Field Tests. It provides for complete implementation of projects listed in the Country by Country projects list described in Section III of the PP. It does not include equipment and materials required for the three other program areas, i.e. Policy, Communications, or Training.

All activities performed in the Technical Program will be on a grant or contract basis, thus permitting careful cost accounting control. Capital equipment and materials acquisition for these projects will be financed by the funds in the CDB Energy Group budget. The Summary Procurement Plan is presented in Annex II-25 (A breakdown of this summary is available on request from RDO/C).

Cable Address:  
CARIBSEC GUYANA  
P.O. BOX 607

ALL COMMUNICATIONS SHOULD BE  
ADDRESSED TO THE SECRETARY-GENERAL

- 79 - CARIBBEAN COMMUNITY SECRETARIAT ANNEX I - 1

Third Floor, Bank of Guyana Building,  
Avenue of the Republic,  
Georgetown,  
Guyana.

UN 29 1979

NO. 120/6

28th June, 1979

DATE	7/10/79
ACTION DATE	Hold for PP
DATE	7/10/79
SIGNATURE	KR

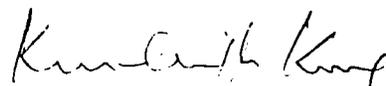
Dear Mr. Wheeler,

As you know, my staff and yours have had detailed discussions on an Alternative Energy Systems programme for the Region. As planned, this programme is a coordinated effort on the part of CARICOM and the Caribbean Development Bank. This letter is to formally request a Grant of approximately US\$ 3,000,000 to support the implementation of the CARICOM portion of the programme.

The CARICOM programme will include the establishment and staffing of an Energy Unit and support programmes in Policy Formulation, Energy Resource Assessment and Energy Training. The programme as designed will strengthen the institutions and increase utilization of resources in the Region.

We look forward to a favourable reply and to a successful establishment of the programme.

Yours sincerely,



SECRETARY-GENERAL

Mr. William Wheeler  
USAID Representative  
RDO/C USAID  
Trident House  
Broad Street  
Bridgetown  
BARBADOS



# CARIBBEAN DEVELOPMENT BANK

P.O. Box 408 Wilbey  
St. Michael Barbados W.I.  
Telephone: 61152 Cable Address: "Caribank," Telex WB 287.

July 5, 1979

JUL

Mr. William B. Wheeler  
AID Representative  
USAID Regional Development Office  
- Caribbean  
P. O. Box 302  
BRIDGETOWN.

ACTION	Schynen
DATE	7/16/79
ACCOMPLISHED	
...	...
DATE	7/17/79
SIGNATURE	[Signature]

Dear Mr. Wheeler:

For some time now, the staff of our two institutions have been holding detailed discussions on an Alternative Energy Systems Project. This letter is to formally request a grant of US\$4,011,000 to assist in the establishment of the project in the Bank.

This project will establish an institutional capability in the Caribbean Region for strengthening national energy planning, including conducting country energy needs assessments, renewable energy resource assessments and for designing, testing, adapting and disseminating alternative energy technologies.

We look forward to a favourable reply and to a successful establishment of the Programme.

Yours sincerely,

Neville V. Nicholls  
Vice-President & General Counsel

AUE:NVN:ct

A. GENERAL CRITERIA FOR PROJECT

1. FY 79 App. Act Unnumbered; FAA Sec. 653 (b); Sec. 634A.  
(a) Describe how Committees on Appropriations of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than \$1 million over that figure)?  
Congressional notification will be accomplished before funds are obligated.
2. FAA Sec. 611 (a) (1). Prior to obligation in excess of \$100,000, will there be (a) engineering, financial, and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?  
Yes.
3. FAA Sec. 611 (a) (2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?  
No such action is required.
4. FAA Sec. 611 (b); FY 79 App. Sec. 101.  
N/A  
If for water or water-related land resources construction, has project met the standards and criteria as per the Principles and Standards for Planning Water and Related Land Resources dated October 25, 1973?
5. FAA Sec. 611 (e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed \$1 million, has Mission Director certified and Regional Assistance Administrator taken into consideration the country's capability effectively to maintain and utilize the project?  
N/A

6. FAA Sec. 209. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.

**This is a regional Project.**

7. FAA Sec. 601 (a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c) encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.

**The Project will foster private competition and improve technical efficiency of industry by developing and putting into use energy technologies which lessen dependence on imported oil**

8. FAA Sec. 601 (b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).

**Goods and services for the Project will come in part from the United States.**

9. FAA Sec. 612 (b) Sec. 636 (h).  
Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized to meet the cost of contractual and other services.
- As indicated in the project paper, participating countries are making substantial contributions to the project.
10. FAA Sec. 612 (d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release?
- No.
11. FAA Sec. 601 (e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?
- Yes.
12. FY 79 App. Act Sec. 608. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity?
- N.A.

**B. FUNDING CRITERIA FOR PROJECT**

**1. Development Assistance Project Criteria**

**a. FAA Sec. 102 (b); 111, 113; 281 a.**

Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?

The project encourages regional cooperation in the energy field and will support the self-help development efforts of participating countries by making them less dependant on imported oil, a major constraint to development.

**b. FAA Sec. 103, 103A, 104, 105, 106, 107.**

Is assistance being made available: (include only applicable paragraph which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source.)

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

(2) (104) for population planning under sec. 104 (b) or health under sec. 104 (c); if so, extent to which activity emphasizes low-cost integrated delivery systems for health,

nutrition and family planning for the poorest people, with particular attention to the needs of mothers and young children, using paramedical and auxiliary medical personnel, clinics and health posts, commercial distribution systems and other modes of community research.

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

(4) (106) for technical assistance, energy, research, reconstruction, and selected development problems; if so, extent activity is:

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

(ii) to help alleviate energy problems;

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

(iv) reconstruction after natural or manmade disaster;

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

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

c. (107) Is appropriate effort placed on use of appropriate technology?

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

The project is a major effort in the Caribbean to alleviate energy problems by developing alternate technologies and make participating countries less dependant on imported oil.

This is a regional project and thus the statute is generally not applicable to the extent that bilateral activities are involved. A 25% host country contribution will be required.

- e. FAA Sec. 110 (b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"?
- No.
- f. FAA Sec. 281 (b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental and political processes essential to self-government.
- The Project will develop energy technologies appropriate to the various participating countries, and will train local technicians in related fields.
- g. FAA Sec. 122 (b). Does the activity give reasonable promise of contributing to the development of economic resources or to the increase of productive capacities and self-sustaining economic growth?
- Yes.
2. Development Assistance Project Criteria (Loans Only)
- a. FAA Sec. 122 (b). Information and conclusion on capacity of the country to repay the loan, including reasonableness of repayment prospects.
- N.A. This is a grant Project.
- b. FAA Sec. 620 (d). If assistance is for any productive enterprise which will compete in the U.S. with U.S. enterprise, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?
- N.A.
3. Project Criteria Solely for Economic Support Fund
- a. FAA Sec. 531 (a). Will this assistance support promote economic or political stability? To the extent possible, does it reflect the policy directions of section 102?
- N.A. ESF funds will not be utilized.
- b. FAA Sec. 533. Will assistance under this chapter be used for military, or paramilitary activities?

A. Procurement

1. FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of goods and services financed? **Yes**
  
2. FAA Sec. 604 (a) Will all commodity procurement financed be from the U.S. except as otherwise determined by the President or under delegation from him? **Yes**
  
3. FAA Sec. 604 (d). If the cooperating country discriminates against U.S. marine insurance companies, will agreement require that marine insurance be placed in the U.S. on commodities financed? **Yes**
  
4. FAA Sec. 604 (e). If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity? **N/A**
  
5. FAA Sec. 608 (a). Will U.S. Government excess personal property be utilized wherever practicable in lieu of the procurement of new items? **Yes**
  
6. FAA Sec. 603 (a) Compliance with requirement in section 901 (b) of the Merchant Marine Act of 1936, as amended, that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S. flag commercial vessels to the extent that such vessels are available at fair and reasonable rates. **U.S. Ships will be used if available. Appropriate determinations will be obtained from AID/W as to unavailability**
  
7. FAA Sec. 621. If technical assistance is financed, will such assistance be furnished to the fullest extent practicable as goods and professional and other services from private enterprise on a contract basis? **Yes**

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

Yes.

8. International Air Transport. Fair Competitive Practices Act, 1974.

If air transportation of persons or property is financed on grant basis, will provision be made that U.S. flag carriers will be utilized to the extent such service is available?

Yes.

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

Yes.

B. Construction

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

N.A.

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

Yes

3. FAA Sec. 620 (k). If for construction of productive enterprise will aggregate value of assistance to be furnished by the U.S. not exceed \$100 million?

N.A.

C. Other Restrictions

1. FAA Sec. 122 (e). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter? **N.A.**
2. FAA Sec. 301 (d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights? **Yes**
3. FAA Sec. 620 (h). Do arrangements preclude promoting or assisting the foreign aid projects or activities of Communist-bloc countries, contrary to the best interests of the U.S.? **Yes**
4. FAA Sec. 636 (i). Is financing not permitted to be used, without waiver, for purchase, long-term lease, or exchange of motor vehicle manufactured outside the U.S., or guaranty of such transaction? **Yes**
5. Will arrangements preclude use of financing:
  - a. FAA Sec. 104 (f). To pay for performance of abortions or to motivate or coerce persons to practice abortions, to pay for performance of involuntary sterilization, or to coerce or provide financial incentive to any person to undergo sterilization? **Yes**
  - b. FAA Sec. 620 (g). To compensate owners for expropriated nationalized property? **Yes**

- c. FAA Sec. 660. To finance police training or other law enforcement assistance, except for narcotics programs? **Yes**
- d. FAA Sec. 662. For CIA activities? **Yes**
- e. FY 79 App. Act Sec. 104. To pay pensions, etc. for military personnel? **Yes**
- f. FY 79 App. Act Sec. 106.  
To pay U.N. assessments? **Yes**
- g. FY 79 App. Act Sec. 107.  
To carry out provisions of FAA sections 209 (d) and 251 (h)? (Transfer of FAA funds to multilateral organizations for lending.) **Yes**
- h. FY 79 App. Act Sec. 112. To finance the export of nuclear equipment, fuel, or technology or to train foreign nations in nuclear fields? **Yes**
- i. FY 79 App. Act Sec. 601. To be used for publicity on propaganda purposes within U.S. not authorized by Congress? **Yes**

## PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS

Name of Entities: Caribbean Community Secretariat  
Caribbean Development Bank  
Dominican Republic

Name of Project: Alternative Energy Systems

Project Number: 538-0032

Pursuant to Part I, Chapter 1, Section 106 of the Foreign Assistance Act of 1961, as amended, I hereby authorize a Grant to the Caribbean Community Secretariat ("CARICOM") of not to exceed One Million United States Dollars (\$1,000,000), a Grant to the Caribbean Development Bank ("CDB") of not to exceed One Million United States Dollars (\$1,000,000) and a Grant to the Government of the Dominican Republic ("GODR") of not to exceed Fifty Thousand United States Dollars (\$50,000) (such amounts, which in the aggregate equal \$2,050,000, being called the Authorized Amount), to help in financing certain foreign exchange and local currency costs of goods and services required for the project described in the immediately following sentence. The project consists of the establishment of an institutional capability in the Caribbean region for (i) strengthening national energy planning, including conducting country energy needs assessments, conservation studies and renewable energy resource assessments, and (ii) designing, testing, adapting and disseminating alternative energy technologies (the "Project").

I approve the total level of AID appropriated funding planned for the Project of not to exceed Seven Million Six Hundred Thousand United States Dollars (\$7,600,000) of Grant funding, including the Authorized Amount, during the period FY 1979 through FY 1982. I approve further increments during that period of Grant funding up to \$5,550,000, subject to the availability of funds in accordance with AID allotment procedures, as follows: CARICOM \$2,247,300, CDB \$3,002,700, and GODR \$300,000 (subject to the acceptability of a feasibility study).

I hereby authorize the initiation of negotiation and execution of the Project Agreement or Project Agreements, as the case may be, by the officer to whom such authority has been delegated in accordance with AID regulations and Delegations of Authority, subject to the following essential terms, covenants and major conditions, together with such other terms and conditions as AID may deem appropriate:

A. Source and Origin of Goods and Services

Except for ocean shipping, and except as set forth in Section E below, goods and services financed by AID under the Project shall have their source and origin in the United States or, in the case of the Grant to CARICOM, in member countries of CARICOM, or, in the case of the Grant to the CDB, in the countries in the Caribbean which are members of the CDB and which are included in AID Geographic Code 341, or, in the case of activities to be carried out in Haiti and the Dominican Republic, respectively, in Haiti and in the Dominican Republic, respectively, except as AID may otherwise agree in writing. Ocean shipping financed by AID under the Project shall be procured in the United States, except as AID may otherwise agree in writing.

B. Conditions Precedent to Disbursement (CARICOM, CDB)

Prior to any disbursement, or to the issuance of any commitment documents under the Project Agreement or Project Agreements, to finance activities of the CARICOM Energy Unit or the CDB Energy Group, as the case may be, for other than technical assistance, professional staff salaries and supporting administrative costs, CARICOM or the CDB, as the case may be, shall, except as AID may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(i) evidence that CARICOM or the CDB, as the case may be, has planned for an adequately staffed Energy Unit or Energy Group, as the case may be, and has a detailed plan governing its operation, including permanent staffing arrangements, and a time-phased work plan governing the use of Project funds for the Policy, Training, Communications and Technical Programs; and

(ii) a copy of a signed contract for technical services to provide CARICOM and the CDB with the necessary expertise for program development and implementation.

C. Covenants (CARICOM, CDB)

Except as AID may otherwise agree in writing, CARICOM and the CDB shall each covenant and agree to:

- (i) evaluate the Project using Project funds in the second and fifth years of Project implementation;
- (ii) maximize communications between the CARICOM Energy Unit and the CDB Energy Group through consultations on work plans, subprojects and terms of reference;
- (iii) utilize guidelines developed by the Project Advisory Committee;
- (iv) report periodically to the Project Advisory Committee with respect to Project implementation; and
- (v) use every effort to secure funds from regular budgeting sources to support the continuation of the staffs of the CARICOM Energy Unit or the CDB Energy Group, as the case may be, beginning in the third year of Project Implementation.

D. Covenant (CDB)

Except as AID may otherwise agree in writing, the CDB shall covenant and agree to use its best efforts to procure goods and services from the countries authorized under Section A above prior to procuring goods and services from countries made eligible for source and origin pursuant to Section E below.

E. Waiver

For the reasons set forth in the Action Memorandum to the Assistant Administrator (LAC), attached hereto, goods and services having a cumulative value of not to exceed \$500,000 may be procured from countries included in AID Geographic Code 899.

Edward W. Cox  
Assistant Administrator  
Bureau for Latin America  
and the Caribbean

August 23, 1979  
Date

DEPARTMENT OF STATE  
AGENCY FOR INTERNATIONAL DEVELOPMENT LAC-DR/IEF-79-23  
WASHINGTON, D C 20523

ASSISTANT  
ADMINISTRATOR

ENVIRONMENTAL THRESHOLD DECISION

Location : Caribbean Regional  
Project Title : Alternative Energy Systems, 538-0032  
Funding : FY 79 Grant - Approximately \$4,000,000  
Life of Project: Three years following signing of the Grant Agreement

Mission Recommendation:

Based on the Initial Environmental Examination, the Mission has concluded that the project will not have a significant effect on the human environment and therefore recommends a Negative Determination.

The Development Assistance Executive Committee of the Bureau for Latin America and the Caribbean has reviewed the Initial Environmental Examination for this project and concurs in the Mission's recommendation for a Negative Determination.

AA/LAC Decision:

Pursuant to the authority vested in the Assistant Administrator for Latin America and the Caribbean under Title 22, Part 216.4a, Environmental Procedures, and based upon the above recommendation, I hereby determine that the proposed project is not an action which will have a significant effect on the human environment, and therefore, is not an action for which an Environmental Impact Statement or an Environmental Assessment will be required.

\_\_\_\_\_  
Assistant Administrator for  
Latin America and the Caribbean

\_\_\_\_\_  
Date

Clearances:

LAC/DR:Environmental Advisor:ROtto ROtto  
DAEC Chairman:MBrown \_\_\_\_\_

ALTERNATIVE ENERGY SYSTEMS  
NO. 538-0032  
INITIAL ENVIRONMENTAL  
EXAMINATION (IEE)

Facesheet

Project Location: Caribbean Regional  
Project Title: Alternative Energy Systems  
Funding: FY 79 Grant - Approximately \$4,000,000  
Life of Project: Three years following signing of the Grant Agreement  
IEE Prepared by: S. C. [Signature], CPD/C [Signature]  
Date: April 2, 1979, revised from November 15, 1978  
Action Recommended: A Negative Determination. (No Environmental Assessment or Environmental Impact Statement Necessary).

Concurrence:

[Signature] April 9, 1979  
William B. Wheeler, AID Representative Date

Assistant Administrator's Decision:

AA/LAC

Approval of Environmental Action Date  
Recommended

Disapproval of Environmental Action Date  
Recommended

ALTERNATIVE ENERGY SYSTEMS (IEE)

I Examination of Nature, Scope and Magnitude of Environmental Impact

A. Description of Project

The project is a series of studies and pilot activities that will assist in the identification and demonstration of applications of alternative energy systems in the Caribbean 1/. The purpose of this project is to develop a capacity in the Caribbean to analyze, plan and advise on the development and implementation of energy systems using non-conventional energy resources. The activities which will be undertaken to achieve this purpose are:

- 1) A regionally coordinated data collection system for collecting and assisting in development of energy accounting and surveillance information.
- 2) A regional cadre of trained energy specialists available to assist in energy applications.
- 3) Various country specific alternative energy generation and conservation studies.
- 4) The dissemination of information through various regional institutions on applications of resources and energy conservation.
- 5) Various identified practical pilot demonstration projects for both supplying community energy needs and evaluation of specific types of non-conventional energy systems.

---

1/ Countries expected to participate are:

LDC's: Antigua, Belize, Dominica, Grenada, Montserrat, St.Kitts/Nevis/Anguilla, St.Lucia, St.Vincent.

MDC's: Barbados, Dominican Republic, Guyana, Haiti, Jamaica.

B. IMPACT IDENTIFICATION AND EVALUATION

Impact  
Identification  
and  
Evaluation 1/

Impact Areas and Sub-Areas

A. LAND USE

1. Changing the character of the land through:

- a. Increasing the population \_\_\_\_\_ N \_\_\_\_\_
- b. Extracting natural resources \_\_\_\_\_ L \_\_\_\_\_
- c. Land clearing \_\_\_\_\_ L \_\_\_\_\_
- d. Changing soil character \_\_\_\_\_ N \_\_\_\_\_

2. Altering natural defenses \_\_\_\_\_ N \_\_\_\_\_

3. Foreclosing important uses \_\_\_\_\_ N \_\_\_\_\_

4. Jeopardising man or his works \_\_\_\_\_ N \_\_\_\_\_

5. Other factors

\_\_\_\_\_  
\_\_\_\_\_

B. WATER QUALITY

1. Physical state of water \_\_\_\_\_ N \_\_\_\_\_

2. Chemical and biological states \_\_\_\_\_ N \_\_\_\_\_

3. Ecological balance \_\_\_\_\_ N \_\_\_\_\_

4. Other factors

\_\_\_\_\_  
\_\_\_\_\_

1/ Definition of symbols:

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

C. ATMOSPHERIC

- 1. Air additives \_\_\_\_\_ N \_\_\_\_\_
- 2. Air pollution \_\_\_\_\_ N \_\_\_\_\_
- 3. Noise pollution \_\_\_\_\_ N \_\_\_\_\_
- 4. Other factors \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

D. NATURAL RESOURCES

- 1. Diversion, altered use of water \_\_\_\_\_ L \_\_\_\_\_
- 2. Irreversible, inefficient commitments \_\_\_\_\_ N \_\_\_\_\_
- 3. Other factors \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

E. CULTURAL

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

F. SOCIOECONOMIC

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

G. HEALTH

- 1. Changing a natural environment \_\_\_\_\_ N
- 2. Eliminating an ecosystem element \_\_\_\_\_ N
- 3. Other factors  
\_\_\_\_\_  
\_\_\_\_\_

H. GENERAL

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

I. OTHER POSSIBLE IMPACTS (not listed above)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### C. Discussion of Impacts

The project will explore four areas of renewable energy sources:

1) solar, 2) wind, 3) bio-mass and 4) mini-hydro. The pilot and demonstration sub-projects selected are designed to rapidly produce tangible results in the aim of functioning hardware which utilizes locally abundant resources and operates in accordance with local environmental conditions. Some examples of these are: solar crop driers, wind power devices, bio-mass methane generators and low head hydro turbines. The equipment to be used will be selected from available functioning systems which have been modified to suit Caribbean environment and natural resources. Solar power may be applied to cooling and refrigeration mechanisms as well as electrical generation. Bio-mass applications include bio-gas generation units for fuel source, liquid fuel from sugar cane and charcoal production from waste materials. Wind and hydro devices are to be applied to various mechanical electrical generating requirements in rural and urban areas.

The pilot nature of the sub-projects developed under this project requires that the site be carefully selected, construction closely supervised and operations continuously monitored, to maximize the information available for system adjustment and replication. Due to the application of pilot/demonstration development techniques, until proven for wide application, the sub-projects are confined to small physical areas. Engineering specifications and performance criteria are to be consistent with standard engineering practice applicable to existing technologies. The specific sub-project sites under this Grant will be selected both during project development and implementation by the regional coordinating agency in cooperation with the local governments and regional institutions; thus have not been determined. The evaluation of sub-projects funded under this Grant include analyses of technical, economic, social and environmental features of proposed designs, operation and management. The demonstration sub-projects are expected to have the following characteristics:

- 1) The environmental effects will be very limited, if any, and localized due to the scale and pilot nature of the sub-projects and their decentralization throughout the Caribbean.
- 2) The sub-projects will involve developed and tested techniques of non-conventional energy usage for which engineering practices and available hardware do not produce adverse environmental effects.

- 3) The project activities will be regularly monitored in terms of operating performance and environmental effects. If the need should arise the coordinating agency has the capacity to revise a project to achieve a more desirable and effective performance.

D. Conclusion

Review of the type of activities foreseen under this loan reveals no evidence that the environmental effects would:

- 1) Have a negative impact on the human environment;
- 2) have impacts which are likely to be irrevocable or highly controversial; or
- 3) which might establish a precedent for adverse future action.

It concluded that the implementation of sub-projects under this project will be beneficial or have no impact on the environment. The sub-projects planned under the three year project are in the nature of controlled experimentation for the purpose of demonstration and will be carefully monitored.

The environmental effects are beneficial in that solar and wind exploitation is non-polluting and non-depleting. Sub-project management is to be designed to assure that detrimental effects do not occur. The replacement by non-conventional renewable energy sources of fossil fuels will reduce air pollution.

Consequently, a negative determination has been recommended in respect to further environmental assessment.

II Recommended Environmental Action

The sub-projects to be conducted in this Grant program are of the nature of controlled experimentation for the purpose of testing and application of existing alternative energy technologies to usage in the Caribbean. During the testing of these technologies the environmental effects will be analysed and carefully monitored. It is concluded that this project will not have a significant effect on the environment and, therefore, a "negative determination" is appropriate.

## Environmental Analysis

### 1. Discussion

Under this Project technology applications will be field tested in four areas of renewable energy resources: solar, wind, biomass and mini-hydro. Solar applications include crop drying, water heating and water distillation.

Wind applications include water pumping and electricity generation. Biomass applications include methane generation from agricultural wastes, direct combustion of biomass fuels (e.g., bagasse) and charcoal production. Hydro applications will be in the form of low-head, small-scale and electricity generation. Geothermal energy potential may be examined at several sites in the Caribbean but actual applications are beyond the scope of the field-testing program.

Because of the limited nature of the research and development activities under this project, no adverse environmental effects are anticipated. The individual field tests contemplated are small in size and will be dispersed throughout the Caribbean. In order to determine their regional applicability, the field tests will be of a pilot nature to assess what adaptations of available technology or, in some cases, new developments are necessary for widespread use. It is a research oriented approach which ensures careful site selection, consideration of the project's economic, environmental and social impacts, and close monitoring and evaluation of all project operations. Thus the potential for any direct impacts from this project will be minimal.

In the longer term, the project is directed toward greater development of alternative energy resources in the Caribbean and wider use of the technologies undergoing field tests.

The exploitation of non-conventional and renewable sources of energy is, in general, an environmentally desirable strategy for energy development. The utilization of solar and wind energy has minimal direct pollution impacts and does not depend on non-renewable resources. Biomass energy technologies aim for more efficient utilization of indigenous renewable energy resources and are often designed specifically to reduce environmentally destructive practices (e.g., return of biogas sludge to the fields, increased efficiency of charcoal production to slow deforestation). Hydropower facilities have no direct environmental impacts as a result of electricity generation.

Typically, the energy technologies identified for development in the Caribbean are small in scale and utilize renewable energy resources to supply small dispersed demands. In all cases, the recommended technologies reduce the negative environmental, health and social impacts currently associated with fossil;fuel based energy technologies.

Alternative energy development is not impact-free, however, and in the case of micro-hydro and biomass systems further examination is warranted. There is the additional consideration of pollution generated during the manufacture and transportation of alternative energy technologies. However studies performed by the U.S. Department of Energy and the Illinois Center for Advanced Computation suggest that pollution impacts as a result of manufacture and transport are small compared to the life-time pollution savings from not burning fossil fuels. The major environmental impacts are those associated with utilization of micro-hydro and biomass energy technologies and not from manufacture of renewable energy resource equipment.

## 2. Micro-Hydro

The development of hydropower resources for electricity generation, even at the scale (5 to 50kw) envisioned in this project, may have significant environmental implications. Potential effects are principally related to site characteristics and are in the area of land use, ecological balance and flood risk. The following specific criteria address the siting concerns of hydro development and will be incorporated in the project evaluation criteria employed by the CDB.

### Land Use

- o Land requirements for reservoir; for generating facility; for transmission lines.
- o Dislocations (human, economic, etc.) caused by hydro development.
- o Agricultural potential precluded by committed land.
- o National needs, priorities for land use.
- o Present value and projected future value (opportunity costs) of land.
- o Other development potential (residential, tourism, etc.) foregone.
- o Downstream water flow requirements; development effects

### Flood Risk

- o Variability of weather pattern (e.g., severity of rainy season).
- o Implications for impoundment size, type, etc.
- o Construction needs, costs for building to "worst case" specifications.
- o Ability of installation to moderate or minimize normal flood potential.
- o Downstream flood risks
- o Location of settlement, population centers, other land use.
- o Determination of flood plain; range of potential damage.

## Ecological Concerns

- o Effects on stream ecology; flow requirements:
  - indigencus fish population
  - siltation characteristics
  - overall balance
  - effects on water table
  - geological characteristics, expects changes
  - erosion potential; new rum off characteristics, etc.
  - secondary development effects (industrial, recreational, residential, etc.)

Although the impacts from micro-hydro development are likely to be small, especially in the case of reprofit installation on existing facilities, it is necessary to systematically assess project benefits and costs individually. It will be the responsibility of the project evaluation staff (CDB, participating Research Institution and outside contractors) to ensure that specific criteria for prevention of significant environmental impact are met.

### 3. Biomass

#### (a) Charcoal

Charcoal sub-projects are designed to increase the efficiency of production processes, to make better use of a variety of waste materials, and to assist in the development of more organized markets for charcoal fuel. In this way, environmentally destructive charcoal practices related to random tree-cutting and inefficient production will be minimized. More importantly, however, any charcoal production strategy can have serious impacts if it is not accompanied by integrated reforestation and land management efforts. Problems of tree and plant denudation, erosion of hillsides, water quality (excessive siltation) and climatic changes are particularly acute in Haiti and could become serious in other Caribbean countries (e.g., Antigua). These concerns must be addressed in the consideration of any charcoal project in order to prevent further risk of ecological damage and to assist efforts in overall ecological repair.

Criteria for charcoal projects would include:

- o Presentation of an overall impact master plan which accounts for reforestation needs, soil erosion effects, long-term productivity measures and recommended harvesting rates.
- o Identification of planning and control mechanisms to carry out the plan identified above.
- o The utilization of efficient charcoal production kilns to minimize fuelwood impacts per unit of charcoal output.

- o The implementation of a training program to increase the use of efficient charcoal stoves, such as the Lorena model developed in Guatemala.

(b) Energy Farming

Energy plantations, or other large scale biomass utilization schemes, must be managed to insure a continuing supply of material while maintaining a balanced ecosystem. Continued cropping can deplete soil nutrients and these must be monitored to insure that soil productivity is not reduced. This is particularly true in the Caribbean where commercial fertilizers are becoming more necessary and costly in agricultural production. Additionally, any mono-culture may be subject to fungal or insect attack. As with charcoal, careful ecological analysis must accompany large-scale biomass strategies. The following criteria will be used in biomass energy farming project selection.

- o Land requirements for project, material needs for continued supply.
- o Value of energy production and demand for biomass fuels; market potential.
- o Existing environmental characteristics: soil, vegetation, geology, water resources, etc.
- o Risks of ecological damage from material harvesting erosion potential, soil depletion, moisture retention/evaporation, flood risks, climatic effects, etc.

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ACTION  
aid ANNEX I-5

CKT W40114  
RR RUEHWN  
DE RUEHC #2784 0271738  
ZNR UUUUU ZZH  
R 271536Z JAN 79  
FM SECSTATE WASHDC  
TO AMEMBASSY BRIDGETOWN 4388  
BT  
UNCLAS STATE 022784

INFO  
AMB  
DCM

CHRON  
RF

ACTION	Schynen
DUE DATE	2/1/79
ACTION TAKEN	NO IMMEDIATE ACTION NECESSARY BUT WILL TAKE ACTION PRIOR TO 3/31/79
DATE	2/1/79
SIGNATURE	[Signature]

JAN 29 1979

AIDAC

E.O. 12065 12065: N/A

TAGS:

SUBJECT: DAEC REVIEW OF CARIBBEAN REGIONAL ALTERNATIVE ENERGY SYSTEMS PID

1. THE DAEC REVIEWED AND APPROVED THE SUBJECT PID ON DECEMBER 19, 1978. IN DEVELOPING THE PP, THE RDO/C SHOULD ADDRESS THE FOLLOWING POINTS. THE PP SHOULD FULLY DESCRIBE: (1) THE MISSION'S STRATEGY IN THE ENERGY SECTOR FOR THE CARIBBEAN REGION, (2) THE RELATIONSHIP BETWEEN THIS STRATEGY AND THE COUNTRY ENERGY ASSESSMENTS (CEA) TO BE UNDERTAKEN, (3) THE NATURE OF THE TYPICAL CEA INCLUDING, INTER ALIA, ITS CONTENTS AND USES, AND (4) HOW THE NEEDS FOR LARGER INFRASTRUCTURE PROJECTS IDENTIFIED IN THE CEAS WILL BE ADDRESSED. IT HAS NOTED THAT THIS PROJECT APPEARS TO LEND ITSELF TO PARALLEL FINANCING WITH THE IBRD OR OTHER DONORS FINANCING THE LARGE SCALE INFRASTRUCTURE PROJECTS AND WITH AID FOCUSING ON THE INITIAL COUNTRY ASSESSMENTS/STUDIES AND APPROPRIATE SMALLER SCALE ALTERNATIVE ENERGY PROJECTS.

2. PROJECT COMMITMENT: THE PID AS WELL AS DISCUSSION AT THE DAEC PROVIDED LITTLE EVIDENCE TO DEMONSTRATE REGIONAL GOVERNMENTS' COMMITMENT TO THE PROJECT. THE PP SHOULD INDICATE WHAT TANGIBLE COMMITMENTS HAVE BEEN AND/OR WILL BE

MADE TO THE PROJECT, E.G., NEW POLICIES, STRENGTHENING OF RELEVANT INSTITUTIONS, AND LEVELS OF FINANCIAL SUPPORT. THIS POINT SHOULD NOT ONLY COMMITMENTS MADE BY THE LOCAL GOVERNMENTS IN THE REGION BUT ALSO BY THE VARIOUS PARTICIPATING REGIONAL INSTITUTIONS INCLUDING CARICOM, CMI, LWI, AND CDB.

3. PROJECT DESIGN: TO ENSURE THAT THE CEAS AND STUDIES TO BE FINANCED UNDER THE PROJECT ARE NOT DUPLICATIVE AND ARE INDEED NECESSARY, THE PP SHOULD DISCUSS THE ACTIVITIES ALREADY UNDERTAKEN OR CONTEMPLATED IN THE ENERGY SECTOR BY THE IBRD, AS WELL AS BY OTHER DONORS. CONCERN WAS VOICED THAT THE FUNDING PROPOSED FOR ENERGY ASSESSMENT/STUDIES IS LOW AND THAT THE THREE YEAR LOP MAY BE TOO SHORT. THEREFORE, THE PP SHOULD ANALYZE THE PROPOSED SCOPE AND CONTENT OF THESE ASSESSMENTS/STUDIES AND PROVIDE SUFFICIENT FUNDS TO CARRY THEM OUT. IT SHOULD BE NOTED THAT DOE AND DSE MAY HAVE FUNDS FOR SUPPORTING ENERGY ASSESSMENTS AND THAT IT MAY BE POSSIBLE TO PROVIDE ADDITIONAL LAC BUREAU ALLOCATIONS TO THIS PROJECT LATER THIS FISCAL YEAR.

4. INSTITUTIONAL CAPABILITY: CARICOM APPEARS TO BE THE APPROPRIATE IMPLEMENTING/COORDINATING INSTITUTION FOR THE PROJECT ALTHOUGH IT SUFFERS FROM SERIOUS INSTITUTIONAL CONSTRAINTS. THE PP SHOULD PROVIDE AN INSTITUTIONAL ANALYSIS OF CARICOM WITH PARTICULAR ATTENTION GIVEN TO THE ENERGY DESK AND/OR OTHER APPROPRIATE CARICOM OFFICES INVOLVED IN THE PROJECT IMPLEMENTATION/COORDINATION EFFORTS. THIS ANALYSIS SHOULD INCLUDE, INTER ALIA, CARICOM'S ORGANIZATION AND OFFICE COMPOSITION, STAFF CAPABILITIES, AND THE EFFECT OF THE "BRAIN DRAIN" ON THE INSTITUTION. ON THE BASIS OF THIS INSTITUTIONAL ANALYSIS, THE TECHNICAL ASSISTANCE AND TRAINING COMPONENTS OF THE PROJECT SHOULD BE DETERMINED.

5. BENEFICIARIES: THE PP SHOULD DISCUSS BOTH THE DIRECT AND INDIRECT IMPACT OF THE PROJECT ON THE POOR MAJORITY OF THE REGION,

6. FEASIBILITY ANALYSIS. PID ASSUMES THAT ALTERNATIVE ENERGY TECHNOLOGIES CAN PROVIDE ENERGY AT COSTS COMPARABLE TO CONVENTIONAL SOURCES SUCH AS LARGE HYDRO-ELECTRIC AND FOSSIL FUELS. TO SUBSTANTIATE THIS CRITICAL ASSUMPTION, THE PP SHOULD COMPARE THE ESTIMATED COST PER UNIT OF ENERGY OUTPUT OF THE VARIOUS ALTERNATIVES PROPOSED WITH

BOTH CURRENT AND PROJECTED FUTURE CONSUMPTION LEVELS. BOTH FINANCIAL AND ECONOMIC COST COMPARISONS SHOULD BE MADE. IF REGIONAL GOVERNMENTS PROVIDE SUBSIDIES OR LEVY TAXES ON EXISTING ENERGY SOURCES, THE PP SHOULD TAKE THESE INTERVENTIONS INTO ACCOUNT IN COMPARING THE REAL COSTS OF CONVENTIONAL AND NON-CONVENTIONAL ENERGY SOURCES. THE PP SHOULD DISCUSS WHAT POLICY CHANGES, IF ANY, WILL BE REQUIRED TO REMOVE EXISTING ENERGY PRICE DISTORTIONS AND ALLOW ALTERNATIVE ENERGY SOURCES TO COMPETE ECONOMICALLY WITH EXISTING SOURCES. IF THE DEVELOPMENT OF NEW ENERGY SOURCES WILL REQUIRE SPECIAL GOVERNMENT SUPPORT BASED ON AN INFANT INDUSTRY ARGUMENT, CAREFUL DEMAND ANALYSIS SHOULD BE INCLUDED INDICATING THE TIME PERIOD NEEDED TO REACH A COST LEVEL THAT IS COMPETITIVE WITH CONVENTIONAL ENERGY SOURCES.

7. REE: PPO/DO SHOULD FORWARD TO AIA/A A MORE COMPLETE REE PROJECT DESCRIPTION JUSTIFYING MISSION 1'S REE THAT "MICRO-HYDRO" AND "BIOMASS CONVERSION" ENERGY GENERATION ACTIVITIES CONTEMPLATED UNDER THE PROJECT ARE NOT LIKELY TO CAUSE ANY SIGNIFICANT DIRECT OR INDIRECT NEGATIVE IMPACT ON THE ENVIRONMENT. MISSION 1: REQUESTED TO FORWARD REVISED DESCRIPTION TO LAC/DR WITHIN SIXTY DAYS TO PERMIT TIMELY AA/LAC THRESHOLD DECISION. VANCE

ET

#2784

LOGICAL FRAME WORK  
ALTERNATIVE ENERGY SYSTEMS

<p><u>Goal</u> To develop a capability to utilize renewable energy sources in the Caribbean as alternatives to imported fossil fuels and to encourage energy conservation measures.</p>	<p><u>Measures of Goal Achievement</u> Increase in number of low-income inhabitants employing non-conventional energy technologies in home and work environments results in decreased costs and/or higher disposable incomes for rural poor.</p>
<p><u>Purpose:</u> To establish an institutional capability in the Caribbean region for strengthening national energy planning including conducting country energy needs assessments, conservation studies and renewable energy resource assessments and for designing, testing, adapting and disseminating alternative energy technologies.</p>	<p><u>End of Project Status:</u></p> <ol style="list-style-type: none"> <li>1. Each country will have developed a resource in national energy planning and policy analysis.</li> <li>2. CARICOM will have established a unit and developed an institutional capability to assist countries to carry out national energy planning, energy assessments, resource surveys and other appropriate studies pertaining to energy policy-making and strengthen energy training capabilities at existing institutions in the region.</li> <li>3. CDB will have established an energy group and developed an institutional capability to design and manage a communications program including an information clearinghouse for exchanging information pertaining to alternative energy applications for the region, and analyze and finance applied research and feasibility proposals for alternative energy technologies.</li> </ol>

Means of Verification:

1. World Bank Country Reports
2. Country Energy Assessments
3. Energy Consumption and Demand Surveys
4. Survey of low-income families using non-conventional energy technologies
5. Micro-economic studies measuring growth rate related to introduction of alternative energy technologies
6. Project evaluation

1. Project evaluation in fifth year
2. CDB records and reports
3. CARICOM records and reports
4. Quarterly project reports, interim evaluations, annual Alternative Energy Advisory meetings in Region

Important Assumptions

1. Cost of fossil fuel imports will continue to rise (and consume foreign exchange earnings thus making alternative energy technologies cost effective investments for the Caribbean countries).
2. Alternative energy technologies will permit the electrification of remote villages and households which could not efficiently be served by extending the traditional fossil fuel generated system.
3. Local communities will accept and use non-conventional energy technologies.
4. Countries in the Region will restrict future growth of consumption through more efficient energy use.
5. Countries will be willing to adopt a national pricing structure for energy (i.e. petroleum products should not be supplied at lower than international prices).

1. Countries in Region will perceive the need to plan for their energy requirements and be willing to develop indigenous energy resources.
2. Private sector willing to support non-conventional energy generation.
3. Alternative energy is socially and culturally acceptable.

Means of Verification

1. National Energy Assessments.
2. Survey of Plans in Region.
3. Survey of field-tested projects.
4. CDB reports and records.
5. CARICOM reports and records.
6. USAID reports and records.
7. Training program enrollments.
8. Utilization records of communication/  
information system.

1. AID financial records.
2. CDB financial records.
3. CARICOM financial records.

Important Assumptions

1. Countries willing to incorporate energy planning into macro-economic planning.
2. Adequate number of human resources already exist in area who can be trained in energy planning and non-conventional technologies.
3. Caribbean countries willing to cooperate and make human and technical resources available for developing their energy systems.

Full allotment of funds will be received as planned.

Outputs:

1. National energy planning activities.
  - a. National energy assessments completed or updated including national resource and consumption surveys.
  - b. National economic development plans have energy policy component.
2. Technical and analytical training courses in energy management and technology development.
  - a. A cadre of trained specialists in energy planning, energy management and accounting, and non-conventional energy technology applications including their design, implementation, and maintenance.
3. Regional communications network established throughout the Region to collect and disseminate results of tested demonstrated pilots, energy information, and coordination of energy related activities.
4. Field-tested applied research projects in renewable energy technologies.

Magnitude of Outputs:

(Cummulative)

<u>FY 79/80</u>	<u>81</u>	<u>82</u>	<u>83</u>	<u>84</u>
3	8	12	14	-
1	6	7	12	14
-	10	25	30	50
127	362	678	1046	1404
x ALL YEARS	x	x	x	x
8	15	22	34	36

INPUTSAID DEVELOPMENT GRANTIMPLEMENTATION TARGETS BY AID EXPENDITURES (\$000's)

		7,600						
		1st year <u>FY 79/80</u>	2nd <u>81</u>	3rd <u>82</u>	4th <u>83</u>	5th <u>84</u>	<u>Total</u>	
A.	CARICOM Energy Unit	A.	248.5	285.1	163.5	163.1	149.8	1,010.0
	1. Policy Program	1.	255.0	273.0	185.0	157.4	67.5	937.9
	2. Training Program	2.	502.3	107.8	420.7	139.6	154.0	1,324.4
B.	CDB Energy Group	B.	373.5	362.8	213.9	109.2	30.0	1,089.4
	3. Communications Program	3.	110.7	136.3	121.9	118.9	124.7	612.5
	4. Technical Program	4.	<u>355.0<sup>1/</sup></u>	<u>742.1</u>	<u>641.9</u>	<u>369.3</u>	<u>217.5</u>	<u>2,625.8</u>
			1,845.0	1,907.1	1,746.9	1,057.5	726.7	7,600.0

1/ Includes bagasse plant for D.R. \$300,000

International Donor Agencies with  
Alternative Energy Projects in the Caribbean Region

<u>NAME</u>	<u>PROJECT</u>
1. BDD - British Development Division	(a) Geothermal Studies, St. Lucia (b) Dominica Hydro Survey (c) Tropical Products Institute - charcoal in Guyana, Jamaica, Dominica - Copra Drying with solar driers
2. CDB - Caribbean Development Bank	(a) Crop Drying Project, Guyana (b) Ambient Solar Cooling, Barbados (c) Solar Refrigeration (d) Surplus Bagasse Utilization, Barbados Sugar Factories
3. CIDA - Canadian International Development Agency	(a) Hydro Survey in Haiti
4. CSC - Commonwealth Science Council	(a) Formulating Caribbean Alternative Energy Program and Projects (b) CMI Equipment Upgrading and Replacement (c) Biogas Seminar in Jamaica (d) Energy Accounting Seminar (W/OAS) Puerto Rico
5. CEC - Commission of European Communities	(a) Based on "Solar Energy for Development" meeting held in Italy in March, 1979, will be devoting large sums
6. EDF - European Development Fund	(a) Central Agriculture Laboratory Cooling Project, Barbados Photovoltaic Cooling System
7. DSE - German Foundation for International Development	(a) Wind surveys and Windmill installation in Haiti

<u>NAME</u>	<u>PROJECT</u>
8. IBRD - World Bank	(a) Caribbean Basin Energy Study for the Caribbean Group for Cooperation in Economic Development
9. IDB - Inter-American Development Bank	(a) Solar Energy Planning Project in the Dominican Republic
10. OAS - Organization of American States	(a) Country Alternative Energy surveys using energy accounting procedures (b) Energy Accounting Seminar (W/CSC), Puerto Rico
11. OLADE - Latin American Organization for Energy Development	(a) Geothermal assessment in the Dominican Republic
12. UNDP - United Nations Development Program	(a) Alternative Energy Projections for Caribbean (b) Energy Accounting Program in Jamaica (c) Reforestation and Charcoal Project in Guyana
13. ECLA - United Nations Economic Commission for Latin America	(a) Joint Project for Environmental Management in the Wider Caribbean (reforestation)
14. UNESCO - United Nations Economic and Social Committee	(a) Sponsoring Biogas meeting in September 1979, in Barbados or Trinidad
15. NASA - U.S. National Aeronautics and Space Administration	(a) Promote Wind Energy Systems in North, Central and South America
16. DOE - U.S. Department of Energy	(a) Solar International Commercialization Program (b) LDC Energy Program
17. USAID - Agency for International Development	(a) Haiti Bilateral Appropriate Technology Project (b) Jamaica Bilateral Energy Project (c) Central American Wood Energy Project

SECOND MEETING OF THE CARIBBEAN GROUP FOR COOPERATION

IN ECONOMIC DEVELOPMENT

CHAIRMAN'S REPORT: SUBGROUP A - REGIONAL PROGRAMS

June 8, 1979

In the discussion of the energy sector the following were noted as some of the major needs of the region:

- a. an improvement in energy planning capacity and the development of national energy plans;
- b. an improved energy data base;
- c. financing of deferred maintenance and rehabilitation of existing electric power systems;
- d. development of indigenous energy sources; and
- e. efficient energy pricing, which would reflect the true cost of providing energy.

It was agreed that external donors should consider increasing capital flows and technical assistance for energy development. In addition to electric power development, such assistance could be extended to exploration and production of petroleum, and development of other mineral fuels and alternative energy sources. The USAID program to develop alternate energy sources in the region was acknowledged to be an important one. IDB and the World Bank explained their programs and willingness to consider financing energy development.

EXPECTED ACCOMPLISHMENTS UNDER ALTERNATIVE  
ENERGY PROJECT, BY COUNTRY

ANGUILLA

Like many of the small island LDCs, Anguilla faces severe problems in overall management of expenditures for fossil fuel imports. By the end of the Project it is expected that Anguilla will make significant advances in understanding its energy problems in terms of energy accounting, conservation potential within the existing central supply system, and realistic prospects for alternative sources of energy supply. This will be accomplished through the training of individuals in energy accounting techniques, supply/demand analysis, and policy and planning skills. These capabilities, combined with cooperative assistance from other participating countries in the Project, will assist Anguilla in obtaining financial and technical resources needed in solving its energy problems.

In addition, it is expected that a number of alternative energy technology field tests will take place in Anguilla by project end. These include solar applications for water distillation and crop drying. The demonstration of the commercial potential of these technologies will spur the development of these and other alternative supply options.

ANTIGUA

Antigua's most critical energy problems lie in the cost, reliability, operation and maintenance of the central electricity supply system. Interest in alternative energy sources is high, but is constrained by lack of financial resources and technical capabilities in specific energy areas. By the close of the Alternative Energy Project several achievements are expected for Antigua:

- strengthening of overall energy management activities, through training of individuals in energy accounting, demand analysis, and cooperation with other Caribbean countries in common problem areas;

- steps toward alleviating central electricity system operation and maintenance problems, such as by implementation of a conservation plan, through energy management training and cooperative problem solving with other utilities in the Region;
- development, demonstration and several commercial applications of alternatives to conventional energy supply; in particular, wind, electric water pumping and biogas generators;
- analysis of potential of larger scale alternative energy systems, such as biomass - fired steam - electric generation facilities.

#### BARBADOS

The relatively developed institutional, industrial and commercial infrastructure of Barbados will facilitate accomplishment of a variety of alternative energy development objectives by the end of this Project. These include:

- strengthening of energy management capabilities and measures;
- development of a detailed solar and wind resource data base;
- field testing of grid-connected wind-electric applications;
- utilization of solar stills.

Ongoing activities in energy management and conservation initiatives, solar hot water heating, solar cooling and bagasse utilization will be supported, evaluated and disseminated. It is expected that through this Project, Barbados and its available expertise will more effectively serve as a technical resource for the region as well as a development model in important respects for other island economies.

## BELIZE

While energy problems in Belize are similar to those of other Caribbean LDCs, prospects for alternative energy development are more varied. By project end, it is anticipated that Belize will have made the following achievements:

- strengthened the activities of CASE (Committee for Alternative Sources of Energy);
- developed an energy policy and planning capability, through the policy assistance, training and communications components of the Project, including development of a conservation strategy and an alternative energy plan;
- demonstration of mini-hydro technology and preparation of support analyses for development of numerous sites;
- field testing of wind water pumping, solar crop drying and biomass utilization technologies.

In addition, a major objective is to bring Belize more closely into Caribbean cooperation initiatives through this Project. In this way, Belize will more effectively confront constraints of obtaining financial, technical and informational assistance.

## DOMINICA

Like other small island LDCs, Dominica energy problems are highlighted by a severe petroleum import dependence, lack of financial resources for alternative energy development and lack of technical energy skills. Hydro and biomass potential are substantial and accomplishments anticipated as a result of this project are:

- development of an energy planning and management capability;
- demonstration of micro-hydro applications for local electrification;
- development of integrated charcoal production strategies to help offset gas imports.

In general, Dominica requires broad-based development of all energy skills. An important objective and expected result of this Project is simply the initiation of integrated and cooperative energy development strategies.

### DOMINICAN REPUBLIC

A major goal and expected result of the Alternative Energy Project is to effectively involve the Dominican Republic in Caribbean-wide energy cooperation initiatives. Several independent energy management and alternative energy development projects are already underway, and it is expected that these (industrial conservation, bagasse utilization, solar hot water, energy accounting) will be assessed and the results distributed for wider use in the Project. Other specific accomplishments anticipated are:

- assistance in strengthening general energy policy and planning skills;
- field testing of wind water pumping (irrigation) and solar crop drying (in particular, bagasse drying for fuel production);
- assessment of all forms of alternative energy potential;
- support for the newly formed Energy Commission as a focus for integrated energy activities and a model for other nations.

### GRENADA

Grenada's needs for broadly directed, basic energy skills development will be addressed by all components of this Project. It is expected that by Project end Grenada will have the beginnings of an energy planning and management capability, and that incorporation in the Project will open numerous development options through cooperation with other countries in the region. Grenada also has significant alternative energy potential, and a number of specific technology applications will be initiated.

- biogas generation;
- wind water pumping for irrigation.

In addition, assessment of alternative energy resources (solar, wind, biomass and hydro) must be carried out. The training of individuals in energy areas and technical assistance in policy and technological disciplines will help to initiate this activity.

## GUYANA

It is expected that a number of objectives for Guyana will be met under this Project:

- support and strengthening of the recently formed National Energy Commission, particularly in areas of energy conservation and planning and renewable resource development;
- support and dissemination of ongoing activities in alternative energy, namely charcoal and biogas production, and research on ethanol from sugar cane;
- field testing of grid-connected mini-hydro applications to begin to take advantage of Guyana's immense hydro resource.

Renewable energy resource potential is substantial enough in Guyana to consider export of certain fuel forms (charcoal, methanol), and it is hoped that examination of these prospects is begun under this Project. Another goal and anticipated result is to draw Guyana more meaningfully into co-operative regional activities. Aside from project activities relating specifically to Guyana, this will be accomplished through the significant support given to CARICOM, based in Georgetown.

## HAITI

Considering Haiti's singular status and pressing basic needs, it is hoped that limited, fundamental objectives will be achieved under this Project.

- establish a means to incorporate Haiti into Caribbean technical assistance cooperation initiatives;
- assist the government in broad-based energy skills development;
- strengthen community level organizations focusing on basic human needs in alternative energy projects.

Specific accomplishments anticipated in the alternative energy area are:

- demonstration of efficient charcoal production and use strategies for cooking fuel, integrated with comprehensive reforestation activities;

- field tests of wind water pumping for irrigation use;
- initiation of activities in country-wide assessment of renewable energy potential (hydro, solar, biomass, wind).

A significant result of this Project would be that a general understanding of the uses of alternative energy is promoted, and that technology field tests clearly demonstrate their application to satisfying basic needs.

#### JAMAICA

Jamaica's sophistication in the energy policy and alternative energy areas, combined with its developed institutional, industrial and commercial infrastructure, provide a substantial technical resource to the Caribbean Project. Thus a primary objective for Jamaica by the Project's end is the widespread (regional) utilization of its resources in the Project. This will be accomplished through the distribution of research results from Jamaican activities to applicable users throughout the region and by locating a significant number of Project activities at UWI, Mona Campus. Jamaica, too, will benefit substantially from this role.

Specific accomplishments expected for Jamaica include:

- strengthening energy policy, planning and management activities currently underway, to begin to alleviate severe energy import problems;
- coordination of energy activities presently taking place in many areas of government and the private sector;
- development of biogas (with diesel option) generation systems for farm use;
- development of efficient charcoal production techniques for cooking, fuel applications;
- general support and dissemination of all renewable energy activities receiving attention in Jamaica.

### MONTSERRAT

The major accomplishments resulting from this Project in Montserrat are similar to those for other Caribbean LDCs. Development through training and policy assistance of an energy management and planning capacity will help Montserrat to control impacts associated with heavy petroleum import dependence, and alternative energy technology field tests will begin to create supply options to offset petroleum use. Grid-connected windmills and biogas generators will be field-tested in Montserrat, and an assessment of solar energy potential for crop drying and hot water heating will initiate the process of indigenous energy resource development. Considering the level of interest in alternative energy and Montserrat's small size, it is expected that alternative energy activities will have made significant progress by the Project's termination.

### ST. KITTS-NEVIS

By the end of the Alternative Energy Project, St. Kitts-Nevis is expected to have made progress as follows:

- initiation of comprehensive energy planning and management activities focused on reducing oil import bills;
- increased institutional cooperation in energy projects; e.g. between St. Kitts Electricity Corporation and St. Kitts Technical College;
- initiation, through technology field tests, of more widespread development of solar hot water heating, grid-connected wind electricity, wind water pumping and solar crop drying applications.

The Project will also be instrumental in achieving increased cooperation between St. Kitts-Nevis and other Caribbean countries.

### ST. LUCIA

Despite the diversity of renewable energy resource potential in St. Lucia, most attention has been focused on the Soufriere geothermal site. A more general understanding and broadly based development of alternative energy is expected to result from this Project. Specifically the Project will have:

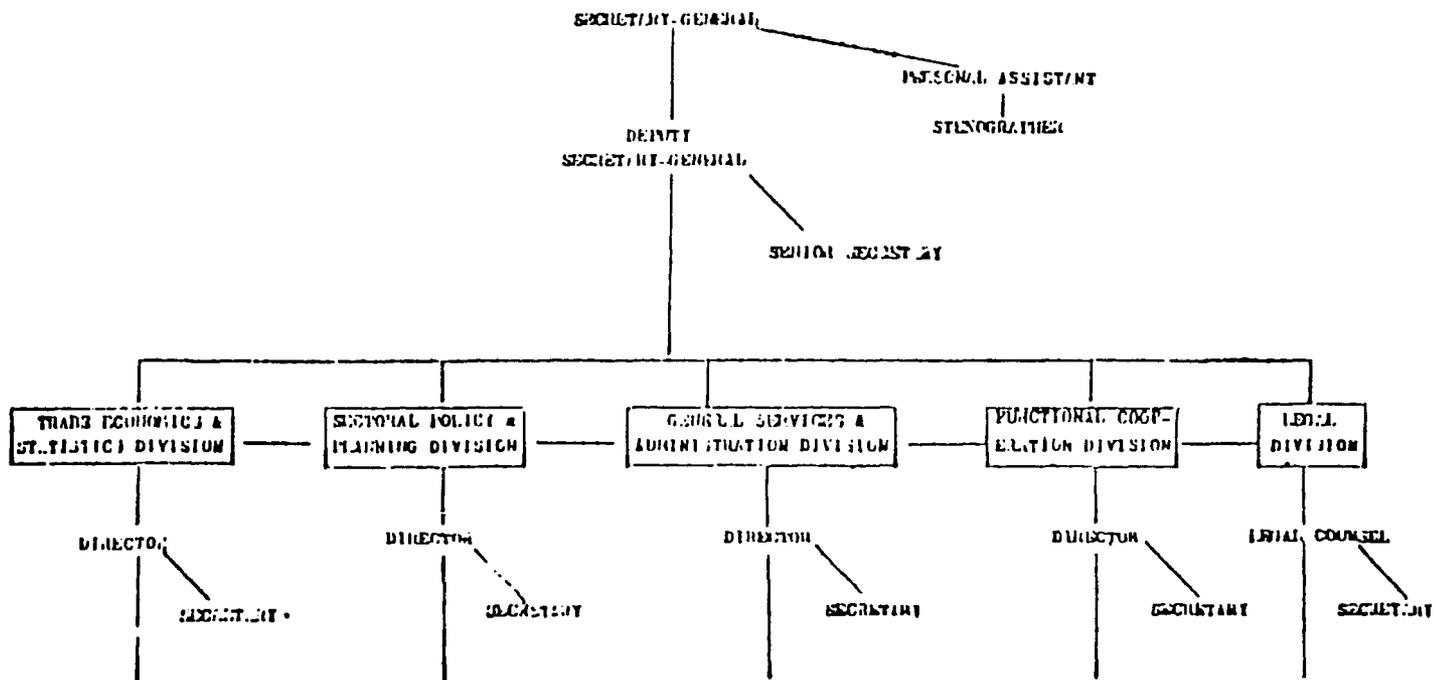
- assisted the development of the new Energy Commission;
- initiated an energy policy and planning process directed toward managing fuel import problems;
- helped facilitate the commercial development of geothermal energy by supporting follow-up activities (e.g. helping to arrange financing) to the work already performed;
- promoted solar hot water and crop drying technology development through field tests;
- helped begin other alternative energy activities in assessment of wind, solar and biomass resources.

#### ST. VINCENT

Although St. Vincent could not be visited during the performance of contract work, it will participate in the Project. Several objectives can be foreseen for St. Vincent based on earlier work (Prefeasibility Study performed by SAI under AID contract) done there which identified potential projects. The activities currently planned under the Alternative Energy Project are crop drying and biogas generation field tests. Like other small island LDCs, it is anticipated that St. Vincent will be able to initiate integrated energy management and alternative energy development efforts as a result of the policy, technical and communications assistance components of the Project, and that it will be a full participant in all forms of cooperative regional development initiatives related to the Project.

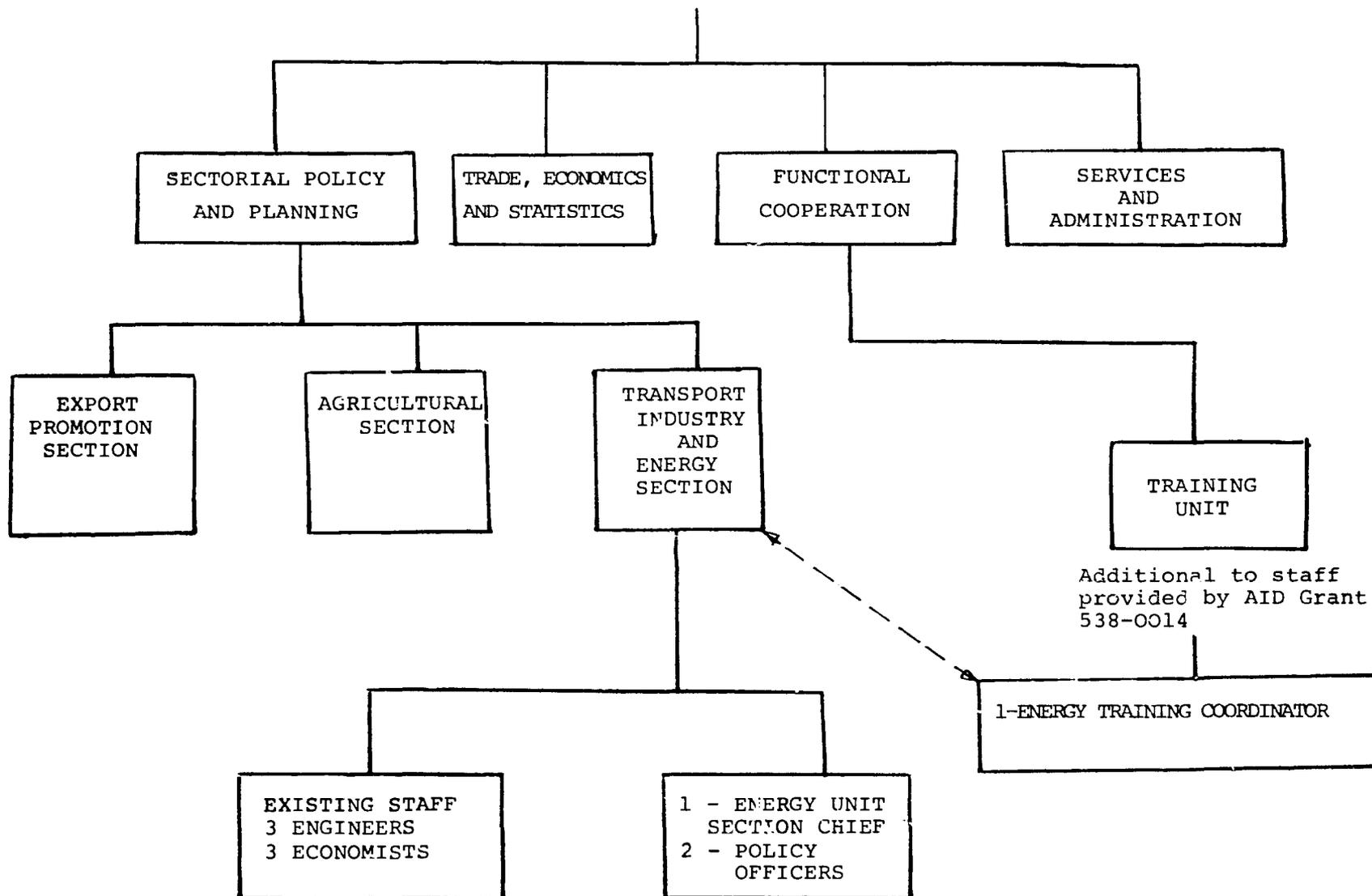
CARIBBEAN COMMUNITY DISCUSSION

ORGANISATION CHART



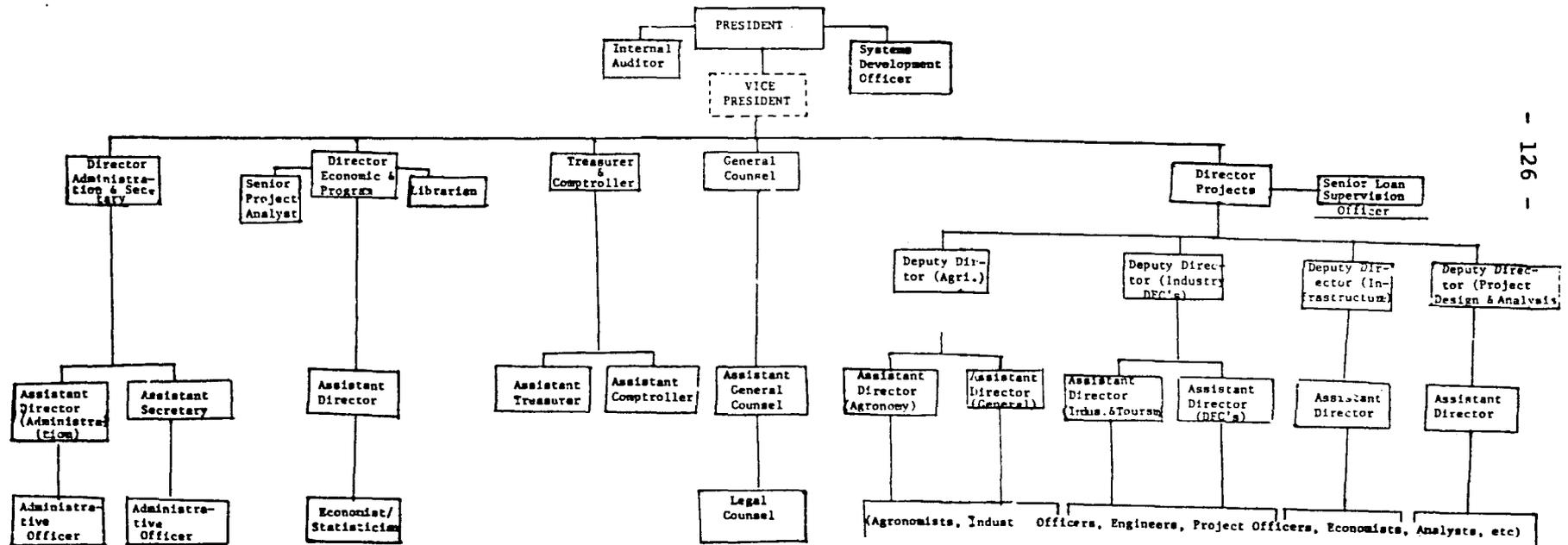
CARICOM ORGANIZATIONAL CHART

LOCATION OF ENERGY UNIT



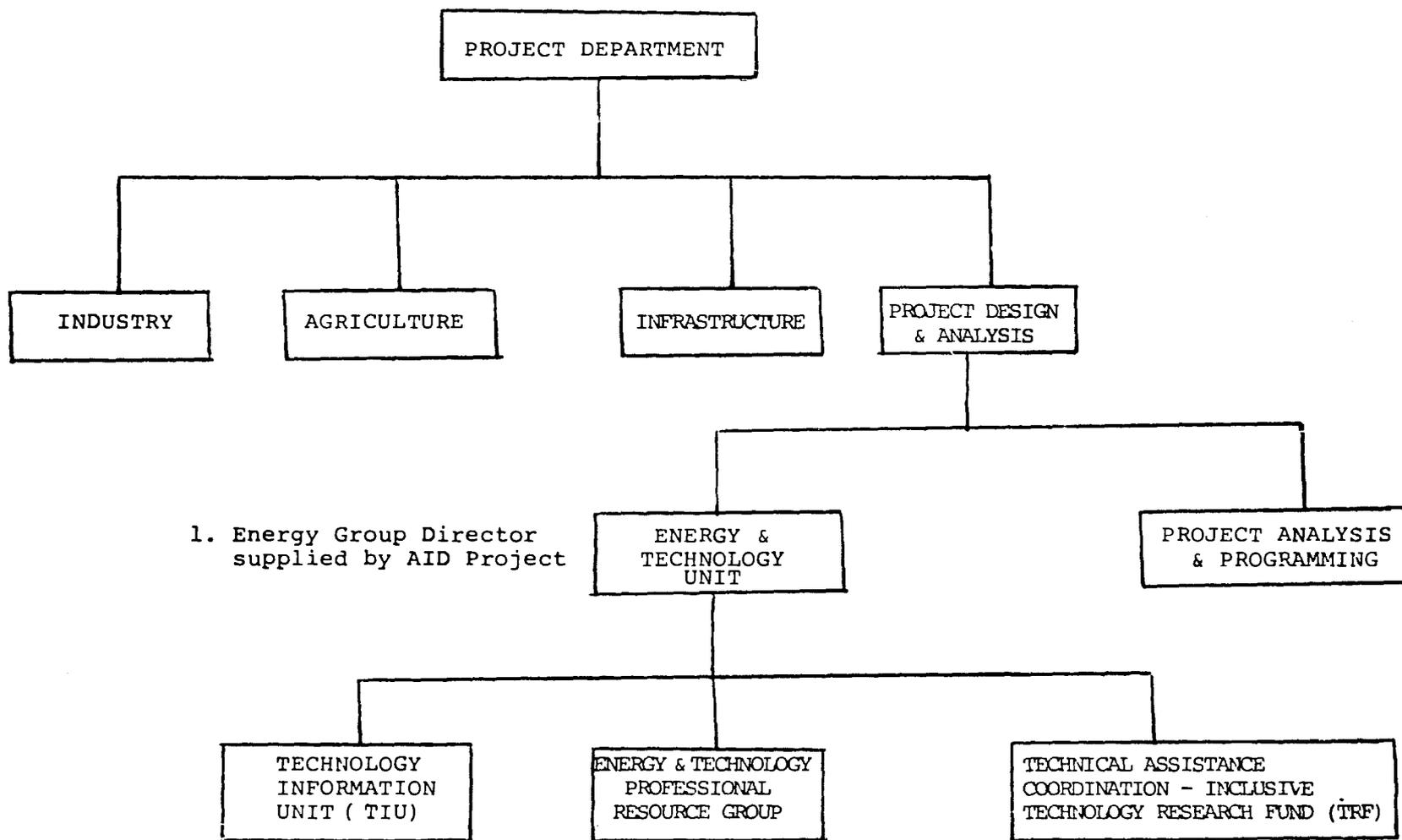
**CARIBBEAN DEVELOPMENT BANK**  
**DEPARTMENTAL ORGANIZATION**  
 (Professional Staff)

ANNEX



CDB ORGANIZATIONAL CHART

LOCATION OF ENERGY GROUP



1. Energy Group Director  
supplied by AID Project

1 Energy Communication  
Officer  
supplied by AID  
Project

1 Economist supplied  
by AID Project  
1 Technical Officer  
supplied by AID Project

**NOTE:** CDB Management is considering elevating the Technical Assistance Coordination function to the same level as the Energy & Technology Unit (TIU).

DESIGNATED GOVERNMENT AGENCIES  
AND CONTACT PERSONS

COUNTRY	LEAD AGENCY	CONTACT
ANGUILLA	MINISTRY OF TOURISM & NATURAL RESOURCES	Fabian Fahie Perm. Sec.
ANTIGUA	MINISTRY OF COMMUNICATIONS & PUBLIC WORKS	Errol James Perm. Sec.
BARBADOS	MINISTRY OF AGRICULTURE	Percival Jeffers Dep. Chief Agri. Officer (C.S.C. rep)
BELIZE	MINISTRY OF ENERGY & COMMUNICATIONS AND COMMITTEE FOR ALTERNATIVE SOURCES OF ENERGY (CASE) (AN ENERGY SPECIFIC PUBLIC AND PRIVATE ORGANIZATION)	Hugh McCain, Perm. Sec, of Ministr. and Director Case.
DOMINICA	MINISTRY OF COMMUNICATIONS & WORKS	M.C. Doctrove, Perm. Sec.
DOMINICAN REPUBLIC	COMMISSION ENERGIA	Alex Pena Exex. Sec.
GRENADA	MINISTRY OF COMMUNICATIONS, WORKS & LABOR	Selwyn Strachan Min.
GUYANA	NATIONAL SCIENCE RESEARCH COUNCIL also NATIONAL ENERGY COMMISSION	Patrick Munroe, Director
HAITI	MINISTRY OF MINES & ENERGY RESOURCES & MINISTRY OF PLANNING	Max Antoine
JAMAICA	MINISTRY OF MINING & NATURAL RESOURCES	William Saunders
MONTSERRAT	MINISTRY OF COMMUNICATIONS & WORKS	John Ryan, Perm. Sec.
ST. KITTS - NEVIS	ST. KITTS ELECTRICITY CO.	Wilson Blondell, Mgr. & Chief Engineer
ST. LUCIA	MINISTRY OF COMMUNICATIONS, WORKS & LABOR	Wilfred Gabriel, Dir Electricity Divn.
ST. VINCENT	MINISTRY OF PUBLIC WORKS	Ruben Bailey

REGIONAL RESEARCH INSTITUTION

INSTITUTION	AREAS OF SPECIALIZATION
CARDI (Trinidad)	<ul style="list-style-type: none"> <li>- Agricultural R &amp; D Technology, Policy</li> <li>- Technical Information Dissemination</li> <li>- Sectoral and Market Analysis</li> </ul>
CARICOM (Guyana)	<ul style="list-style-type: none"> <li>- Inter-government cooperation initiatives</li> <li>- Energy policy coordination</li> </ul>
CARIRI (Trinidad)	<ul style="list-style-type: none"> <li>- Industrial technology R &amp; D</li> <li>- Technical Information Dissemination</li> <li>- Market Analysis</li> </ul>
CMI (Barbados)	<ul style="list-style-type: none"> <li>- Training in meteorological sciences</li> <li>- Meteorological Assessment: sun, wind, water,</li> <li>- Instrument utilization training and maintenance.</li> </ul>
CEER (Puerto Rico)	<ul style="list-style-type: none"> <li>- Alternative Energy R &amp; D, analysis and applications; Prototype development</li> <li>- Information dissemination; training</li> <li>- Environmental assessment</li> </ul>
CSC - Commonwealth Science Council (London) Caribbean Alternative Energy Programme	<ul style="list-style-type: none"> <li>- Alternative Energy Project Identification</li> <li>- Communications - Regional</li> <li>- Coordination</li> </ul>
INDOTEC (Santo Domingo, DR)	<ul style="list-style-type: none"> <li>- Industrial R &amp; D: technology development technical assistance</li> <li>- Industrial Conservation Studies</li> <li>- Information dissemination</li> </ul>
UASD (Santo Domingo, DR)	<ul style="list-style-type: none"> <li>- Alternative Energy technical analysis</li> <li>- Energy Policy Studies</li> </ul>
University of Guyana, (Georgetown, Guyana)	<ul style="list-style-type: none"> <li>- Solar R &amp; D: Charcoal, crop drying, wind energy</li> <li>- Biomass technologies</li> </ul>
University of the West Indies (UWI) - Mona Campus (Jamaica)	<ul style="list-style-type: none"> <li>- Training</li> <li>- Energy Policy Studies</li> <li>- Technology R &amp; D</li> </ul>
UWI - St Augustine Campus (Trinidad)	<ul style="list-style-type: none"> <li>- Energy Technology Engineering Analysis</li> </ul>
UWI- Cave Hill (Barbados) Campus	<ul style="list-style-type: none"> <li>- Policy/Legal Studies</li> </ul>

### Jamaican Energy Planning

The Government of Jamaica has taken the lead in energy planning with their publication of the Five Year Development Plan - Energy Sector Plan. This document comprehensively treats present consumption patterns, forecasts future demand levels, and identifies policies for achieving the report objective.

As stated in that report -

"Energy planning is vital to the achievement of these (economic) goals, particularly with respect to a reduction in energy demand growth rate while ensuring minimum negative impact on the economy. This requires a detailed knowledge of energy flows throughout each sector of the economy, which can only be derived by establishing a National Energy Accounting System. From this information, energy conservation can be implemented through energy supply/demand balances and management, especially in the industrial, agricultural and transport sectors, and must also include a revision of energy prices and taxes."

In the Energy Sector Plan, objectives and procedures are described and then an Implementation Plan is developed. The objectives include:

- i. Short-Term Objectives (1-3 years)
  - (a) Enhance energy conservation by conducting comprehensive Energy End Use Surveys.
  - (b) Reduce the energy intensity, whilst sustaining desired rates of economic growth by identifying those sectors/technologies where the energy intensity can be reduced. This may require replacement of energy inefficient capital equipment in industry, agriculture and transportation. Detailed sectoral studies should be completed during the Short-term.
  - (c) Rationalization of energy prices through fiscal measures and abolition of subsidies on various products to achieve economic allocation of energy resources. The cost of energy to the low income groups would continue to be cushioned to the greatest extent possible.

- ii. Medium-Term Objectives (3-5 years)
  - (a) Diversification of the present energy supply mix based on detailed technical studies (coal retrofitting program, etc.).
  - (b) Develop economically feasible non-conventional energy sources adapted to local needs through the transfer of technology (solar, wind and biomass, etc.).
- iii. Long-Term Objective (5 years and beyond)
  - (a) Accelerated exploration to identify and develop conventional renewable and non-renewable indigenous sources of energy (e.g. oil and gas, hydropower, peat, etc.).
  - (b) Maximize energy self-sufficiency through the development of non-conventional energy sources.

The Implementation Plan applies the identified procedures and uses four major tools. These include a National Energy Accounting System, Energy Demand Management (Conservation), Energy Supply Management and the Development of Non-Conventional Energy Resources. Fiscal incentives, energy prices and energy taxes are all mentioned as tools for energy demand management.

The report concludes with an analysis of the implications of energy sector planning and identifies a series of policy issues such as energy prices and taxes, planning coordination, fiscal incentives for supply augmentation and conservation technology investment, transportation issues, policy issues for new findings and institutional issues.

Attached is an outline of typical national energy accounting survey and report format. A comprehensive energy accounting survey involves a study of the present status and future trends of the energy economy. This encompasses the economic activity associated with the production of various forms of primary energy (both commercial and non-commercial), their transformation into secondary forms of energy (e.g., electricity), international trade in various forms of primary or secondary energy, the energy distribution system and end-use patterns of consumers. A comprehensive energy survey will be structured to provide data and information on the following aspects of the energy economy:

ENERGY ACCOUNTING SURVEY: REPORT OUTLINE

- I. Historical Setting and Social Change
- II. Geography and Population
  - a. major geographic areas and water availabilities
  - b. climate
  - c. vegetation
  - d. minerals other than energy
  - e. settlement patterns and trends
  - f. population and trends
- III. Character and Structure of Economy
  - a. patterns of growth and resource allocation
  - b. foreign participation in economy
  - c. labor
  - d. development plans
- IV. Energy Resources
  - a. indigenous commercial
  - b. non-commercial
  - c. imported
  - d. renewable
- V. Energy Use by Sector
  - a. Agriculture
    - 1. historical trends--traditional patterns
    - 2. crops
    - 3. improvement program
  - b. Manufacturing and Industry
    - 1. historical trends--traditional
    - 2. mining capabilities and major products
    - 3. electric power
  - c. Trade and Transportation
    - 1. trends in domestic transportation
    - 2. tourism
    - 3. communication
  - d. Residential and Commercial
    - 1. end uses
    - 2. trends
  - e. Rural/Urban Comparisons and Trends

- VI. Overview of Energy Role in the Future Economy
  - a. consumption patterns and trends
  - b. resource availability
  - c. potential for new alternative technologies and increased use of renewable energy resources.
  
- VII. Summary Tables for Energy Data
  
- VIII. Data Sources
  - a. agencies list
  - b. associations list
  - c. publication list
  - d. banks
  - e. manufacturers
  - f. AID (in-country)
  - g. international agencies
  - h. embassies

PROJECT COMPONENT BUDGET

<u>CARICOM ENERGY UNIT</u>	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	TOTAL COST
<u>LABOR</u>						
Section Chief 5 PYs	\$20,000	\$22,000	\$24,200	\$26,600	(\$29,200) <sup>1/</sup>	\$92,800
Overhead <sup>2/</sup> includes 5 PYs Secretary support etc. 1.0	20,000	22,000	24,00	26,600	29,200	121,800
Asst. Project Manager 5PYs	10,000	11,000	(12,100) <sup>1/</sup>	(13,300) <sup>1/</sup>	(14,600)	21,000
Overhead 1.0 5PYs	10,000	11,000	12,100	13,300	14,600	61,000
Training Coordinator 5PYs	13,000	14,300	15,700	(17,300)	(19,000)	43,000
Overhead 1.0 5PYs	13,000	14,300	15,700	17,300	19,000	79,300
2 Energy Specialists (Regional Consultants) 10PYs	24,000	26,400	29,000	32,000	35,100	146,500
Overhead 0.5 (Due to extensive travel will share staff) 5PYs	-	13,200	14,500	16,000	17,500	61,200
Joint Technical Advisory Group 2.5 yrs for 2 years @ 100,000/yr	125,000	125,000	-	-	-	250,000
<u>TRAVEL &amp; PER DIEM</u>						
3 Program Staff @ 3,000/year	9,000	9,900	10,900	12,000	13,200	55,000
2 Energy Specialists @ 5,000/year	-	11,000	12,000	13,300	14,600	50,900
<u>COMMUNICATIONS</u>						
3 Program Staff @ 1,500/year	<u>4,500</u>	<u>5,000</u>	<u>5,400</u>	<u>6,000</u>	<u>6,600</u>	<u>27,500</u>
Includes 10% inflation factor compounded annually						
<b>TOTAL</b>	<b>248,500</b>	<b>285,100</b>	<b>163,500</b>	<b>163,100</b>	<b>149,800</b>	<b>1010,000</b>
<sup>1/</sup> (Funded by CARICOM)			(12,100)	(30,600)	(62,800)	(105,500)
<sup>2/</sup> Overhead as estimated here includes the direct costs of secretarial staff, insurance, education & housing allowances, etc.						

PROJECT COMPONENT BUDGET

<u>POLICY PROGRAM</u>	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	TOTAL COST
<u>LABOR</u>						
Outside experts (includes travel and per diem)	\$100,000	\$75,000	\$40,000	\$25,000	\$10,000	\$250,000
<u>PROJECTS</u>						
Country Energy Assessments	50,000	82,500	60,500	39,900	-	232,900
Country Policy Studies	75,000	82,500	60,500	65,500	36,500	321,000
Regional Policy Studies	30,000	33,000	24,000	26,000	21,000	134,000
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TOTAL	255,000	273,000	185,000	157,400	67,500	937,900

PROJECT COMPONENT BUDGET

<u>TRAINING PROGRAM</u>	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	TOTAL COST
<u>TRAINING SUB-PROGRAMS</u>						
2 Regional Energy Specialists training - \$4,000/year; travel and per diem, \$10,000/year.	\$28,000	-	-	-	-	\$28,000
28 Country Energy Generalists - @ 7,500/person including travel and per diem, 14 in 1980 and 1982 salaries paid by governments (56,000)	96,000	-	\$116,200	-	-	212,200
20 Engineers and Designers - 10 Scholarships in 1980 and 1981 @ 10,000 limit/scholarship \$4,000 tuition 5,000 stipend, \$1,000 travel	120,000	-	145,200	-	-	265,200
780 Professionals training - 14 short term seminars \$3,000 materials and college overhead, \$12,000/year salary per lecturer total of man years, per diem for two man years, 300 days \$5,000/year (some local experts used) travel \$5,000/year.	98,300	107,800	59,500	65,100	72,000	402,700
574 Technicians training - (14) 10,000 initial grants for first two years salary and equipment purchase (based on St.Kitts \$7,000 estimate) \$4,000/year thereafter	160,000	-	99,800	74,500	82,000	416,300
Includes 10% inflation compounded annually						
<b>TOTALS</b>	<b>502,300</b>	<b>107,800</b>	<b>420,700</b>	<b>139,600</b>	<b>154,000</b>	<b>1,324,400</b>

PROJECT COMPONENT BUDGET

<u>CDB ENERGY GROUP</u>	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	TOTAL COST
<u>LABOR</u>						
Asst. Director 5PYs	\$20,000	\$22,000	\$24,200	\$26,600	(\$29,200) <sup>1/</sup>	\$92,800
Overhead includes 5PYs secretary support etc. 1.0	20,000	22,000	24,200	26,600	( 29,200)	92,800
Technical Officer (environmen- tal specialist) 5PYs	15,000	16,500	18,150	(19,950) <sup>1/</sup>	( 21,900)	49,650
Overhead 1.0 5PYs	15,000	16,500	18,150	(19,950)	( 21,900)	49,650
Communications Officer 5PYs	15,000	16,500	18,150	(19,950)	( 21,900)	49,650
Overhead 1.0 5PYs	15,000	16,500	18,150	(19,950)	( 21,900)	49,650
Financial Officer 5PYs	13,000	14,000	(15,730) <sup>1/</sup>	(17,290)	( 18,980)	27,000
Overhead 1.0 5PYs	13,000	14,000	(15,730)	(17,290)	( 18,980)	27,000
Joint Technical Advisory Group, 2.5 PYs @ 100,000/year	125,000	125,000	-	-	-	250,000
Consultants 6PYs for Techni- cal Program (includes travel & per diem)	100,000	75,000	75,000	50,000	30,000	330,000
<u>TRAVEL AND PER DIEM</u>						
4 Program staff @ 3,000/year	15,000	16,500	11,970 (7,260)	3,990 (15,960)	(21,900)	47,460
<u>COMMUNICATIONS</u>						
4 Program staff @ 1,500/year	7,500	8,250	5,985 (3,630)	1,995 (7,980)	- (10,950)	23,730
Includes 10% inflation factor compounded annually TOTAL <sup>1/</sup> (Funded by CDB)	373,500	362,750	213,955 (42,350)	109,185 (138,320)	30,000 (213,890)	1,089,390 (394,560)

PROJECT COMPONENT BUDGET

<u>COMMUNICATIONS PROGRAM</u>	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	TOTAL COST
<u>LABOR</u>						
Consultancy services @ \$750/week 1.8PY 2CPW 15,000		30PW 24,750	20PW 18,150	15PW 14,980	10PW 10,980	\$83,860
Workshops and Seminars (4 conferences/year) .5PY	4,500	4,950	5,450	5,990	6,590	27,480
Abstract and Translation services	7,200	7,920	8,710	9,580	10,540	43,950
<u>MATERIALS</u>						
Document acquisition, subscriptions	8,000	12,000	8,000	5,000	5,500	38,500
Energy Libraries	5,000	6,000	6,000	6,500	8,150	31,650
<u>TRAVEL AND PER DIEM</u>						
53 in region RT @ 200	10,600	11,660	12,800	14,100	15,800	64,960
28 US Caribbean RT @ 400 (tapering)	11,200	12,320	8,000	6,000	6,660	44,180
375 days per diem @ \$60/day (tapering)	22,500	24,750	23,000	23,500	25,850	119,600
Consultant per diem @ 300/PW 20PW 6,000		30PW 9,900	20PW 7,260	15PW 5,990	10PW 4,390	33,540
<u>REPRODUCTION AND SUPPLIES</u>						
Newsletter & Brochures 6 x 6pp x 1500 x 15	8,100	8,910	9,800	10,780	11,860	49,450
Conference meeting \$150 each x 4/year	660	660	730	800	880	3,730
<u>COMMUNICATIONS</u>						
Long distance and cables	9,127	10,300	11,600	13,000	14,600	58,627
Postage and Handling	2,800	2,200	2,420	2,660	2,920	13,000
<b>TOTAL</b>	<b>110,687</b>	<b>136,320</b>	<b>121,920</b>	<b>118,880</b>	<b>124,720</b>	<b>612,510</b>

TECHNICAL PROGRAM BUDGET SUMMARY

<sup>1/</sup> Excludes \$300,000 for the bagasse crop dryer in the D.R. to be reviewed and if qualified, bilaterally granted in FY 1979.

	(\$ 000's)					TOTAL
	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984	
Yearly Technical Program Total	355.0	742.1	641.9	369.3	217.5	2325.8 <sup>1/</sup>
<u>IDENTIFIED SUB PROJECTS</u>						
<u>WIND</u>						
A. Renewable Energy Resource Assessments	39.8	28.7	18.5	17.6	-	104.6
B. Analytic Support	19.0	-	-	-	-	19.0
C. Applied R & D	-	11.4	11.4	13.5	-	36.3
D. Field tests	47.0	204.6	228.2	26.1	14.0	519.9
						Subtotal 679.8
<u>BIOMASS</u>						
A. Renewable Energy Resource Assessments	16.7	19.0	11.7	12.8	-	60.2
B. Analytic Support	-	26.4	31.6	26.0	-	84.0
C. Applied R & D	-	-	31.7	24.6	4.5	60.8
D. Field tests	19.1	202.3	41.0	19.7	-	282.1
						Subtotal 487.1
<u>DIRECT SOLAR</u>						
A. Renewable Energy Assessments	55.8	11.4	16.2	-	-	83.4
B. Analytic Support	14.9	7.2	10.0	-	-	32.1
C. Applied R & D	-	16.2	12.0	7.0	-	35.2
D. Field Tests	22.3	62.7	27.0	1.6	1.0	114.6
						Subtotal 265.3
<u>HYDROPOWER</u>						
A. Renewable Energy Resource Asses.	78.8	17.6	-	-	-	96.4
B. Analytic Support	16.6	11.1	-	-	-	27.7
C. Applied R & D	-	30.2	17.6	12.4	-	60.2
D. Field Tests	-	43.3	85.0	58.0	6.2	192.5
						Subtotal 376.8
<u>TO BE IDENTIFIED DURING LIFE OF PROJECT</u>	25.0	50.0	100.0	150.0	191.8	Subtotal 516.8

ENERGY RESOURCE ASSESSMENT, GENERAL ENERGY MANAGEMENT TRAINING

Center for Energy and Environmental Research  
Puerto Rico

(offers a variety of alternative energy studies and short courses in energy accounting.)

Energy Management Training Program  
Stoney Brook University New York

SOLAR

Short Courses and Workshops are offered by the following organizations:

- Dr. E.A. Farber, Solar Energy and Energy Conversion  
Laboratory  
University of Florida  
Gainesville, Florida 32603

(Offers courses from time to time. Some are long (1 year +), others are for the summer or a semester. Usually good sound engineering courses with an emphasis on smaller scale systems.)

- J.R. Williams, Georgia Institute of Technology  
School of Mechanical Engineering  
Atlanta, Georgia 30332

(Courses in solar-wind, perhaps at a more sophisticated level than appropriate for developing country efforts. One year graduate training available.)

- Center for Environmental Technology  
Imperial College  
London, U.K.

(Offers one year post-graduate degree. Focus is on tropical agriculture, linking schools of mining, engineering, geology, botany, zoology and pest management. The Center works in conjunction with the International Institute for Tropical Agriculture in Ibaden, Nigeria.)

- International Centre for Theoretical Physics  
P.O. Box 586  
I-34100  
Trieste, Italy

(The Centre is the contact for the 1st International Symposium on Non-Conventional Energy, scheduled for August 27-September 21, 1979 in Miramara-Trieste.)

- Jordon College  
Cedar Springs, Michigan 49319

(Offers seminars, workshops, and degree programs in Alternate Energy.)

- Colorado Sunworks  
Box 455  
Boulder, Colorado 80306

(Offers workshops in Solar Technology, Solar Design,  
Solar Architecture and Solar Construction.)

- Total Environmental Action  
Harrisville, N.H.

(Offer periodic workshops on solar energy)

#### WIND

- A tour of the U.S. Department of Energy's Small Wind System's Testing Facility at Boulder, Colorado.
- A tour of the U.S. Department of Energy's 125' diameter 200 KW wind system at Clayton, New Mexico.
- A tour of the manufacturing and test facilities of:
  - O Windworks, Inc.  
Route 3, Box 44A  
Mukwonago, Wisconsin  
(414) 363-4088
  - O Dakota Sun and Wind, LTD  
Box 1781  
811 First Avenue, N.W.  
Aberdeen, South Dakota 57401
  - O Eneritech  
Box 420  
Norwich, Vermont 05055  
(802) 649-1145
  - O Aluminum Company of America  
(Contact: Paul Vasburgh)  
Alcoa Center, Pennsylvania 15069  
(412) 339-6651
- Enrollment in the waterpumping windmill short course offered by New Mexico Solar Energy Institute of the University of New Mexico, Las Cruces, New Mexico.  
(Contact: Mr. Rasmussen.)
- Short intensive training in electrical wind machine installation, system design, and site selection. This would probably only be available through working with a manufacturer or a consultant for a short time.

Caribbean Regional Training Project (538-0014)Project Summary

The project goal is to improve the productivity of public and private sector enterprises in the Eastern Caribbean. In support of this goal, the project has two purposes. First, the project will upgrade the managerial and technical skills of civil servants and small businessmen in the CARICOM States, with particular emphasis on the LDCs and Barbados. Second, the project will develop institutional capabilities to design and provide management, administration, supervisory and clerical skills training and to identify, develop, coordinate and implement participant training activities in specialized technical and managerial areas.

The purpose will be accomplished through the provision of inputs which support activities designed to make more effective use of the existing training capacity of regional and national institutions in the Caribbean. These inputs include staff support, travel and per diem, technical assistance, training equipment and supplies, materials production, library development, and assorted training grants.

The project is to be implemented over four years by the East Caribbean Common Market Secretariat (ECCM) and the Caribbean Community Secretariat (CARICOM). The ECCM Secretariat will be the recipient of \$1,550,000 in AID grant funding to design and implement a Public Services Training Program. This program will provide on a periodic basis, and through a common services approach, basic training to approximately 4,500 public sector employees of various levels of responsibility. The CARICOM Secretariat will be the recipient of \$2,450,000 in AID grant funding to design and implement a Participant Training Program.

This program will provide Individual Training Grants and Special Focus Seminars in response to the need for specialized technical and managerial training. Individual Training Grants will be provided for government officials to receive specialized, short-term training in areas such as health, education and food production. Special Focus Seminars will support group training that deals with the specific technical or managerial problems common to several or all of the participating countries. Together, the Public Service Training and Participant Training Programs will contribute to alleviation of impediments which hinder the ability of Caribbean States to plan and implement development activities as well as to absorb and effectively utilize extra-regional development assistance.

The immediate project beneficiaries are employees in the private and public sector of participating countries who receive the training provided for in the project. Lower income groups in rural areas and urban centers will benefit from improved services resulting from the training of these employees. It is also anticipated that unemployed and underemployed individuals, particularly the youth, will benefit through the participant training which assists small businesses to identify and take advantage of opportunities to expand output and employment.

TECHNOLOGY INFORMATION UNIT AND TECHNOLOGY RESEARCH FUND

## (1) Introduction

The Technology Information Unit (TIU) functions primarily as a staff service to the Industry, Agriculture, and Technical Divisions of the CDB. In addition, it serves the technical information needs of the national Development Finance Corporations (DFCs), other Caribbean development organizations, and the private sector. To the extent resources are available, the TIU also assists non-Caribbean development and information organizations, especially where the assistance is reciprocated.

The Technology Research Fund (TRF) is used by the CDB for research and pilot projects to adapt, define, and/or demonstrate specific technologies appropriate to the needs of the Caribbean region. Emphasis is placed on projects in the less developed countries and on projects of specific benefit to lower income groups.

Both the TIU and the TRF should support and reinforce the growing network of Caribbean information and research resources. Both will be expanded and adapted to serve the needs of the Alternative Energy Project.

## (2) TIU Information Service

The TIU is the focal point within the CDB for locating, gathering, storing, evaluating, selecting, and disseminating technical information. Technical information in this context would cover energy manufacturing processes and equipment (at all appropriate scales, from cottage industries up), agriculture and agro-industry, fishing equipment and techniques, construction materials and processes, and supporting natural resource data. The TIU will maintain a library of basic technical information and a much wider collection of references about outside technical information resources. These TIU operations will be closely coordinated with those of the CDB Library to get the most efficient use of equipment (microfiche printers, etc.), space, and skills. Although the TIU will be responsible for the technical information resources of the CDB, this material would be regarded as part of the CDB Library collection.

Information requests will come to the TIU from a variety of sources, including CDB and DFC loan officers who are formulating or analyzing projects, businessmen, development corporations, research organizations, government departments, and voluntary service organizations. The TIU staff, based on their own technical knowledge, will select the appropriate information from their files, or would acquire it from outside sources.

The TIU will coordinate with other Caribbean information banks, such as CARDI and CARIRI, to avoid unnecessary duplications and to make the best use of specialized skills. For certain categories of information, each organization should specialize on behalf of all the organizations. Throughout the Caribbean, the TIU should make cooperating organizations aware of what resources each can provide and insure that vital information gaps are closed, either by the TIU or by another organization.

To assist in coordinating and disseminating technical information, the TIU will publish a small newsletter on a monthly basis, describing selected technical items of specific interest to Caribbean development, including research projects, both in and outside the region, new product developments (particularly those suitable for small-scale applications), publications, profiles of Caribbean information and research organizations, and regional meetings and conferences. The newsletter would exchange information among cooperating institutions, inform outside organizations of relevant developments, reduce duplications of effort, and focus on areas needing further work. Other organizations should be invited to make regular contributions in their areas of interest.

### (3) Technology Research Fund

In the course of the CDB's work, including that of the TIU, certain areas will appear where relatively small expenditures of research, development, or demonstration funds will seem likely to provide substantial development benefits. To take advantage of these opportunities, a Technology Research Fund (TRF) is being established in the CDB. The TIU will prepare project proposals for funding by the TRF and for execution by selected Caribbean research institutions. These proposals will be coordinated and reviewed with the appropriate operating division (Industry, Agriculture or Technical) and with CDB management.

Projects for TRF funding should:

- focus on "key information" needed to unlock specific development potential;
- contribute, if successful, to development projects that increase employment and/or income, or reduce costs, or improve housing or other aspects of living conditions;
- focus on benefits to lower income groups;
- lead to projects for which there is a felt need and potential individual or institutional support;
- result in near term useful results; and
- utilize and support existing Caribbean research and development institutions.

EXISTING COMMUNICATIONS AND INFORMATION NETWORKS

CARIRI

The Caribbean Industrial Research Institute (CARIRI) is a center for expertise and information on industrial technology development. CARIRI operates a technical information center that emphasizes a user awareness. Many of their staff are sent to the U.S. to become trained information specialists. They have steered away from traditional library procedures which do not address the user's needs. CARIRI's "user approach" enables the person unfamiliar with specific titles or documents to obtain the information he/she needs. Through training or apprenticeship with CARIRI, the Coordinating Agency's information staff can benefit from the Institute's expertise in information procurement, processing and dissemination. These two information centers could coordinate efforts by establishing a referral service to respond to requests.

CARORO also publishes a Construction Cost Bulletin which gives information on the Trinidad and Tobago Construction Industry relating to market prices of building materials and measured labor rates for construction tasks. Through the AID program, their efforts could be expanded to collect such data relating to alternative energy technologies for the Caribbean region. Their contacts with industrial customers could be useful in the dissemination of information and in promoting the adoption and production of various alternative energy technologies.

CARDI

The Caribbean Agricultural Research and Development Institute was established in 1975 to serve the twelve member states of the Caribbean Community (CARICOM). CARDI receives its financial support from member states on a formula agreed to by heads of governments are project aid from external funding agencies. It is a successor to the Regional Research Center--part of the former Imperial College of Tropical Agriculture. The institute was formed to 1) provide for the research and development needs of agriculture in the region; 2) provide and extend new technologies in production processes, storage and distribution of agricultural products and; 3) coordinate and integrate research and development efforts of member states where appropriate.

CARDI is affiliated with the University of the West Indies with headquarters at the St. Augustine, Trinidad campus and other major branch universities in Jamaica and Barbados. CARDI has access to the university's field experiment station, library and computer facilities. However, it is a fully autonomous organization. The Institute's regional centers work very closely with staff of the various national ministries of agriculture and collaborates fully with universities and other agencies involved in agricultural and rural research and development in the region. This facilitates exchange of materials and information and collaboration in outreach programs of mutual interest.

CARDI can serve as a vehicle for information dissemination and project coordination for alternative energy initiatives in the agricultural sector. Although they have not developed any alternative energy projects to date, they have expressed interest in carrying out an "on-farm" demonstration project in solar crop drying.

This would involve a training and outreach component for agricultural students and extension agents to be trained in solar crop drying techniques. Demonstrations would then be carried out in select rural/agricultural communities. It was noted, however, as with many other programs, that there is a shortage of skilled human resources, especially for the management of programs in the less developed islands. Additional hiring would be required to carry out such a project.

#### CMI

The Caribbean Meteorological Institute, based in Barbados, serves fourteen countries in the region in meteorological data collection, research and training. The Institute has nineteen professionals and has used a good deal of its resources in training operational personnel. CMI processes meteorological data from eighty collection centers around the region. Since their training program is well established, the Institute is planning to emphasize research activities such as solar energy data acquisition, solar radiation effects on housing, passive design concepts, agricultural water requirements of various crops and global monitoring for atmospheric pollution. Solar and wind data acquisition would be the primary areas of interest in the AID program.

Presently, it is almost impossible to accurately determine possible levels of alternative energy contribution to energy supply in many islands because solar radiation, wind and hours of sunshine data are simply not available in detail. With sufficient funding, CMI could purchase the additional equipment necessary to monitor and measure wind profiles and insulation levels, train personnel in these skills and provide the AID Coordinating Agency's information center and the member countries with detailed regional data.

#### University of the West Indies

The University of the West Indies has three campuses which are located in Jamaica, Barbados and Trinidad. These are named the Mona, Cave Hill and St. Augustine campuses, respectively. Also, there are extra rural campuses throughout the region. Each of the three major campuses offers general studies curricula, but also specializes in certain disciplines. Mona in Jamaica has the faculties of arts, general studies, natural sciences, medicine, social sciences, and the School of Education. In Barbados, the faculties are general studies, natural sciences, and law. In Trinidad and Tobago, the faculties are natural sciences, social sciences, school of education, agriculture, engineering, arts and general studies. In general, Jamaica is seen as the specialist in medicine, Barbados in law, and Trinidad in technological fields. Solar energy research and development has in the past occurred mainly in Trinidad. Dr. Oliver Headly of the chemistry department has worked with students on design, construction and installation of crop dryers and solar stills. The solar stills project is also incorporated into a number of high school science classes. Dr. Satkumanathan and students in the engineering department have been working on flat plate collector designs for solar water heaters and have experimented with designs for solar cooling systems, including an ammonia absorption system.

The university is the home for a major portion of the Caribbean Scientific community. While the campuses are indeed fragmented at the personal, institutional level, independently each represents a

substantial communications, training and information center. Through standard university communications mechanisms such as faculty meetings, student organizations, newsletters, bulletins and seminars, information on alternative energy developments and projects can be disseminated.

In addition the university could serve as a unique communications and training link with the Center for Energy and Environment Research (CEER) in Puerto Rico and perhaps the University of Florida in Gainesville. A visiting students and/or faculty program would be instrumental in the transfer of information and skills.

#### CADEC

Christian Action for Development of the Eastern Caribbean (CADEC) is an organization that works with community self-help groups in addressing the needs of the rural poor. Their base is in Barbados and regional offices and programs are located throughout the Caribbean. The Barbados office operates an Appropriate Technology Resource Center. Presently they are making arrangements with CDB to make use of the Bank's Technology Information Unit and possibly to collaborate on an Appropriate Technology newsletter. The AID program can supply both the resource center and the proposed newsletter with information on alternative energy developments. In addition, CADEC's tremendous outreach capabilities can assist in 1) identifying needs of the rural poor. 2) dissemination of information at the community level, and 3) operating training programs at the local level.

#### BIMAP

Barbados Institute of Management and Productivity (BIMAP) is a private nonprofit organization that serves business, industry and government by providing management consulting and training programs, and small business assistance, research and information. BIMAP has sixteen professional staff members and plans to line four production engineers. Their training facilities accommodate over five hundred students annually and offer a variety of courses in business management, financing and human resources. BIMAP conducts seminars, workshops and symposia in special interest topics such as marketing and quality control. They also have done work on research projects and data collection. Examples of these include company and industry surveys, manpower surveys, management information, market research and business indicators and conditions.

The BIMAP Director, Mr. Rudy Gibbons, expressed serious interest in the AID program. He felt his organization could effectively contribute in a training capacity, in development of marketing and feasibility studies and in the front end work of bringing an innovation to the commercialization stage.

#### Peace Corps and Private Voluntary Organizations

A large number of private, voluntary organizations (PVO's) and peace corps volunteers are working in the Caribbean. Due to time constraints, it was only possible to meet with a few representatives of these groups. It was learned that over two hundred and fifty PVO's are currently operating in Haiti alone. A majority of these groups are affiliated with church organizations and do most of their work in rural communities. Two groups in particular, the Haitian American Community Help Organization (HACHO) and the Catholic Relief Services are working on reforestation projects.

HACHO recently acquired funds to purchase a 500 hectare lot. The group plans to establish an energy plantation using lucene and/or eucalyptus. These groups, like the Peace Corps, are active in community organizing, training and projects development at the local level. Their outreach capabilities can be extremely useful in this program to transfer technical information and skills to people in the rural areas.

TECHNICAL ANALYSIS OF NON-CONVENTIONAL SYSTEMS

Photovoltaics

Photovoltaic energy conversion probably presents the greatest possibilities for long term solar energy application, to the extent that it is now possible to foresee future development.

There are three general areas of application:

- (i) Small, on-site electricity generating systems for houses, schools, small commercial buildings, and irrigation;
- (ii) Large central station power plants producing electricity for the public grid, most probably in a peaking mode.
- (iii) Electric vehicles for private and public transportation.

All of these are long-term possibilities, and depend on the cost of photo cells being reduced to competitive levels within a reasonably short time span (7 - 20 years). They will all present formidable economic problems to the Caribbean as well as to other regions, in terms of finding the capital necessary for investment on the scale that would be required for meaningful energy substitution. But these economic constraints will arise from any feasible alternative to petroleum, and do not lessen the case for photovoltaics as a technology to be considered.

It is also plain, however, that the local advantages to be gained from photovoltaics (or from any other alternative technology) will depend on the extent to which components can be fabricated locally, thus making the greatest possible local contribution to project cost. For if all the components for a new technology have to be imported, then the net benefits of petroleum replacement, in foreign exchange terms, will be zero or even negative.

This amounts to saying that photovoltaics will only be beneficial if the capability for manufacturing photo cells is developed in the region. The level of technology required is of the same order as producing components for electronic equipment, and should be well within the technical capability of the region.

This means that the University and other teaching institutions should recognize this need at an early date, and should orient training programmes towards turning out the required skills when the time arrives.

At least one teaching institution (CAST in Jamaica) has already embarked in this direction, and others should be preparing to follow their lead.

#### Ocean Thermal

Large scale electricity generation in the Caribbean in the distant future may well involve a combination of photovoltaic plants for day time peaking, and ocean thermal plants for baseload operation.

There are several places among the islands that can provide the necessary site requirements of relatively deep water (2000 ft.) within a mile or so off shore. Given that OTEC is a technology most suitable in the tropics anyway, there is an added interest for following developments in this area of technology.

Probably it is unwise to short-circuit the official developments programmes in major countries, although at least one Caribbean territory has had an offer from a prospective manufacturer interested in producing an OTEC plant at competitive prices immediately. But the very existence of such an offer merely serves to emphasize that OTEC is a coming technology which should be carefully watched.

#### Solar Thermal

An alternative to photovoltaics for central station electricity generation is solar thermal, having the form of large fields of concentrating collectors either by tracking plane mirrors reflecting sunlight to a central tower, or by one of the many variations on the general principle of a parabolic focussing reflector. Such devices can also be used to drive mechanical refrigeration machinery to provide cooling for foodstuffs or drugs.

This form of solar application appears less versatile than photovoltaics, in that there are smaller possibilities for local, on-site generation, and also because the problems of energy storage may be greater. There is also the additional problem (arising with photovoltaics as well) of the availability of flat land to the extent of a few square miles, in the largest scale systems which is not useful for

any other purpose; though in some cases, such as Jamaica, potential sites have already been identified.

It is also questionable whether solar thermal application will achieve the same level of cost reductions which photovoltaics are expected to attain, but in spite of these caveats, solar thermal is a developing technology whose potential should be followed and evaluated.

### Solar Cooling

One specific application of solar thermal energy of great interest in the Caribbean is the use of solar energy for space cooling, airconditioning and refrigeration, through the use of the absorption cooling cycle. The Barbados Government has already initiated some projects in this area, and others are being considered in Jamaica. The U.S. Government has carried out one project in the Virgin Islands, and others are being considered in Puerto Rico.

In spite of the great interest and of the obvious need in the region for air conditioning and refrigeration for food preservation, solar thermal cooling is a technology that should be regarded with caution, despite the fact that its technical feasibility is well established and that it is immediately available.

This arises from the inherent limitations of the absorption refrigeration cycle, which is basically rather inefficient and it is doubtful whether it can be improved much further.

The low efficiency of absorption cooling implies relatively large solar collector areas, with correspondingly long pay back times, which, at present costs, work out to about 25 - 30 years.

Paradoxically, solar cooling may be economically more attractive in temperate climates than in the tropics. This is because, in a region which may require heating for 60% of the year and cooling for only 20%, a solar system will be sized mainly towards the heating application, which is more efficient than the cooling, and the whole system will show a better economic return than if it operated for cooling alone.

In addition, absorption cooling systems could only be installed in new buildings, as it would not be economically feasible to discard air conditioning equipment in existing buildings for replacement with absorption systems. Therefore the rate at which solar cooling would make an impact on the

total energy demand situation would be extremely slow. The costs of absorption cooling may decrease, but hardly to an extent to make up for this disadvantage.

For all these reasons it will be worthwhile to wait a few more years till photovoltaic systems become available for local on-site generation operating conventional equipment rather than pursuing solar thermal projects which can be implemented immediately, but whose eventual potential may be less.

### Ocean Farming

This is the area for long term application which is probably the least known and where basic studies have to be made, to determine the type of species to be grown, their characteristic conditions, and potential impacts. But given the limited land area likely to be available on island territories for energy farming, it may well be necessary to take to the oceans for energy recovery, and it is surely worthwhile to study, say, the growing of kelp in suitable areas, and the most appropriate means for converting it to energy use.

### Photochemical

With appropriate substrates, solar energy can be directly converted to hydrogen or methane. These gases can then be used in fuel cells or heat engines to provide mechanical and electrical power. This technology has not progressed beyond the laboratory stage, however, and it is not clear that it will become economical soon. It does represent a potentially useful conversion system, and progress in this field should be monitored.

### Technology Area Descriptions

#### Wind Power

Wind energy powered the sailing ships and cane grinding machinery prevalent in the Caribbean region in the 1700s and 1800s.

Wind power technology has undergone significant improvement since those times, and is currently the subject of millions of dollars of research and development funds in such countries as Canada, U.S. and Denmark. Caribbean nations could benefit from these developments by adapting available

technologies and applying new research principles to Caribbean needs. Although the power available from the wind is subject to variability on an hourly, daily or seasonal basis, there are instances where it can be successfully exploited at reasonable cost when compared to electricity generated from oil, especially where the demand for power or mechanical work is interruptible.

The wind energy resource is recognized to be quite large throughout much of the Caribbean. The Caribbean Meteorological Institute, with support from the Commonwealth Science Council, is currently implementing a program to improve the data and assessment of wind power potential. This is a necessary step in encouraging wind power technology commercialization and may be supported under the Resource Assessment Budget. There are a number of technology development needs which will have to be addressed in the Analytic Support and Applied R & D areas before wind power technology can be expected to regain its importance as a power source in this region. These include:

- End-Use Applications Analysis, which would survey a range of potential wind-power application with respect to wind power density and duration, machine and driveline efficiencies, task requirements, and a range of estimated installed system costs. Such applications could include water-pumping, electricity generation for grid-connected or battery system application, refrigeration and air-conditioning, mechanical energy storage via compressed air or thermal energy production. A demonstration project applying available technologies to these tasks will be funded as appropriate.

- Corrosion Protection Design Study, which would assess the costs and benefits of using a variety of materials for windmill components in Caribbean environments.

- System Maintenance Study, designed to assess the need for maintenance of a variety of wind technology applications and to identify construction methods and machine designs which would simplify and reduce the cost of maintenance procedures. A discussion of the skills required for various chores would be described, and a training program would be designed to address these needs. The field test project would follow on this work by applying the knowledge in actual demonstrations.

### Biomass Utilization

Human societies had always, before petroleum, relied on renewable energy resources such as firewood, charcoal, animal power or wind to drive their machinery, cook their food or light their dwellings. Because of the requirements for land or containment of animals, biomass resources may not be generally applicable in some Caribbean territories.

However, because it produces fuels which are in familiar, useful forms (charcoal, methane, liquid fuels), the potential of biomass resources is quite large and should be developed to a considerable extent, determining the ultimate potential for biomass resources to supply energy in useful forms.

There are several biomass technologies which are currently in commercial use which could benefit from technology improvements. These include charcoal production and utilization and bagasse burning. Large scale biogas production to generate grid-fed electricity is also feasible, assuming that a large, concentrated feedback can be utilized.

Other biomass technologies such as medium or small-scale biogas facilities or alcohol fuel production will require analytic and research work before demonstrations will be attempted. Thus, a balanced program approach for biomass will include resource assessments, analytic and research support and selected field test projects.

### Hydropower Program

Hydro power facilities currently supply significant amounts of electrical energy in Jamaica, Haiti, the Dominican Republic, Dominica and St. Vincent. All but St. Vincent appear to have remaining potential, and Belize and Guyana have significant unexploited hydropower resources. (Guyana has a truly enormous resource, but has no capital funds to develop it, or a means of utilizing its power if it were developed).

Much of these unexploited resources are in the form of small flow, low head streams which heretofore have not been deemed useful. Hydrological surveys should be performed to identify the best available sites, and field testing carried out to demonstrate civil works techniques, to develop local skills, and to assess the feasibility and desirability of further development of the resource. The hydropower program will involve four components:

- o Renewable Energy Resource Assessment + to determine the extent and location of primary sites.
- o Analytic Support - to assess the technical and economic feasibility of proposed field tests and to identify topics for applied R & D in this field.
- o Applied R & D - designed to address significant problems arising from Caribbean applications of this technology.
- o Field tests ; will be performed to demonstrate the feasibility of the technology and to provide performance data for later applications.

A typical micro-hydro facility would require a water containment and/or collection structure; an equipment pad and shed housing the turbine, generator and control system; and an outfall structure. The scale contemplated under this program is between 5 and 50 KWe.

#### Direct Solar Utilization

Direct solar energy utilization with hot water heaters, crop dryers and water distillation units has been successful in the commercial sector for up to three decades in some parts of the world such as Australia or Israel. This program intends to extend the usefulness of these technologies through demonstration and through analytic and an applied research support.

Other direct uses of solar energy also have potential in this region, including driving heat engines for mechanical or electrical energy (refrigeration) or through photovoltaic cells. Direct photochemical energy conversion (producing hydrogen or methane gas) is also under investigation in some countries. However, economical applications of these technologies may not occur until the end of the Alternative Energy Systems Project and will only be supported through the analytic component of this program.

Solar resource assessments will be necessary for most of the countries included in the project.

Analytic studies will determine applications and ultimate market sizes and will investigate the use of various direct solar advanced systems. In the Applied R & D area, studies are planned which will address corrosion and maintenance problems encountered in Caribbean applications of these technologies.

The field test program for direct solar utilization has been designed to produce the broadest possible exposure by funding educational institutions, (solar stills), public facilities (hot water) and a broad range of farm and domestic applications (e.g. crop dryers).

### Geothermal Energy

Geothermal energy has been utilized on a large scale around the world for a hundred years or more. The heat or steam obtained from productive geothermal resources can be used to drive generators or heat homes and is economically utilized in about eight countries around the world today.

Yet geothermal resources are typically tapped in large scale projects; many of the resources in the islands are smaller than would be necessary for economic feasibility. In addition, each developed site will be very costly; this AID program could not fund a single installation from the field test budget without severely affecting the program funds for other areas. Although renewable in some locations, geothermal energy is not really an "alternative" source of energy. This project considers it to be a conventional technology with severe site selection requirements, worthy of analytic support.

Because of its limited applicability and expensive development costs, geothermal energy will receive only analytic support funding from the discretionary fund, if appropriate.

For fuller treatment and analysis of the technical program, see Section III, B. Technical Analysis.

Selection Criteria for Executing Agencies

I. GENERAL CRITERIA

- A. Credibility of organization; reputation in development activities.
- B. Major goals and areas of operation of organization and its development role in the Caribbean.
- C. Past experience in outreach programs.
- D. Demonstrated understanding of regional political and socio-economic constraints.
- E. Experience with a combined energy and development focus.
- F. Ability of local infra-structure to support the institutes' activities.
- G. Degree of coverage of participating countries; accessibility of institution to participants.

I. ANALYSIS OF ORGANIZATION

A. Administrative And Managerial

- 1. Overall organizational structure; experience with management systems.
- 2. Competence and efficiency of administrative procedures.
- 3. Demonstration of competency in financial management.
- 4. Demonstrated program planning (manpower, budgeting etc.)
- 5. Overall Project Evaluation experience and capability.
- 6. Track Record in managing projects.
- 7. Ability to attract and keep qualified professionals.
- 8. Growth requirements of organization to develop region-wide capability.

B. Policy Development Capabilities

- 1. Experience in policy development studies.
- 2. Degree of coverage of region.
- 3. Ability to reach the appropriate government levels with policy suggestions.
- 4. Capability to facilitate country energy assessment.

C. Technical Capability

1. Major technical work and experience areas.
2. Past involvement in joint-effort technical assistance projects.
3. Past experience with energy-related technical assistance.
4. Technical capability of existing staff.
5. Technical project evaluation capability.
6. Technical training capability.
7. Ability to effectively disseminate technical information and organize information transfer mechanisms.

D. Communications and Information Transfer

1. Existing technical information resources.
2. Extent of communication and information sharing networks in the region.
3. Links with information sources outside the region.
4. Ability to establish and sustain targeted communications/Information dissemination mechanisms.

E. Training and Educational

1. Direct training experience.
2. Experience in organizing and administering training programs.
3. Experience in training out-reach programs.
4. Established relations with other educational training institutions.

F. Economic Capabilities

1. Ability to assess economic feasibility of projects.
2. Soundness and adaptability of economic evaluation criteria.
3. Demonstrated expertise in cost analysis.
4. Demonstrated capability in planning methods.

G. Background In Energy

1. Breadth of involvement in energy matters.
2. Solar and renewable energy resource experience.
3. Continuing energy-related activities in absence of program.

CARICOM AND CDB ENERGY GROUP STAFFING  
RESPONSIBILITIES AND QUALIFICATIONS

1. Section Chief/Director Responsibilities (CARICOM & CDB)

Responsibilities include:

- 1) Overall coordination and management of AID-financed energy project;
- 2) Encouragement of country participation and contribution to the program;
- 3) Responsibility for reporting to and coordinating with Advisory Committee on overall program strategies and guidelines;
- 4) Coordination of the four program areas to ensure optimum use of resources and achievement of project objectives.

Qualifications - Technical background or related experience in program and project management. Person should be experienced in project evaluation and implementation. Must be able to coordinate programs having different areas of emphasis. Strong institutional background and personnel management capability is necessary.

2. Communications Officer Responsibilities (CDB)

Responsibilities include:

- 1) Implementation of region-wide information dissemination and collection system;
- 2) Organization of seminar and workshops for educational and information transfer purposes.

Qualifications - A broad background in design and implementation of communication and information transfer networks. Knowledge of Eastern Caribbean information networks. Experience in identifying information sources and needs and the delivery of appropriate information. Organizational and promotional capabilities will be helpful in making the region aware that the communications program exists.

### 3. Training Officer Responsibilities (CARICOM)

Responsibilities include:

- 1) Coordination and administration of all facets of training program;
- 2) Organization and design of effective technical training programs;
- 3) Coordination of training program with other AID-funded training projects managed by CARICOM.

Qualifications - Training Officer should have a broad background in design, organization and implementation of technical training programs. Should be experienced in curricula development, institutional program organization and management, and have familiarity with Caribbean training organizations.

### 4. Policy Officers Responsibilities (CARICOM)

Responsibilities include:

- 1) Developing energy policy studies relevant to needs of region;
- 2) Evaluating and managing policy research contracts;
- 3) Ensuring that policy study results are made available to participating countries;
- 4) Integration of policy research and results with other programs within Caribbean Alternative Energy Project:

Qualifications - Policy officers should have a broad background in policy studies and energy policy development. Proposal evaluation and contract management with institutional background will be important.

### 5. Economist/Financial Analyst Responsibilities (CDB)

Responsibilities include:

- 1) Assisting other program officers in development of economically feasible programs.
- 2) Analysis of programs and projects for potential commercial viability.

Qualifications - Economist/Financial Analyst should have a background in applied economics and commercialization. Broad experience in financial and market analysis, economic development, and evaluation of programs for their economic relevancy is required. Must be able to assist other program officers in program development within an institutional framework.

6. Technical Officer Responsibilities (CDB)

- 1) Provide technical inputs into Energy Group guideline and project criteria formulation;
- 2) Act as reference for communications, training and policy officers;
- 3) Review and evaluate technical aspects of project proposals for funding;
- 4) Monitor project contracts for progress towards objectives;
- 5) Provide overall technical program management and evaluation, including environmental analysis and review.

Qualifications - 1) Extensive technical background in mechanics, physics, electrical systems, environmental analysis, or engineering. 2) Working experience with quantitative analysis techniques. 3) Working experience with energy systems studies. 4) Desire contract and program management experience.

## Economic Feasibility Comparisons

### a) Wind Electric vs. Diesel Electric

#### Summary

A comparison of the economics of wind electric generation vs. diesel electric generation shows wind systems to be economically competitive in favorable wind regimes. Results of the benefit/cost analysis show a benefit/cost ratio of greater than 1.0 for wind electric generation assuming a real cost increase in diesel fuel of 3%/year. Used in conjunction with the existing electrical generation systems, wind electrical systems could supply a portion of the electricity requirements of many Caribbean countries.

Today's wind electric systems are capable of interconnecting for parallel generation with a diesel engine-generator, rather than simply charging storage batteries as in the past. In this parallel generation configuration, when wind energy is available, the diesel engine-generator operates at a correspondingly reduced output and fuel use level. The wind electric system's output therefore translates as a fuel savings for the diesel engine.

Site-specific wind data of the nature needed for precise economic comparisons is not readily available in the region. For the purposes of this study a hypothetical wind speed regime will be used based upon preliminary data for some regions.

#### Analysis

Instrumentation for measuring and recording wind energy data for electric power generation will be provided under the proposed project. The resulting information would allow a detailed evaluation of a country's or the region's wind energy potential.

Following is an analysis of a grid-connected wind-electric system, a type of system which the project consultants (DH&R) believe to be one of the least economically feasible of the proposed renewable resource energy technologies. Economic feasibility of this technology is hampered by the high cost of connection and integration to the utility grid, the requirement for and high cost of machines with high availability and performance factors; the requirement for and resulting sophistication of systems that produce power compatible to the utility grid and the non-intermittent nature of electricity demand versus the intermittent nature of wind electricity supply. Thus, an acceptable economic return for this relatively high-priced system would suggest a more positive outcome for many other renewable resource based technologies.

The following assumptions are used in comparing the economic feasibility of a wind energy conversion system (WECS) with a diesel system of comparable output.

Assumptions and Parameters

Application	10 Kwe grid connected WECS and synchronous inverter with no storage and annual output of 30,660 Kwh (based on fractional load factor of 0.35).
Benefits	Consumers would be willing to pay (at least) the real cost of diesel-generated electricity. Benefits can thus be assumed to be equal (at least) to the cost of such energy.
Wind Regime	12 - 14 m.p.h. average wind speed.
Capital Costs of WECS	\$20,000 - This represents the median value of the cost range (\$12,750 to \$19,750 or \$16,250) for currently available wind machines for this type of application, plus \$3,500 for spares, tower, and installation and \$3,750 for site preparation and start up. All capital costs are incurred in the first year.
Capital Cost of diesel System	Approximately \$300/Kwe. Assuming a load factor of 0.5, an 8 Kwe unit costing \$2,400 would be required.
Operating Costs of WECS	Taxes, insurance, operation and maintenance: 4% of total cost/year.
Discount Rate	10% and 12%
Conventional energy Prices	Diesel fuel for utility U.S.\$1.00/gallon (Montserrat local price).
Fossil Fuel Costs	As indicated below.
Operating Cost of Diesel System	Diesel consumption is approximately 0.08 gallons/Kwhe. Assuming 30% diesel efficiency at current diesel prices each Kwhe generated costs approximately \$0.08.

These assumptions lead to following cost and benefit estimates.

	<u>Year 1</u>	<u>Years 2-20</u>	
Cost of WECS System Capital Costs	20,000	-	
Operating Costs	<u>800</u>	<u>800</u>	
	<u>Year 1</u>	<u>Year 16</u>	<u>All Other Years</u>
Benefits of WECS System (or Cost of Alternative 8K Diesel System)			
Capital Costs*	2,400	17,315(10%)	-
Operating Costs (assuming no real increase in fossil fuel prices)	2,543	17,375(12%) 2,543	2,543

\*Life of diesel generator is 15 years. Salvage value in year 20 is two-thirds of the total capital cost discounted at 10% and 12%, equalling 238 and 166 respectively.

$$\frac{\text{Present Value of Benefits}}{\text{Present Value of Costs}} = \frac{\$16,322}{\$17,315} = .94^{**}$$

Given World market conditions for fossil fuels, the assumption of no real increase in the price of diesel oil is not realistic. Further calculations show a 3% annual real increase in diesel prices would generate a B/C ratio of about 1.26 discounting at 10% and 1.10 discounting at 12%.

It should be noted, however, that wind-powered additions to a system may require in varying amounts a diesel back-up system to ensure adequate power at all times. This analysis assumes that no back-up is necessary since sufficient total supply is present in the system. The extent to which this factor would affect the economic viability of the wind-driven system would increase as the need to provide a back-up system increases. If a back-up system is needed and the more it is used, the less desirable is the wind-generated system. This preliminary analysis suggests that, given present technology, the economic viability of wind driven systems may still be marginal and will depend on the characteristics of the demand and the site and other aspects of the situation into which systems would be placed.

\*\*Discounting at 10%

b) Cost of Biogas-fired Diesel ElectricitySummary

The largest percentage of generating capacity in the Caribbean region is currently distillate oil fired diesel generator sets. The high cost of this fuel has initiated interest in finding substitute fuel sources that can efficiently drive diesel generator sets.

Alternative fuel sources for diesel sets can include residual oil, ethanol, methanol, methane, butane or ethane gas. Diesel engine generator sets may operate efficiently on any fuel source that is of sufficient energy content and quality. There has been world-wide experience with alternate fueled diesel systems, however, no Caribbean projects are known to have existed. Most of the experience consists of diesel sets fired by gas from wood-gasification projects or biogas produced from anaerobic digestors. Substitution of biomass derived fuel for distillate oil would represent a major alternative to the current Caribbean energy situation.

The following cost analysis briefly compares biomass derived fuel versus that of distillate oil for operation of diesel generator sets. The analysis utilizes cost data developed in Jamaica for a biogas project under development. The Jamaican project utilizes an existing dairy farm as the source of the biomass for anaerobic fermentation to methane gas. Although the dairy farm example may have limited applicability in the region, it provided more accurate data for this analysis than would a hypothetical situation. The potential in the region for using sugar-cane, casava, and a wide range of biomass materials for the production of both liquid and gaseous fuels is considerable. Thus, the positive results of this analysis based on a dairy herd example are indicative of the potential for other biomass conversion technologies.

Analysis

This analysis compares the cost of distillate fuel versus the cost of producing biogas fuel, the cost of electricity produced from these two fuel sources, and the total cost of electricity produced from these two fuel sources over the lifetime of the diesel generator system. This analysis assumes that the diesel generator and digester both have a 15 year life. The life of the generator is determined by the level of maintenance of the system over time. Major replacement of parts every 8-10 years costing approximately one-half of the total capital costs supplants replacement of the entire generator. Building this factor into the analysis further increases the benefit-cost ratio. The first series of calculations determines the total gas output from a plug-flow digester fed by 210 dairy cows. The cost of the digester system is then described. Finally, the calculation of the cost of biogas fired electricity versus diesel generated electricity is determined.

Biogas Production: Assumptions and Calculations

1) 210 head dairy herd producing 80 lbs. waste/head/day with 15% total solids, and 80% of the total solids (TS) are volatile solids (VS).

$$210 \times 80 \text{ lbs./head/day} \times 0/15 \text{ TS} \times 0/80 \text{ VS} = 2016 \text{ lbs. VS/day.}$$

- 2) 2016 lbs. of volatile solids/day is equal to  $16,128 \text{ ft}^3$  gas produced/day.  
( $2016 \text{ lbs. VS/day} \times 8 \text{ ft}^3/\text{lb. VS/day} = 16,128 \text{ ft}^3/\text{day}$  of gas.)
- 3) Gas is assumed to have a Btu value of  $660 \text{ Btu}/\text{ft}^3$ .  
( $660 \text{ Btu}/\text{ft}^3 \times 16,128 \text{ ft}^3/\text{day} = 10.65 \times 10^6 \text{ Btu day}$ ). Thus,  $10.6 \times 10^6 \text{ Btu/day}$  are available from a 210 head dairy herd for electricity production.
- 4) Assumes 90% animal waste recovery and that the cost of collection and handling is offset by the value of nitrogen rich fertilizer remaining after digestion.
- 5) Cost of the digester system is as follows:

*Digester with gas storage	\$50,000
Gas cleaning	2,000
Total	<u>\$52,000</u>
Yearly digester O & M costs (5% of total cost)	\$ 2,600/yr
Automatic electric control equipment	\$ 3,000
Diesel modification for biogas firing	\$ 50/Kwe

\*Plug flow anaerobic digester, cost based on work performed at Agricultural Teaching and Research Center, Cornell University for a 70 head dairy herd.

6) Digester System costs

- a) First year system costs  
 $\$52,000 + \$2,600 = \$54,600$
- b) Annual system cost  
 $\$2,600/\text{yr}$  for operational costs (incl. maintenance)
- c) Present value of cumulative future costs  
(a 10% discount rate is used)\*\*  
 $\$54,600 + \$21,752 = \$76,352$

PV of future costs is determined by adding first year costs to PV of annual costs in the year they occur.

- 7) Lifetime average fuel cost of biogas
  - a) life-time fuel production  
 $10.65 \times 10^6 \text{ Btu/day} \times 15 \text{ yrs} \times 365 \text{ day/yr} = 58.3 \times 10^9 \text{ Btu}$
  - b) Average fuel cost  
 $\frac{\$76,352}{58.3 \times 10^9} = \$1.31/10^6 \text{ Btu}$

Average fuel cost is determined by dividing the PV of the total cost of the digester system by the total amount of gas produced over the system's lifetime.

8) Cost of biogas fired electricity

The cost of the diesel generator (\$300/Kwe) is assumed to be the same for both the biogas and distillate oil example. Additionally, in the case of the biogas-fueled diesel set modifying the diesel to burn the biogas (\$50/Kwe), and a derating of the diesel to 70% of its rated capacity due to the lower fuel value of the biogas will be

\*\*Assuming a 12% discount rate does not change the final cost of biogas fuel/Kwe in the subsequent calculations.

calculated into the cost of electricity. It is assumed for the purposes of this analysis that a 30 Kwe generator will run 24 hours/day for 15 yrs. The diesel oil fired engine has a heat rate of 10,000 Btu/Kwhe.

9) Total electricity Production

- a) 24 hrs/day x 15 yrs. x 365 days/yr x 30 Kwe =  $3.95 \times 10^6$  Kwhe  
The above equation calculates total number of Kwhe produced by the diesel generator over the life of the equipment.
- b)  $0.7 \times 3.95 \times 10^6$  Kwhe =  $2.77 \times 10^6$  Kwhe

Due to the derating of the diesel generator set operating on biogas fuel the total lifetime Kwhe production must be multiplied by a derating factor of 0.7. This increases the fuel consumption of the biogas fired diesel generator from 10,000 Btu/Kwhe to 13,000 Btu/Kwhe.

- c) Cost of diesel modification

$$\frac{(30 \text{ Kwe} \times \$50) + \$3,000}{2.77 \times 10^6 \text{ Kwhe}} = 0.16 \text{¢/Kwhe}$$

To determine the Kwhe charge for electricity generated from biogas, the costs of modifying the diesel to run on biogas and the automatic control equipment must be determined. By dividing these costs by the total number of Kwhe that will be generated, the cost attributable to these modifications of a standard diesel generator set may be obtained on a ¢/Kwhe basis.

- d) Cost of biogas fuel/Kwhe
  - i) The cost of producing biogas fuel over the life of the project is equal to the PV of the acquisition and maintenance costs of biogas digester.

$$\frac{\$76,352}{2.77 \times 10^6 \text{ Kwhe}} = 3 \text{¢/Kwhe}$$

Dividing lifetime fuel cost by total number of Kwhe produced will give a fuel cost/Kwhe of biogas produced electricity.

- ii) Capital cost/Kwhe of the diesel generator.

The capital and operational costs of the diesel generator set are approximately 3¢/Kwhe. Operational costs are traditionally higher for biogas fired systems. Total biogas electricity cost is:

$$3 \text{¢/Kwhe} + 0.16 \text{¢/Kwhe} + 3 \text{¢/Kwhe} = 6.16 \text{¢/Kwhe}$$

fuel +	modification,	diesel	=	total cost
cost	capital	capital		
	cost	cost		

10) Cost of diesel electricity vs. biogas electricity

¢/Kwhe	<u>Diesel</u>	<u>Biogas</u>
	8.0*	6.2

\*average Caribbean residential electricity rate.

11) These calculations lead to the following cost and benefit estimates.

	<u>Year 1</u>	<u>Years 2 - 15</u>
<u>Cost of Biogas Electricity</u>		
Capital Costs	65,500	-
Operating Costs	7,884	7,884
<u>Cost of Diesel Electricity</u>		
Capital Costs	9,000	-
Operating Costs	13,140	13,140

Assuming 3% annual real increase in fossil fuel prices:

- a) Discounting at 10%,  $\frac{\text{Present Value of Benefits}}{\text{Present Value of Costs}} = \frac{\$67,553}{\$56,500} = \underline{1.2}$
- b) Discounting at 12%,  $\frac{\text{Present Value of Benefits}}{\text{Present Value of Costs}} = \frac{\$52,724}{\$56,500} = \underline{.93}$

c. Solar Heating of Water

The following analysis compares the cost of heating water for a hotel's use by three different methods: solar, electricity, and propane. The amount of hot water required is assumed to be 300 gallons/day, or 108,000 gallons/year, and the water temperatures must be raised from 70° F to 140° F. The energy required for this task is  $62.4 \times 10^6$  Btu/year. Given typical weather conditions in the Caribbean, the solar system would require 180 square feet of solar collectors. The cost of the collectors, a three-day storage capacity, installation and back-ups is estimated to be \$5,400. Since there is no fuel cost, operating costs are limited to an estimated 2% (or \$108) annually for maintenance.

The capital cost of heating water by electricity is estimated at \$800, or \$8/gallon for a 100 gallon water heater. Electricity costs are estimated at \$0.08/Kwhe. Assuming the system has 80% efficiency, the fuel cost is estimated at \$1,829.<sup>1/</sup>

An equivalent propane system would require a 100 gallon heater estimated to cost \$1,000 which is assumed to have an 80% efficiency. About 7,800 lbs of propane fuel costing about \$40 per 100 lbs would be required annually. The annual fuel cost is thus estimated at \$3,120.<sup>2/</sup>

Based on previous analyses of similar projects the life of a solar generated system is more than 10 years and the life of a propane generated system is less than 10. Adjusting for one or both of these factors further enhances the cost-effectiveness of the alternative energy source over the conventional systems.

These cost estimates are summarized in the following table:

1/ The yearly fuel cost is obtained by multiplying the annual energy requirement ( $62.4 \times 10^6$  Btu) by the inverse of the energy efficiency rating (1.25), converting Btu's into Kwh's (1Kwh/3412 Btu) and multiplying by the electricity cost (\$0.08/Kwh).

2/ -  $62.4 \times 10^6$  Btu/year  $\times$  1.25  $\times$  \$40/10<sup>6</sup> Btu = \$3,120.

	<u>Year 1</u>	<u>Years 2-10</u>
<b>Solar Heating</b>		
Capital Costs	\$5,400	-
Recurrent Costs	108	108
<b>Electrical Heating</b>		
Capital Costs	\$ 800	-
Recurrent Costs	1,829	1,829
<b>Propane Heating</b>		
Capital Costs	1,000	-
Recurrent Costs	3,120	3,120

Utilizing a 10% and 12% discount rate and assuming a 3% annual increase in fuel costs, the benefit/cost ratio of solar versus electrical heating is 2.85 and 2.66, respectively. Given higher estimated capital and operating costs for propane versus electrical heating, the benefit/cost ratios of solar versus propane are greater than those calculated for solar versus electrical. In each case, the solar system compares extremely favorably with the fossil fuel system.

Implementation Schedule

<u>Event No.</u>	<u>Item</u>	<u>Date</u>
1	Grant Authorizations	July 31, 1979
2.	Grant Agreements signed	August 26, 1979
3.	Initiate Staff Procurement Actions, CDB/CARICOM	September 15, 1979
4	Conditions Precedent for disbursement met	October 31, 1979
5.	Operable Staff Conditions Achieved	October 31, 1979
6.	Notice for Expressions of Interest 1) Equipment, Procurement, Contracts; 2) Management Consultants	November 3, 1979
7.	Notice for Candidates; Long- Term Training	November 30, 1979
8.	Hire Consultants to Assist in Program	November 30, 1979
9.	Select Equipment Procurement Contractor	November 30, 1979
10.	First Advisory Committee Meeting	December 1, 1979
11.	Issue Requests for Phase I Field Test Proposals	January 1, 1980
12.	Country Energy Assessments Initiated	January 1, 1980
13.	Planning and Policy Program Initiated	January 1, 1980
14.	Renewable Energy Assessment Initiated	January 1, 1980
15.	Selection of Long-Term Training Candidates	January 1, 1980
16.	Initiate First Year Field Test Contract Awards (Short-Term Procurement 2 months; Long-Term Procurement 6 months)	February 1, 1980

<u>Event No.</u>	<u>Item</u>	<u>Date</u>
17.	Implement Full Communications Program (Newsletter, Plan First Conferences, Plan First Speaker)	June 30, 1980
18.	Implement Full Training Program (Short-Term Training, Professional Training)	June 30, 1980
19.	Semi-Annual Progress Reports Completed	February 28, 1980
20.	Second Advisory Committee Meeting	June 15, 1979
21.	First Year Field Test Contract Awards Completed	June 30, 1980
22.	Initiate Unsolicited Proposal System	July 30, 1980
23.	Semi-Annual Progress Report Completed	August 30, 1980
24.	Initiate Unsolicited Proposal Awards (Phase II Field Tests)	September 1, 1980
25.	Initiate Second Year Field Test Contract Awards	September 30, 1980
26.	Technical Conference and Program Review Meeting	November 1, 1980
27.	Advisory Committee Meeting	November 15, 1980
28.	Second year Contract Awards Completed	February 28, 1981
29.	Semi-Annual Progress Report Completed	February 28, 1981
30.	Advisory Committee Meeting	April 15, 1981
31.	Semi-Annual Progress Report Completed	August 30, 1981
32.	Initiate Third Year Field Test Contract Awards	September 30, 1981
33.	Technical Conference and Program Review Meeting	November 1, 1981
34.	Advisory Committee Meeting	November 15, 1981
35.	Third Year Field Test Contract Awards Completed	February 28, 1982
36.	Semi-Annual Progress Report	February 28, 1982

<u>Event No.</u>	<u>Item</u>	<u>Date</u>
37.	Semi-Annual Progress Report/ Interim Grant Review	August 30, 1982
38.	Phase I Field Test Project Evaluation Report	September 30, 1982
39.	Technical Conference and Program Review Meeting	November 1, 1982
40.	Advisory Committee Meeting	November 15, 1982
41.	Semi-Annual Progress Report	February 28, 1983
42.	Semi-Annual Progress Report	August 30, 1983
43.	Technical Conference and Program Review Meeting	November 1, 1983
	(Note: Communications, Training and Policy Program Activities occur throughout the period and are not given detailed time line treatment.)	
44.	Advisory Committee Meeting	November 15, 1983
45.	Semi-Annual Progress Report	February 28, 1984
46.	Final Field Test Disbursements	June 30, 1984
47.	Project Terminates	August 30, 1984
48.	Final Report and Project Evaluation	September 30, 1984

538-0032

JUN 12 1980

ACTION MEMORANDUM FOR THE ACTING ASSISTANT ADMINISTRATOR (LAC)

FROM : LAC/DR, Marshall D. Brown

SUBJECT: PAF Amendment for the Caribbean Regional Alternative Energy Systems project (538-0032)

Your approval is required to amend the Project Authorization and Request for Allotment of Funds (PAF) for the Caribbean Regional Alternative Energy Systems project to reallocate up to \$50,000 in funding from Phase II to Phase I of the Solar Bagasse Drying activity in the Dominican Republic.

Discussion: The Alternative Energy Systems project, which was authorized on August 23, 1979, is designed to institutionalize alternative energy capabilities in the Caribbean Region and to test viable alternative energy technologies. The project purpose is to assist various Caribbean institutions and governments to develop regional and national skills and technologies in energy related fields. This is to be accomplished through three related activities: 1) a \$3,247,500 grant to the Caribbean Commonwealth Secretariat (CARICOM) for energy assessment/policy formation and training activities; 2) a \$4,002,700 grant to the Caribbean Development Bank (CDB) for the establishment of an energy communication/information network and for field testing appropriate energy technologies; and 3) a \$350,000 grant to the Government of the Dominican Republic (GODR) for undertaking a Feasibility Study and possible installation of a solar bagasse drying operation. A separate grant was made to the GODR because it is not a member of the CDB and therefore, would not have been eligible to participate directly in the energy technology component of the project.

The solar bagasse drying activity in the Dominican Republic is to be carried out in two phases. Phase I is comprised of a feasibility study and preliminary design work. Initiation of Phase II, the construction and operation of a pilot plant, is contingent upon the outcome and acceptability of the feasibility study. The PAF authorized \$50,000 in FY 79 for Phase I, and the remaining \$300,000 in subsequent years, subject to the results of the feasibility study. USAID/Dominican Republic has advised the LAC Bureau that to carry out Phase I of the project successfully, more than the originally authorized \$50,000 is needed. Proposals received by the Mission for the feasibility study and preliminary design work range up to \$100,000. RDO/C has been consulted, and concurs in the use of up to a total of \$100,000 for the Phase I activities. In addition, USAID/Santo Domingo believes that should the requested reallocation result in a shortfall for Phase II, the GODR is sufficiently committed to the project to supply this additional funding.

Recommendation: That you sign the attached Amendment No. 1 to the Project Authorization and Request for Allotment of Funds, approving the reallocation of \$50,000 in support of the Phase I Feasibility Study.

UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY  
AGENCY FOR INTERNATIONAL DEVELOPMENT  
WASHINGTON, D.C. 20523

ASSISTANT  
ADMINISTRATOR

PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS  
(Amendment No. 1)

Name of Entities: Caribbean Community Secretariat  
Caribbean Development Bank  
Dominican Republic

Name of Project: Alternative Energy Systems

Project Number: 538-0032

Pursuant to Section 106 of the Foreign Assistance Act of 1961, as amended, the Caribbean Alternative Energy Systems project was authorized on August 23, 1979 (the "PAF"). The PAF is hereby amended as follows:

(i) The first paragraph of the Preamble to the PAF is hereby amended by (a) deleting the figure "\$50,000" from the ninth line thereof and substituting the figure "\$100,000" therefor and (b) deleting the figure "\$2,050,000" from the tenth line thereof and substituting the figure "\$2,100,000" therefor; and

(ii) The second paragraph of the Preamble to the PAF is hereby amended by (a) deleting the figure "\$5,550,000" from the sixth line thereof and substituting the figure "\$5,500,000" therefor and (b) deleting the figure "\$300,000" from the penultimate line thereof and substituting the figure "\$250,000" therefor.

Except as expressly amended or modified hereby, the PAF remains in full force and effect.

Edward W. Coe  
Acting Assistant Administrator  
Bureau for Latin America  
and the Caribbean

June 13, 1980  
Date

Clearances:

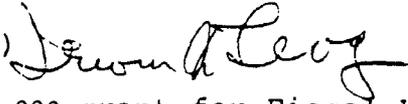
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LAC/DR:ILevy: date 6/12  
LAC/DR:MBrown: date 6/12

GC/LAC:GMWinf:ckg:6/3/80.X22182

AUG 23 1979

ACTION MEMORANDUM FOR THE ASSISTANT ADMINISTRATOR (LAC)

FROM: LAC/DR, Irwin Levy (Acting)



Problem: Authorization of a \$2,050,000 grant for Fiscal Year 1979 and approval of life of Project (LOP) grant funding of \$7.6 million to finance the Alternative Energy Systems Project (No. 538-0032).

Discussion: The Project evolved from an AID-financed survey of the energy needs of the Caribbean region carried out in 1979. As a result of this study, this Project was designed to institutionalize alternative energy capabilities in the region and to test viable alternative energy technologies. The purpose of the Project is to provide assistance to various Caribbean institutions and governments for the development of regional and national skills and technologies in energy related fields. To assist in achieving this purpose, four separate but related activities will be undertaken: (1) policy planning and energy assessments, (2) training, (3) establishment of an energy communication and information network, and (4) field testing of applied energy technologies.

The Caribbean Community Secretariat (CARICOM) and the Caribbean Development Bank (CDB) will be the executing agencies for the Project. Under the Project, a grant will be provided to CARICOM to finance the strengthening of regional and national capabilities in energy planning and policy formulation and to develop policy and energy related technical training programs. The CDB will receive a grant which will enable it to strengthen an existing network, enabling it to disseminate renewable energy information and to provide field testing of a variety of small-scale renewable energy technologies appropriate for use in the Caribbean area. Grant funds will also be made available to the Dominican Republic under this regional Project to undertake an energy assessment and to fund a solar bagasse drying pilot project.

The total Project cost is \$8.5 million over a five year period. A.I.D. will contribute \$7.6 million, of which approximately \$.9 million will be for policy planning and energy assessments, \$1.3 million for technical and analytical training, \$.6 million for communication and information dissemination, \$2.6 million for field testing of alternative energy technologies, and \$2.1 million for institution building activities. Since this is a regional program,

Section 110 (a) of the FAA does not apply, and no counter-part contribution is required. However, CARICOM and the CDB will provide \$105,000 and \$395,000 respectively, and the territories included in the Project will contribute \$376,000.

The Project was not included in the FY 79 Congressional Presentation. An Advice of Program Change was submitted to Congress on July 25, 1979, and the waiting period expired on August 8, 1979. An Initial Environmental Examination was prepared and a negative determination was made by the AA/LAC on May 18, 1979.

The LAC Bureau's Development Assistance Executive Committee reviewed the Project and recommended approval on July 17, 1979, subject to certain revisions in the Project Paper. These revisions have been incorporated into the Project Paper.

Source and origin of goods and services under the Project will be Code 000 and member countries of the CDB and CARICOM (except the U.K. and Canada). Source and origin of goods and services procured for activities carried out in the Dominican Republic and Haiti will be Code 000 and the Dominican Republic and Haiti, respectively. However, because of the nature and scope of energy technologies contemplated and the related training and information sources envisioned under the Project, a waiver is being requested to permit procurement of goods and services of up to \$500,000 from Code 899 countries. This request is the result of findings made during the course of Project development. Those findings indicate that in the area of certain solar, wind, biomass, micro-hydro and other technologies, several Code 899 countries have undertaken more extensive research and possess greater experience and capability than the U.S. For example, India has developed extensive capability in the design, construction and operation of the types of small scale, methane gas production units which would be suitable for use in the Caribbean. A British firm is presently engaged in operating small-scale prototype projects in solar-pumped irrigation in India, Mali, the Philippines and the Sudan. The CDB hopes to include this prototype within the Project, and draw upon the technical expertise already developed, as well as utilize the low cost, low maintenance design made possible through this firm's prior efforts. In addition, a small-scale, wave energy project is being executed by a Code 899 firm in Mauritius, whose adaptation to coral reef features

would be ideally suited to the eastern Caribbean region. The U.S. has no proven capability in this area of small-scale, wave energy technology. An institute affiliated with McGill University in Canada has conducted a broad range of studies and demonstration activities in Barbados on alternative energy technologies. This institute possesses data and expertise which is vital to the Project's success, and the CDB's ability to contract with this institute would considerably facilitate implementation of several phases of the Project. Other instances of probable procurement from other than the U.S. would involve micro-hydro prototypes, small boilers for agricultural waste, algae production, and small-scale charcoal furnaces. Acquisition of publications and resource information would also involve Code 899 countries to the extent that such information is uniquely available from such sources and applicable to activities under the Project.

The waiver will be accompanied by a covenant pursuant to which the CDB will carefully evaluate U.S. availability of goods and services before proceeding with procurement from Code 899 sources. Precedent for this type of arrangement can be found in Chapter 16, B.1 (c) of Supplement B to A.I.D. Handbook 1. Authority to waive the authorized geographic procurement Code for transactions up to \$500,000 has been delegated to the Assistant Administrator under A.I.D. Delegation of Authority No. 40. A.I.D. Handbook 1, Supplement B, Chapter 5B4b and 5C4a, provides that a waiver of geographic code for purchase of, respectively, commodities and services may be based upon non-availability of the required commodity or service from the authorized geographic code. SER/COM clearance on the Project Authorization signifies concurrence with the waiver.

Recommendation: That you (1) approve the Alternative Energy Systems Project and sign the attached Project Authorization and Request for Allotment of Funds, thereby authorizing a grant of \$2,050,000 for FY 1979 funding, and approve incremental funding of the Project up to \$7,600,000; and (2) approve the requested source, origin, and nationality waiver, permitting procurement of grant-financed goods and services up to a total of \$500,000 by signing below, certifying that the exclusion of procurement from Code 899 would seriously impede attainment of U.S. Foreign Policy objectives and the objectives of the Foreign Assistance Program.

Approved: Edward W. Coy

Disapproved: \_\_\_\_\_

Date : Aug 23 1979

**DEPARTMENT OF STATE**  
**AGENCY FOR INTERNATIONAL DEVELOPMENT**  
WASHINGTON, D. C. 20523

**ASSISTANT  
ADMINISTRATOR**

**PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS**

Name of Entities: Caribbean Community Secretariat  
Caribbean Development Bank  
Dominican Republic

Name of Project: Alternative Energy Systems

Project Number: 538-0032

Pursuant to Part I, Chapter 1, Section 106 of the Foreign Assistance Act of 1961, as amended, I hereby authorize a Grant to the Caribbean Community Secretariat ("CARICOM") of not to exceed One Million United States Dollars (\$1,000,000), a Grant to the Caribbean Development Bank ("CDB") of not to exceed One Million United States Dollars (\$1,000,000) and a Grant to the Government of the Dominican Republic ("GODR") of not to exceed Fifty Thousand United States Dollars (\$50,000) (such amounts, which in the aggregate equal \$2,050,000, being called the Authorized Amount), to help in financing certain foreign exchange and local currency costs of goods and services required for the project described in the immediately following sentence. The project consists of the establishment of an institutional capability in the Caribbean region for (i) strengthening national energy planning, including conducting country energy needs assessments, conservation studies and renewable energy resource assessments, and (ii) designing, testing, adapting and disseminating alternative energy technologies (the "Project").

I approve the total level of AID appropriated funding planned for the Project of not to exceed Seven Million Six Hundred Thousand United States Dollars (\$7,600,000) of Grant funding, including the Authorized Amount, during the period FY 1979 through FY 1982. I approve further increments during that period of Grant funding up to \$5,550,000, subject to the availability of funds in accordance with AID allotment procedures, as follows: CARICOM \$2,247,300, CDB \$3,002,700, and GODR \$300,000 (subject to the acceptability of a feasibility study).

I hereby authorize the initiation of negotiation and execution of the Project Agreement or Project Agreements, as the case may be, by the officer to whom such authority has been delegated in accordance with AID regulations and Delegations of Authority, subject to the following essential terms, covenants and major conditions, together with such other terms and conditions as AID may deem appropriate:

A. Source and Origin of Goods and Services

Except for ocean shipping, and except as set forth in Section E below, goods and services financed by AID under the Project shall have their source and origin in the United States or, in the case of the Grant to CARICOM, in member countries of CARICOM, or, in the case of the Grant to the CDB, in the countries in the Caribbean which are members of the CDB and which are included in AID Geographic Code 941, or, in the case of activities to be carried out in Haiti and the Dominican Republic, respectively, in Haiti and in the Dominican Republic, respectively, except as AID may otherwise agree in writing. Ocean shipping financed by AID under the Project shall be procured in the United States, except as AID may otherwise agree in writing.

B. Conditions Precedent to Disbursement (CARICOM, CDB)

Prior to any disbursement, or to the issuance of any commitment documents under the Project Agreement or Project Agreements, to finance activities of the CARICOM Energy Unit or the CDB Energy Group, as the case may be, for other than technical assistance, professional staff salaries and supporting administrative costs, CARICOM or the CDB, as the case may be, shall, except as AID may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(i) evidence that CARICOM or the CDB, as the case may be, has planned for an adequately staffed Energy Unit or Energy Group, as the case may be, and has a detailed plan governing its operation, including permanent staffing arrangements, and a time-phased work plan governing the use of Project funds for the Policy, Training, Communications and Technical Programs; and

(ii) a copy of a signed contract for technical services to provide CARICOM and the CDB with the necessary expertise for program development and implementation.

C. Covenants (CARICOM, CDB)

Except as AID may otherwise agree in writing, CARICOM and the CDB shall each covenant and agree to:

(i) evaluate the Project using Project funds in the second and fifth years of Project implementation;

(ii) maximize communications between the CARICOM Energy Unit and the CDB Energy Group through consultations on work plans, subprojects and terms of reference;

(iii) utilize guidelines developed by the Project Advisory Committee;

(iv) report periodically to the Project Advisory Committee with respect to Project implementation; and

(v) use every effort to secure funds from regular budgeting sources to support the continuation of the staffs of the CARICOM Energy Unit or the CDB Energy Group, as the case may be, beginning in the third year of Project Implementation.

D. Covenant (CDB)

Except as AID may otherwise agree in writing, the CDB shall covenant and agree to use its best efforts to procure goods and services from the countries authorized under Section A above prior to procuring goods and services from countries made eligible for source and origin pursuant to Section E below.

E. Waiver

For the reasons set forth in the Action Memorandum to the Assistant Administrator (LAC), attached hereto, goods and services having a cumulative value of not to exceed \$500,000 may be procured from countries included in AID Geographic Code 899.

Edward W. Coy  
Assistant Administrator  
Bureau for Latin America  
and the Caribbean.

August 23, 1979  
Date

Clearances:

GC/LAC:JKessler	<u>JK/AHW</u>	Date	<u>8/22/79</u>
LAC/DR:LArmstrong	<u>AK</u>	Date	<u>8/22/79</u>
LAC/DR:MBrown	<u>MB</u>	Date	<u>8/22/79</u>
SEP/COM:PHagen	<u>PH</u>	Date	<u>8/22/79</u>

GC/LAC:GM ~~inter~~ter:jlo:8/20/79:x29182

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A.I.D. Project Number 538-0032

PROJECT  
GRANT AGREEMENT  
BETWEEN  
THE CARIBBEAN DEVELOPMENT BANK  
AND THE  
UNITED STATES OF AMERICA  
FOR  
ALTERNATIVE ENERGY SYSTEMS

Dated: August 25, 1979

FISCAL DATA

Appropriation No. : 72-1191021  
Allotment No. : 946-54-538-00-69-91  
Amount Obligated: U.S. \$1,000,000

CONFIRMED COPY

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PROJECT GRANT AGREEMENT

Dated August 25, 1979

Between

The Caribbean Development Bank ("Grantee")

And

The United States of America, acting through the  
Agency for International Development ("A.I.D.")

Article 1: The Agreement

The purpose of this Agreement is to set out the understandings of the Parties named above ("Parties") with respect to the undertaking by the Grantee of the Project described below, and with respect to the financing of the Project by the Parties.

Article 2: The Project

SECTION 2.1. Definition of Project. The Project, which is further described in Annex 1, will establish an institutional capability in the Caribbean region for strengthening national energy planning. It includes conducting country energy needs assessments, conservation studies and renewable energy resource assessments; and the designing, testing, adapting and disseminating of alternative energy technologies. Annex 1, attached, amplifies the above definition of the Project. Within the limits of the above definition of the Project, elements of the amplified description stated in Annex 1 may be changed by written agreement of the authorized representatives of the Parties named in Section 8.2, without formal amendment of this Agreement.

SECTION 2.2. Incremental Nature of Project

(a) A.I.D.'s contribution to the Project will be provided in increments, the initial one being made available in accordance with Section 3.1 of this Agreement. Subsequent increments will be subject to availability of funds to A.I.D. for this purpose, and to the mutual agreement of the Parties, at the time of a subsequent increment, to proceed.

(b) Within the overall Project Assistance Completion Date stated in this Agreement, A.I.D., based upon consultation with the Grantee, may specify in Project Implementation Letters appropriate time periods for the utilization of funds granted by A.I.D. under an individual increment of assistance.

Article 3: Financing

Section 3.1. The Grant. To assist the Grantee to meet the costs of carrying out the Project, A.I.D., pursuant to the Foreign

Assistance Act of 1961, as amended, agrees to grant the Grantee under the terms of this Agreement not to exceed One Million United States ("U.S.") Dollars (\$1,000,000) ("Grant"). As shown in the budget contained in Annex 1, A.I.D. plans to provide future increments of funding to the project up to a total of \$3,002,700. Such funding is subject to availability of funds to A.I.D. for the project and mutual agreement of the Parties to proceed with the project. The Grant may be used to finance foreign exchange costs, as defined in Section 6.1 and local currency costs, as defined in Section 6.2. of goods and services required for the Project.

SECTION 3.2. Grantee Resources for the Project

(a) The Grantee agrees to provide or cause to be provided for the Project all funds, in addition to the Grant, and all other resources required to carry out the Project effectively and in a timely manner.

(b) The resources provided by Grantee for the Project will be not less than the equivalent of U.S.\$395,000, including costs borne on an "in-kind" basis.

SECTION 3.3. Project Assistance Completion Date.

(a) The "Project Assistance Completion Date" (PACD), which is August 31, 1984, or such other date as the Parties may agree to in writing, is the date by which the Parties estimate that all services financed under the Grant will have been performed and all goods financed under the Grant will have been furnished for the Project as contemplated in this Agreement.

(b) Except as A.I.D. may otherwise agree in writing, A.I.D. will not issue or approve documentation which would authorize disbursement of the Grant for services performed subsequent to the PACD or for goods furnished for the project, as contemplated in this Agreement, subsequent to the PACD.

(c) Requests for disbursement, accompanied by necessary documentation prescribed in Project Implementation Letters are to be received by A.I.D. or any bank described in Section 7.1 no later than nine (9) months following the PACD, or such other period as A.I.D. agrees to in writing. After such period, A.I.D., giving notice in writing to the Grantee, may at any time or times reduce the amount of the Grant by all or any part thereof for which requests for disbursement, accompanied by necessary supporting documentation prescribed in Project Implementation Letters, were not received before the expiration of said period.

Article 4: Conditions Precedent to Disbursement

SECTION 4.1. First Disbursement. Prior to the first disbursement under the Grant, or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made, the Grantee will, except as the Parties may otherwise agree in writing, furnish to A.I.D. in form and substance satisfactory to A.I.D. a statement of the name of the person holding or acting in the office of the Grantee specified in Section 8.2., and of any additional representatives, together with a specimen signature of each person specified in such statement.

SECTION 4.2 Additional Disbursement: Prior to disbursement under the Grant, or to issuance by A.I.D. of documentation pursuant to which disbursement will be made, for any purpose other than Technical Assistance and professional staff salaries with supporting administrative costs, the Grantee will, except as the Parties may otherwise agree in writing, furnish to A.I.D. in form and substance satisfactory to A.I.D.:

(a) Evidence that the Grantee has planned for an adequately staffed Energy Unit or Group and has a detailed plan governing its operation including permanent staffing arrangements, and a time-phased work plan governing the use of project funds for the Policy, Training, Communications and Technical Programs.

(b) A contract for technical services to provide both CARICOM and CDB with expertise necessary for program development and implementation.

SECTION 4.3. Notification. When A.I.D. has determined that the conditions precedent specified in Section 4.1 and 4.2. have been met, it will promptly notify the Grantee.

SECTION 4.4. Terminal Dates for Conditions Precedent.

(a) If all of the conditions specified in Section 4.1 have not been met within 90 days from the date of this Agreement, or such later date as A.I.D. may agree to in writing, A.I.D., at its option, may terminate this Agreement by written notice to Grantee.

(b) If all of the conditions specified in Section 4.2 have not been met within 150 days from the date of this Agreement, or such later date as A.I.D. may agree to in writing, A.I.D., at its option, may cancel the then undisbursed balance of the Grant, to the extent not irrevocably committed to third parties, and may terminate this Agreement by written notice to the Grantee.

Article 5: Covenants:

SECTION 5.1. Project Evaluation. The Parties agree to establish an evaluation program as part of the Project. Project funded evaluations will be conducted during the second and fifth years of Project Implementation. Except as the Parties otherwise agree in writing, the program will include, during the implementation of the Project and at one or more points thereafter:

(a) evaluation of progress toward attainment of the objectives of the Project;

(b) identification and evaluation of problem areas of constraints which may inhibit such attainment;

(c) assessment of how such information may be used to help overcome such problems;

(d) evaluation, to the degree feasible, of the overall development impact of the Project; and

(e) evaluation during the second year of the potential utility and cost effectiveness of creating a national, or regional, energy center to continue alternative energy development after completion of the Project. This evaluation will also identify potential institutions to carry out this function.

SECTION 5.2 Additional Covenants. Except as the Parties may otherwise agree in writing, Grantee agrees to:

- (a) Maximize communications between the energy groups in CARICOM and CDB through consultations on work plans, sub-projects and terms of reference;
- (b) Utilize guidelines developed by the Project's Advisory Committee;
- (c) Report periodically to the Advisory Committee regarding project implementation;
- (d) Use every effort to secure funds from regular budgetary sources to support the continuation of the energy group staffs beginning in the third year of the Project; and
- (e) Use its best efforts to procure goods and services from Eligible Source Countries, as defined in Section 6.1 of this Agreement, prior to procuring from code 899 countries.

Article 6: Procurement Source

SECTION 6.1 Foreign Exchange Costs. Disbursement pursuant to Section 7.1 will be used exclusively to finance the costs of goods and services required for the Project having their source and origin in the United States and Caribbean Member Countries of Grantee. ("Eligible Source Countries"), except that goods and services having a cumulative value of not to exceed \$500,000 may be procured in A.I.D. Geographic Code 899 countries assuming that best efforts to procure them in eligible source countries have been unsuccessful. Marine Insurance shall be procured as provided in the Project Grant Standard Provisions Annex, Section C.1 (b). Ocean transportation costs will be financed under the Grant only on vessels under flag registry of the United States except as A.I.D. may otherwise agree in writing. If A.I.D. determines that there are no vessels under U.S. flag registry available, A.I.D. in a Project Implementation Letter may agree to finance under the Grant ocean transportation costs on vessels under flag registry of another country.

SECTION 6.2 Local Currency Costs. Disbursements pursuant to Section 7.2 will be used exclusively to finance the costs of goods and services required for the Project having their source and, except as A.I.D. may otherwise agree in writing, their origin in the country where the activity is located ("Local Currency Costs").

Article 7: Disbursement

SECTION 7.1 Disbursement for Foreign Exchange Costs.

(a) After satisfaction of conditions precedent, the Grantee may obtain disbursements of funds under the Grant for the Foreign Exchange Costs of goods or services required for the Project in accordance with the terms of this Agreement, by such of the following methods as may be mutually agreed upon:

(1) by submitting to A.I.D., with necessary supporting documentation as prescribed in Project Implementation Letters, (A) requests for reimbursement for such goods or services, or, (B) requests for A.I.D. to procure commodities or services in Grantee's behalf for the Project; or

(2) by requesting A.I.D. to issue Letters of Commitment for specified amounts (A) to one or more U.S. banks, satisfactory to A.I.D., committing A.I.D. to reimburse such bank or banks for payments made by them to contractors or suppliers, under Letters of

Credit or otherwise, for such goods or services, or (B) directly to one or more contractors or suppliers, committing A.I.D. to pay such contractors or suppliers for such goods or services.

(b) Banking charges incurred by Grantee in connection with Letters of Commitment and Letters of Credit will be financed under the Grant unless Grantee instructs A.I.D. to the contrary. Such other charges as the Parties may agree to may also be financed under the Grant.

SECTION 7.2. Disbursement for Local Currency Costs.

(a) After satisfaction of conditions precedent, the Grantee may obtain disbursements of funds under the Grant for Local Currency Costs required for the Project in accordance with the terms of this Agreement, by submitting to A.I.D., with necessary supporting documentation as prescribed in Project Implementation Letters, requests to finance such costs.

(b) The local currency needed for such disbursements may be obtained:

(1) by acquisition by A.I.D. with U.S. Dollars by purchase or from local currency already owned by the U.S. Government; or

(2) by A.I.D. (A) requesting the Grantee to make available the local currency for such costs, and (B) thereafter making available to the Grantee, through the opening or amendment by A.I.D. of Special Letter of Credit in favor of the Grantee or its designee, an amount of U.S. Dollars equivalent to the amount of local currency made available by the Grantee, which dollars will be utilized for procurement from the United States under appropriate procedures described in Project Implementation Letters.

The U.S. dollar equivalent of the local currency made available hereunder will be, in the case of subsection (b) (1) above, the amount of U.S. dollars required by A.I.D. to obtain the local currency, and in the case of subsection (b) (2) above, an amount calculated at the rate of exchange specified in the applicable Special Letter of Credit Implementation Memorandum hereunder as of the date of the opening or amendment of the applicable Special Letter of Credit.

SECTION 7.3. Other Forms of Disbursement. Disbursements of the Grant may also be made through such other means as the Parties may agree to in writing.

SECTION 7.4. Rate of Exchange. Except as may be more specifically provided under Section 7.2, if funds provided under the Grant are introduced into a Participating Country by A.I.D. or any public or private agency for purposes of carrying out obligations of A.I.D. hereunder, the Grantee will make such arrangements as may be necessary so that such funds may be converted into local currency at the highest rate of exchange which, at the time the conversion is made, is not there unlawful.

Article 8: Miscellaneous

SECTION 8.1. Communications. Any notice, request, document, or other communication submitted by either Party to the other under this Agreement will be in writing or by telegram or cable, and will be deemed duly given or sent when delivered to such party at the following addresses:

To the Grantee:

Mail Address:	Caribbean Development Bank P.O. Box 408 Wildey, St. Michael Barbados, W.I.
Alternate address for cables:	CARIBANK Telex WB 287

To A.I.D.:

Mail Address:	AID Representative USAID Barbados C/o U.S. Embassy Bridgetown, Barbados, W.I.
Alternate address for cables:	USAID/American Embassy Bridgetown, Barbados

All such communication will be in English, unless the Parties otherwise agree in writing. Other addresses may be substituted for the above upon the giving of notice.

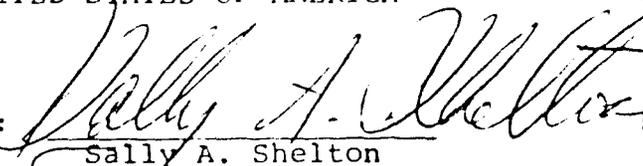
SECTION 8.2. Representatives. For all purposes relevant to this Agreement, the Grantee will be represented by the individual holding or acting in the office of President and A.I.D. will be represented by the individual holding or acting in the office of AID Representative, each of whom, by written notice, may designate additional representatives for all purposes other than exercising the power under Section 2.1 to revise elements of the amplified description in Annex 1. The names of the representatives of the Grantee, with specimen signatures, will be provided to A.I.D., which may accept as duly authorized any instrument signed by such representatives in implementation of this Agreement, until receipt of written notice of revocation of their authority.

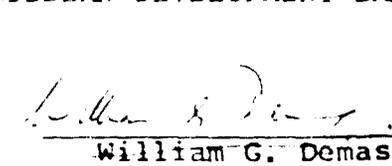
SECTION 8.3. Standard Provisions Annex. A "Project Grant Standard Provisions Annex" (Annex 2) is attached to and forms part of this Agreement.

IN WITNESS WHEREOF, the Grantee and the United States of America, each acting through its duly authorized representative, have caused this Agreement to be signed in their names and delivered as of the day and year first above written.

UNITED STATES OF AMERICA

CARIBBEAN DEVELOPMENT BANK

By:   
Sally A. Shelton

By:   
William G. Demas

Title: Ambassador

Title: President

By:   
William B. Wheeler

Title: AID Representative

## ANNEX I

### PROJECT DESCRIPTION

#### I. PROJECT OBJECTIVES

The goal of the project is to develop a capability to utilize renewable energy sources in the Caribbean as alternatives to imported fossil fuels and to encourage energy conservation measures. This goal can be achieved by introducing cost effective, renewable energy technologies and conservation programs. The project responds to the desires of the MDCs and LDCs of the region to reduce energy dependency and to alleviate the balance of payments problems nearly all of them face because of rising petroleum prices.

The purpose of the project is to establish an institutional capability in the Caribbean region for carrying out energy planning, including conducting country energy needs assessments, and for designing, testing, adapting and disseminating alternative energy technologies. Participating countries will be the Caribbean member countries of the CDB.

#### II PROJECT DESCRIPTION

##### A. Executing Agencies

The executing agencies for the project will be CARICOM and the CDB. These organizations will have overall responsibilities for planning and management under the project while specific activities (field testing and applied research, training, and assessments) will be carried out by regional and national institutions.

Due to the specialized abilities of CARICOM and CDB, the principal project components will be divided as follows:

##### CARICOM

- Policy planning/energy assessment component
- Training component

##### CDB

- Communications/energy information network component
- Energy technologies component

In addition, an Energy Advisory Committee will be established. Its purpose will be to ensure that all project activities are undertaken in a coordinated fashion and to provide policy and project advice to both the CDB and CARICOM. It will be chaired by CARICOM and consist of representatives of the member countries of CARICOM plus the Bahamas, Dominican Republic, Haiti and the CDB. Representatives

of the Committee will be selected by the participating governments and institutions of the region. Technical support to this committee may be provided by the Commonwealth Science Council or outside consultants as is required.

During the project's initial phase of implementation and to support technical advisory activities, a joint contract for five person years of consulting services will be executed between CARICOM/CDB and a U.S. consulting firm. This joint contract will be financed with A.I.D. Grant funds and provide CARICOM and CDB with technical expertise in support of program execution and assistance in the coordination of the program as agreed to by CDB and CARICOM.

## B. CARICOM Project Components

### 1. Policy Planning and Energy Assessments

Grant funds will be used to establish and strengthen the regional and national capabilities in energy planning and policy formulation. CARICOM will negotiate and finance technical assistance to the region and the countries for the preparation of energy assessments, programs of energy conservation, and energy policy review and development. Grant funds will support activities to be carried out by institutions, firms and individuals aimed at improving energy policies and developing energy assessments.

### 2. Technical and Analytical Training

Grant funds will be used to develop within the region a cadre of trained personnel in energy planning, assessment, and renewable energy technology design, project development and maintenance. The training program includes two training areas (1) policy, and (2) technical. CARICOM will utilize experienced regional institutions such as the Center for Energy and Environment Research (CEER) and the University of the West Indies (UWI) to provide both policy and technical training. In areas where no regional expertise exists, professionals will be sent outside the region to obtain the training. The program will utilize institutions within the region as much as possible to expand and improve the availability of regional training. Individual candidates will be selected for the program based upon governmental and institutional recommendations to the training program coordinator of CARICOM. Grant funds will also provide for the training of two energy specialists to work with CARICOM.

## C. CDB Project Components

### 1. Communication and Energy Information Network

The communications activities funded under this grant will be directed at strengthening CDB's existing networks and

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capabilities for dissemination of renewable energy information. The communication program supports and will be administered by the CDB Technology Information Unit. Specific activities include country visitation, alternative energy workshops, and special communications activities such as seminars, abstracts and newsletters.

## 2. Field Testing of Applied Energy Technologies

Grant funds will finance field testing of a variety of small scale renewable energy technologies appropriate for community or individual applications. These tests are a key step in the acceptance and commercialization of renewable energy systems in the region. The CDB will contract with various regional institutions and outside contractors for applied technology design and/or purchase and installation of existing non-conventional energy systems. In each participating country, up to two demonstration sub-projects that meet criteria related to the country's energy policy, technical and economic situation, possible commercialization, and social and environmental requirements will be funded under the grant.

### D. Program Support

The Staffs of both the CARICOM and the CDB will be augmented to provide for management of the program. The Grant to CARICOM will finance approximately thirty-eight person years of staff and consultant support while the Grant to CDB will finance about forty years of staff and nine person years of consultant services. Both CARICOM and CDB will in most cases utilize other institutions and consultants for implementing project activities.

### III FINANCIAL PLAN

The total estimated cost of the project is \$8,126,000. The estimated breakdown of costs of the project by component is shown in the following table. The CARICOM, CDB and countries are providing \$876,000 of in-kind support. The project will be implemented over a five year period commencing on the date of signing the Grant Agreement.

PLANNED FINANCING FOR PROJECT

	U.S. \$000's				
	<u>AID</u>	<u>CARICOM</u>	<u>CDB</u>	<u>COUNTRIES</u>	<u>TOTAL</u>
Policy Program	\$ 938				\$ 938
Training Program	1,324			56	1,380
Communication Program	613				613
Technical Program	2,326			320	2,646
Institution Building CARICOM	985	105	395		1,090
CDB	<u>1,064</u>				<u>1,459</u>
	<u>\$7,250</u>	<u>105</u>	<u>395</u>	<u>376</u>	<u>8,126</u>

Project Grant Standard

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Provisions Annex

Definitions: As used in this Annex, the "Agreement" refers to the Project Grant Agreement to which this Annex is attached and of which this Annex forms a part. Terms used in this Annex have the same meaning or reference as in the Agreement.

Article A: Project Implementation Letters

To assist Grantee in the implementation of the Project, A.I.D., from time to time, will issue Project Implementation Letters that will furnish additional information about matters stated in this Agreement. The parties may also use jointly agreed-upon Project Implementation Letters to confirm and record their mutual understanding on aspects of the implementation of this Agreement. Project Implementation Letters will not be used to amend the text of the Agreement but can be used to record revisions or exceptions which are permitted by the Agreement, including the revision of elements of the amplified description of the Project in Annex I.

Article B: General Covenants

SECTION B.1. Consultation. The Parties will cooperate to assure that the purpose of this Agreement will be accomplished. To this end, the Parties, at the request of either, will exchange views on the progress of the Project, the performance of obligations under this Agreement, the performance of any consultants, contractors, or suppliers engaged on the Project, and other matters relating to the Project.

SECTION B.2. Execution of Project. The Grantee will:

(a) carry out the Project or cause it to be carried out with due diligence and efficiency, in conformity with sound technical, financial, and management practices, and in conformity with those documents, plans, specifications, contracts, schedules or other arrangements, and with any modifications therein, approved by A.I.D. pursuant to this Agreement; and

(b) provide qualified and experienced management for, and train such staff as may be appropriate for the maintenance and operation of the Project, and, as applicable for continuing activities, cause the Project to be operated and maintained in such manner as to assure the continuing and successful achievement of the purposes of the Project.

Article B: General Covenants (Continued)

SECTION B.3. Utilization of Goods and Services.

(a) Any resources financed under the Grant will, unless otherwise agreed in writing by A.I.D., be devoted to the Project until the completion of the Project, and thereafter will be used so as to further the objectives sought in carrying out the Project.

(b) Goods or services financed under the Grant, except as A.I.D. may otherwise agree in writing, will not be used to promote or assist a foreign aid project or activity associated with or financed by a country not included in Code 935 of the A.I.D. Geographic Code Book as in effect at the time of such use.

SECTION B.4. Taxation.

(a) This Agreement and the Grant will be free from any taxation or fees imposed under laws in effect in the territory of participating countries.

(b) To the extent that (1) any contractor, including any consulting firm, any personnel of such contractor financed under the Grant, and any property or transaction relating to such contracts and (2) any commodity procurement transaction financed under the Grant, are not exempt from identifiable taxes, tariffs, duties or other levies imposed under laws in effect in the territory of participating countries, the Grantee will, as and to the extent provided in and pursuant to Project Implementation Letters, pay or reimburse the same with funds other than those provided under the Grant.

SECTION B.5. Reports, Records, Inspections, Audit.

The Grantee will:

(a) furnish A.I.D. such information and reports relating to the Project and to this Agreement as A.I.D. may reasonably request;

(b) maintain or cause to be maintained, in accordance with generally accepted accounting principles and practices consistently applied, book and records relating to the Project and to this Agreement, adequate to show, without limitation, the receipt and use of goods and services acquired under the Grant. Such books and records will be audited regularly, in accordance with generally accepted auditing standards, and maintained for three years after the date of last disbursement by A.I.D.; such books and records will also be adequate to show the nature and extent of solicitations of prospective suppliers of goods and services acquired, the basis of award of contracts and orders, and the overall progress of the Project toward completion; and

Article B: General Covenants (Continued)

(c) afford authorized representatives of a Party the opportunity at all reasonable times to inspect the Project, the utilization of goods and services financed by such Party, and books, records, and other documents relating to the Project and the Grant.

SECTION B.6 Completeness of Information. The Grantee Confirms:

(a) that the facts and circumstances of which it has informed A.I.D., or cause A.I.D. to be informed, in the course of reaching agreement with A.I.D. on the Grant, are accurate and complete, and include all facts and circumstances that might materially affect the Project and the discharge of responsibilities under this Agreement;

(b) that it will inform A.I.D. in timely fashion of any subsequent facts and circumstances that might materially affect, or that it is reasonable to believe might so affect, the Project or the discharge of responsibilities under this Agreement.

SECTION B.7. Other Payments. Grantee affirms that no payments have been or will be received by any official of the Grantee in connection with the procurement of goods or services financed under the Grant, except fees, or similar payments legally established in the participating country where made.

SECTION B.8. Information and Marking. The Grantee will give appropriate publicity to the Grant and the Project as a program to which the United States has contributed, identify the Project site, and mark goods financed by A.I.D., as described in Project Implementation Letters.

Article C: Procurement Provisions

SECTION C.1 Special Rules.

(a) The source and origin of ocean and air shipping will be deemed to be the ocean vessel's or aircraft's country of registry at the time of shipment.

(b) Premiums for marine insurance placed in the territory of a participating country will be deemed an eligible Foreign Exchange Cost, if otherwise eligible under Section C.7(a).

(c) Any motor vehicles financed under the Grant will be of United States manufacture, except as A.I.D. may otherwise agree in writing.

Article C: Procurement Provisions (Continued)

(d) Transportation by air, financed under the Grant, of property or persons, will be on carriers holding United States certification, to the extent service by such carriers is available. Details on this requirement will be described in a Project Implementation Letter.

SECTION C.2. Eligibility Date. No goods or services may be financed under the Grant which are procured pursuant to orders or contracts firmly placed or entered into prior to the date of this Agreement, except as the Parties may otherwise agree in writing.

SECTION C.3. Plans, Specifications, and Contracts. In order for there to be mutual agreement on the following matters, and except as the Parties may otherwise agree in writing:

(a) The Grantee will furnish to A.I.D. upon preparation,

(1) any plans, specifications, procurement or construction schedules, contracts, or other documentation relating to goods or services to be financed under the Grant, including documentation relating to the prequalification and selection of contractors and to the solicitation of bids and proposals. Material modifications in such documentation will likewise be furnished A.I.D. on preparation;

(2) such documentation will also be furnished to A.I.D. upon preparation, relating to any goods or services, which, though not financed under the Grant, are deemed by A.I.D. to be of major importance to the Project. Aspects of the Project involving matters under this subsection ( ) (2) will be identified in Project Implementation Letters;

(b) Documents related to the prequalification of contractors and to the solicitation of bids or proposals for goods and services financed under the Grant will be approved by A.I.D. in writing prior to their issuance, and their terms will include United States standards and measurements;

(c) Contracts and contractors financed under the Grant for engineering and other professional services, for construction services, and for such other services, equipment or materials as may be specified in Project Implementation Letters, will be approved by A.I.D. in writing prior to execution of the contract. Material modifications in such contracts will also be approved in writing by A.I.D. prior to execution; and

Article C: Procurement Provisions (Continued)

(d) Consulting firms used by the Grantee for the Project but not financed under the Grant, the scope of their services and such of their personnel assigned to the Project as A.I.D. may specify, and construction contractors used by the Grantee for the Project but not financed under the Grant, shall be acceptable to A.I.D.

SECTION C.4. Reasonable Price. No more than reasonable prices will be paid for any goods or services financed, in whole or in part, under the Grant. Such items will be procured on a fair and, to the maximum extent practicable, on a competitive basis.

SECTION C.5. Notification to Potential Suppliers. To permit all United States firms to have the opportunity to participate in furnishing goods and services to be financed under the Grant, the Grantee will furnish A.I.D. such information with regard thereto, and at such times, as A.I.D. may request in Project implementation letters.

SECTION C.6. Shipping.

(a) Goods which are to be transported to the territory of participating countries may not be financed under the Grant if transported either: (1) on an ocean vessel or aircraft under the flag of a country which is not included in A.I.D. Geographic Code 935 as in effect at the time of shipment, or (2) on an ocean vessel which A.I.D., by written notice to the Grantee has designated as ineligible; or (3) under an ocean or air charter which has not received prior A.I.D. approval.

(b) Costs of ocean or air transportation (of goods or persons) and related delivery services may not be financed under the Grant, if such goods or persons are carried: (1) on an ocean vessel under the flag of a country not, at the time of shipment, identified under the paragraph of the Agreement entitled "Procurement Source: Foreign Exchange Costs", without prior written A.I.D. approval; or (2) on an ocean vessel which A.I.D., by written notice to the Grantee, has designated as ineligible; or (3) under an ocean vessel or air charter which has not received prior A.I.D. approval.

(c) Unless A.I.D. determines that privately owned United States-flag commercial ocean vessels are not available at fair and reasonable rates for such vessels, (1) at least fifty percent (50%) of the gross tonnage of all goods (computed separately for dry bulk carriers, dry cargo liners and tankers) financed by A.I.D. which may be transported on ocean vessels will be transported on privately owned United States-flag commercial vessels, and (2) at least fifty percent (50%) of the gross freight revenue generated by all shipments

Article C: Procurement Provisions (Continued)

financed by A.I.D. and transportation on dry cargo liners shall be paid to or for the benefit of privately owned United States-flag commercial vessels. Compliance with the requirements of (1) and (2) of this subsection must be achieved with respect to both any cargo transported from U.S. ports and any cargo transported from non-U.S. ports, computed separately.

SECTION C.7. Insurance.

(a) Marine insurance on goods financed by A.I.D. may be financed as a Foreign Exchange Cost under this Agreement provided (1) such insurance is placed at the lowest available competitive rate, and (2) claims thereunder are payable in the currency in which such goods were financed or in any freely convertible currency. If a country by statute, decree, rule, regulation, or practice discriminates with respect to A.I.D.-financed procurement against any marine insurance company authorized to do business in any State of the United States, then all goods financed by A.I.D. hereunder will be insured against marine risks and such insurance will be placed in the United States with a company or companies authorized to do a marine insurance business in a State of the United States.

(b) Except as A.I.D. may otherwise agree in writing, the Grantee will insure, or cause to be insured, goods financed under the Grant imported for the Project against risks incident to their transit to the point of their use in the Project, such insurance will be issued on terms and conditions consistent with sound commercial practice and will insure the full value of the goods. Any indemnification received by the Grantee under such insurance will be used to replace or repair any material damage or any loss of the goods insured or will be used to reimburse the Grantee for the replacement or repair of such goods. Any such replacements will be of source and origin of countries listed in A.I.D. Geographic Code 935 as in effect at the time of replacement, and, except as the Parties may agree in writing, will be otherwise subject to the provisions of the Agreement.

SECTION C.8. U.S. Government-Owned Excess Property. The Grantee agrees that wherever practicable, United States Government-owned excess personal property, in lieu of new items financed under the Grant, should be utilized. Funds under the Grant may be used to finance the costs of obtaining such property for the Project.

Article D: Termination; Remedies.

SECTION D.1. Termination. Either Party may terminate this Agreement by giving the other Party 30 days written notice. Termination of this Agreement will terminate any obligations of the Parties

Article D: Termination; Remedies (Continued)

to provide financial or other resources to the Project pursuant to this Agreement, except for payment which they are committed to make pursuant to noncancellable commitments entered into with third parties prior to the termination of this Agreement. In addition, upon such termination A.I.D. may, at A.I.D.'s expense, direct that title to goods financed under the Grant be transferred to A.I.D. if the goods are from a source outside participating member countries; are in a deliverable state and have not been offloaded in ports of entry.

SECTION D.2. Refunds.

(a) In the case of any disbursement which is not supported by valid documentation in accordance with this Agreement, or which is not made or used in accordance with this Agreement, or which was for goods or services not used in accordance with this Agreement, A.I.D., notwithstanding the availability or exercise of any other remedies under this Agreement, may require the Grantee to refund the amount of such disbursement in U.S. Dollars to A.I.D. within sixty (60) days after receipt of a request therefor.

(b) If the failure of Grantee to comply with any of its obligations under this Agreement has the result that goods or services financed under the Grant are not used effectively in accordance with this Agreement, A.I.D. may require the Grantee to refund all or any part of the amount of the disbursements under this Agreement for such goods or services in U.S. Dollars to A.I.D. within sixty days after receipt of a request therefor.

(c) The right under subsection (a) or (b) to require a refund of a disbursement will continue, notwithstanding any other provision of this Agreement, for three years from the date of the last disbursement under this Agreement.

(d) (1) Any refund under subsection (a) or (b), or (2) any refund to A.I.D. from a contractor, supplier, bank or other third party with respect to goods or services financed under the Grant, which refund relates to an unreasonable price for or erroneous invoicing of goods or services, or to goods that do not conform to specifications, or to services that are inadequate, will (A) be made available first for the cost of goods and services required for the Project, to the extent justified, and (B) the remainder, if any, will be applied to reduce the amount of the Grant.

Article D: Termination; Remedies (Continued)

(e) Any interest or other earnings on Grant funds disbursed by A.I.D. to the Grantee under this Agreement prior to the authorized use of such funds for the Project will be returned to A.I.D. in U.S. Dollars by the Grantee.

SECTION D.3. Nonwaiver of Remedies. No delay in exercising any right or remedy accruing to a Party in connection with its financing under this Agreement will be construed as a waiver of such right or remedy.

SECTION D.4. Assignment. The Grantee agrees, upon request, to execute an assignment to A.I.D. of any cause of action which may accrue to the Grantee in connection with or arising out of the contractual performance or breach of performance by a party to a direct U.S. Dollar contract with A.I.D. financed in whole or in part out of funds granted by A.I.D. under this Agreement.