517014404201

PD-AAI-496

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

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

DOCUMENT CODE: 3

2. COUNTRY/ENTITY: Dominican Republic

3. PROJECT NUMBER: 517-0144

4. BUREAU/OFFICE: USAID/DR

5. PROJECT TITLE (maximum 40 characters): Energy Conservation and Resource Dev.

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 01 DD 31 YY 87

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

A. Initial FY 82 B. Quarter 2 C. Final FY 84

8. COSTS ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY 82 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total			2,533	10,465	5,467	15,932
(Grant)	( )	( )	(1,767)	(2,219)	(2,895)	(5,114)
(Loan)	( )	( )	(766)	(8,246)	(2,572)	(10,818)
Other U.S. 1.						
Other U.S. 2.						
Host Country						
Other Donor(s)						6,290
TOTALS			2,533	10,465	5,467	22,222

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) A, RD, N	740B	710	710			2,000	10,818	5,114	10,818
(2)									
(3)									
(4)									
TOTALS									

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

11. SECONDARY PURPOSE CODE

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

A. Code	BR	INTR	ING				
B. Amount							

13. PROJECT PURPOSE (maximum 480 characters)

To 1) develop a national energy investment planning capability, 2) initiate a continuing program of industrial energy conservation, 3) develop the institutional capacity to exploit small scale hydro and wood fuels as alternative sources of energy, and 4) upgrade the management and planning capabilities of the Dominican Electricity Corporation.

14. SCHEDULED EVALUATIONS

Interim MM 07 YY 83 MM 07 YY 84 Final MM 12 YY 86

15. SOURCE/ORIGIN OF GOODS AND SERVICES

[X] 000 [X] 941 [X] Local [ ] Other (Specify)

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

17. APPROVED BY

Signature

Title: Director, USAID/DR

Date Signed: MM 12 DD 04 YY 81

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

MM DD YY

AID 1330-4 (8-79)

II

PROJECT PAPER
ENERGY CONSERVATION AND RESOURCE DEVELOPMENT

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INTRODUCTION

In the era of low petroleum prices, the Dominican Republic, like many other countries, developed a high degree of dependence on imported petroleum. The economy modernized rapidly in the 1960s and early 1970s in a way which made the country highly vulnerable to the massive increases in oil prices dictated by the OPEC countries. After many years of accommodating the increase in oil imports through high agricultural export earnings, the Dominican Republic suddenly found itself in the late 1970s faced with a crisis threatening to damage severely the country's economy.

Recognizing the need for a fundamental restructuring of energy supply and consumption, the government established a National Energy Policy Commission in 1979 to plan and coordinate the government's response to the crisis. In addition to a series of measures to raise energy prices, conserve available energy resources and increase non-petroleum energy usage, the GODR, through the National Energy Commission, undertook a National Energy Assessment with AID grant funding.

The Energy Assessment was completed in the fall of 1980. It analyzed energy supply and demand, laid out a series of general strategies for dealing with the energy problem, and made several specific recommendations. At the strategy level, the Assessment recommended a long term program emphasizing the development of hydroelectric resources, conversion of oil to coal fired generation of electricity, a major effort at energy conservation, and development of renewable energy resources. This strategy was approved by the cabinet level of the Energy Commission as the basis for Dominican energy policy.

The sector program presented in this Project Paper is based upon the recommendations of the National Energy Assessment and the strategy adopted by the GODR. It consists of a number of activities which are considered crucial to moving this strategy forward and achieving the long term objectives of both the GODR and AID in the energy area. The project proposed has been developed within the context of USAID's overall energy assistance program and much of the groundwork for the project has already been laid by previous AID activities.

The proposed project is fully consistent with the provisions of the Foreign Assistance Act and guidance set forth in the AID Energy Assistance Policy Paper.

I. SUMMARY AND RECOMMENDATION

A. Recommendation

USAID/DR recommends that a Loan of $10,818,000 and a Grant of $5,114,000 be authorized to the Government of the Dominican Republic (GODR) to support Energy Conservation and Resource Development. The Loan/Grant Project will be implemented over a period of five years. The Loan will be repaid over twenty-five years, including a ten year grace period, with interest at 2 percent during the grace period and 3 percent thereafter.

B. Borrower/Grantee and Implementing Agencies

The Borrower/Grantee will be the Government of the Dominican Republic (GODR). Overall implementation of the Project will be coordinated by the National Energy Policy Commission. Certain aspects of the Project will be implemented directly by the Energy Commission, while other Project activities will be implemented by the Commission in collaboration with the following agencies: the Dominican Institute of Industrial Technology (INDOTEC), the Superior Agricultural Institute (ISA), the Dominican Electricity Corporation (CDE), the National Water Resources Institute (INDRHI), and the Central Bank.

C. Summary Project Description

The goal of the Project is to help reduce the dependence of the Dominican Republic on imported petroleum and to increase the availability of affordable energy to all income groups in the country. The subgoal of the Project is to develop the institutional and policy base necessary for achieving energy conservation and non-petroleum resource utilization on a wide scale.

The purposes of the Project are to 1) develop a national energy investment planning capability, 2) initiate a continuing program of industrial energy conservation, 3) develop the institutional capacity to exploit small scale hydro and wood fuels as alternative sources of energy, and 4) upgrade the management and planning capabilities of the Dominican Electricity Corporation.

The Project consists of the following components:

		A.I.D.	($000) GODR	TOTAL
1.	National Energy Planning	250	50	300
2.	Industrial Conservation Program	8,584	4,852	13,436
3.	Mini-Hydro Development Program	3,800	868	4,668
4.	Wood Fuel Development Program	1,598	470	2,068
5.	CDE Technical Assistance Program	700	50	750
6.	Project Administration and Evaluation	1,000	-	1,000
	TOTAL	15,932	6,290	22,222

D. Participants in Project Development

USAID Project Committee

Philip Schwab	Director
Ronald Venezia	Assistant Director
Charles Blankstein	CRD
Allen Merrill	CRD
Tim Hammann	CRD
Betty Facey	CRD
Kenneth Ellis	ARDO
Jack Francis	PRG
Steve Liapis	CONT
Rudolph Fascell	MGT
Bob Burke	LAC/DR

Embassy Staff

Herbert Yarvin	ECON

GODR

Ramón Martínez Aponte	Technical Secretary of the Presidency and President, National Energy Policy Commission
José Ramón Acosta	Executive Secretary, National Energy Policy Commission
Francisco Castillo	Undersecretary of Industry and Commerce
Gil Manuel Canario	National Energy Policy Commission, INDOTEC
Joaquín Santaella	National Energy Policy Commission, INDOTEC
Franklyn Viloria	National Energy Policiy Commission
Luis Alou	National Energy Policy Commission
Gumercindo Estévez	National Energy Policiy Commission
César Gómez	National Energy Policy Commission
José Florentino	General Administrator, CDE
Casto Darío Arias	CDE
Marcelo Jorge	CDE
Daniel Bodden	CDE

Aristedes Martínez	CDE
Diógenes Lemarche	INDRHI
Francisco Schiffino	Central Bank
Leonardo de León	Central Bank
Alberto Rodríguez	ISA
Carlos Nuñez	ISA

World Bank
Oscar Morales
Jorge Gorrio

Inter-American Development Bank
Leonardo Da Silva
Benjamín Valiente

Consultant Teams

Energy/Development International
National Rural Electrification Cooperative Association
U.S. Department of Agriculture
Ebasco Services Corporation

II. BACKGROUND

A. The Energy Situation in the Dominican Republic

The center of the energy problem in the Dominican Republic continues to be the country's heavy dependence on imported petroleum. The rapidly rising costs of imported oil and other petroleum products, along with a growing demand for energy, are placing a serious strain on the balance of payments and development of the economy as a whole.

Currently, all petroleum is imported from Venezuela and Mexico. Local processing at the national refinery (owned 50 percent by the government and 50 percent by Shell) helps reduce somewhat the foreign exchange cost to the country of finished petroleum products. Nevertheless, the amount spent annually on imported petroleum has increased from $42 million in 1973 to around $450 million in 1980. (See Table II.1.) The National Energy Assessment completed last fall estimates that, under current demand and price patterns, the oil import bill will reach $690 million (in 1980 dollars) by 1985 and $1.6 billion by 1990. The drain of petroleum imports on the national economy, of course, is reducing the availability of resources which could otherwise be devoted to developmental and basic human needs programs.

The biggest consumers of imported petroleum are industry, transportation and the public utility (CDE) for electricity generation. The biggest consumers of electricity, in turn, are industry and residences. Overall, imported petroleum represents just under 60 percent of all energy consumed in the country. Although hydro potential is substantial, at present hydroresources represent only 12 percent of all electricity generated and only 2 percent of all energy consumed. Other sources of energy are: bagasse, used for most of the energy requirements of the sugar industry; firewood, which remains the principal energy source in rural areas; and charcoal. (See Table II.3.) Explorations for oil have recently met with some success, with oil having been detected at the deepest well drilled thus for in the country (Charco Largo - 15,500 feet). Although further evaluation indicated that the Charco Largo deposits were not commercially exploitable, additional test wells are now being drilled elsewhere in the country. Deposits of lignite and low grade coal have also been identified in the northeast of the country. The quality of the coal, however, is not considered to be very high (low b.t.u. value, high sulfur content) and the overall investment required to exploit the resource has not yet been determined. In any case, even under the most optimistic circumstances, it will probably be several years before local oil or coal production can begin to make a significant contribution to meeting overall energy demand.

TABLE II.1

PETROLEUM IMPORTS AND BALANCE OF PAYMENTS

(RD$ MILLIONS)

Year	Petroleum Imports	Balance of Payments (Current Account)
1970	18.2	- 125.2
1971	24.4	- 124.1
1972	33.0	- 47.6
1973	42.3	- 97.9
1974	153.5	- 242.13
1975	168.5	- 74.5
1976	171.1	- 241.9
1977	187.8	- 264.5
1978	199.0	- 319.7
1979	306.0	- 380.7
1980	450.0	- 806.8
1981	502.5 1/	- 670.5 1/
1985	690.0 2/	-
1990	1,600.2 2/	-

1/ Embassy estimate

2/ National Energy Assessment estimate

TABLE II.2

PETROLEUM IMPORTS AS A PERCENTAGE OF TOTAL IMPORTS

(RD$ Millions)

Year	Petroleum Imports	Total Imports	Petroleum Imports/Total Imports (%)
1970	18.2	278.0	7
1971	24.4	309.7	8
1972	33.0	337.7	10
1973	42.3	421.9	10
1974	153.5	673.0	23
1975	168.5	772.7	22
1976	171.1	763.6	22
1977	187.8	847.6	22
1978	199.0	859.2	23
1979	306.4	1,055.0	29
1980	450.0	1,515.0	30
1981	502.5 1/	1,556.0 1/	33

1/ Embassy estimate

TABLE II.3

ENERGY SUPPLY IN THE DOMINICAN REPUBLIC - 1978

(Thousands of barrels of oil equivalent)

	Amount	%
Petroleum and Derivatives	14,573	56
Hydro	552	2
Bagasse	5,002	19
Wood	3,375	13
Charcoal	2,740	10
TOTAL	26,242	100

ENERGY CONSUMPTION IN THE DOMINICAN REPUBLIC - 1978

	Amount	%
Industry	9,971	38
Residential	6,828	26
Transportation	4,123	16
Electric Utility (net of sales)	3,946	15
Other (Commercial, Government, Agriculture, etc.)	1,375	5
TOTALS	26,242	100

Source: Energy Strategies for the Dominican Republic: Report of the National Energy Assessment

The problem of rising prices and energy shortages is continuing to have a direct impact on low income groups in the Dominican Republic. Energy is a vital resource which is basic to development - essential to health, productivity, employment and other basic human needs. Electricity, for example, is used by low income groups for pumping drinking water, powering small industrial and food processing activities, running irrigation pumps, refrigerating foods and medicines, operating health facilities and for domestic purposes. As the cost of generating electricity has increased with the rising cost of imported fuel (almost 90 percent of electricity generation in the country requires imported petroleum), electricity has become less affordable, particularly for poorer people. It also has become more costly to expand capacity to serve people in poorer, more isolated rural areas. There already exists a heavy bias in electricity consumption away from poorer, rural areas toward better off urban areas (see Figure II.1), although demand for electricity in rural areas is projected to grow significantly over the next decade.

With access to other affordable energy sources inhibited by scarcity and rising prices, reliance on wood and charcoal is increasing. While wood is essentially a renewable resource, the rate of usage is so high, and the practice of replanting so neglected, that the overall effect is a significant contribution to deforestation. This in turn is further reducing the availability of wood fuels and thus increasing their price.

In sum, dependence on imported fuels and rising costs of both foreign and domestic energy sources are reducing the availability of affordable energy to A.I.D.'s target group, with adverse consequences in terms of health, welfare, productivity and other basic human needs.

B. GODR Response to the Energy Problem

The Government of the Dominican Republic recognizes the seriousness of the energy situation and has taken some important steps to address the problem. A high level of awareness has developed within many government agencies about the need to initiate or reorient programs to deal with energy-related issues. A permanent National Energy Policy Commission, with a qualified professional staff of 50 and an annual budget of $1.3 million, was established in 1979 to help coordinate the energy-related activities of different agencies, analyze the national energy situation and identify and promote appropriate energy policies and programs -- in effect, to develop a comprehensive national approach for dealing with the energy problem.

With assistance from AID, the Energy Commission appears to be developing into a solid analytical and technical organization capable of focusing attention on energy problems, formulating sound policy recommendations, and assisting other institutions in the development and implementation of energy programs.

The first major contribution of the Energy Commission to helping the GODR come to grips with the overall energy problem was the National Energy

Assessment completed in September 1980. The Assessment analyzes the energy situation of the Dominican Republic in detail, projects future energy supply and demand under different policy and economic assumptions and recommends alternative long range strategies for dealing with the problem.

The establishment of an energy information system within the Commission under the AID financed Energy Policy Development Project should further strengthen its ability to carry out its various functions.

Permanent chairmanship of the Energy Commission was recently passed from the Secretary of Industry and Commerce to the Technical Secretariat of the Presidency, a move which should increase the influence of the Commission as a whole and move the Commission staff closer to the center of government decision making.

The overall stated goal of the government in the area of energy is to reduce the dependence on imported oil while maintaining insofar as possible balanced and equitable economic growth. The government appears to recognize that any strategy for achieving this goal will have to involve both: 1) conservation -- the more rational, efficient use of available energy in industries, homes, transportation, the public utility and other sectors of the economy, and 2) development and utilization of indigenous resources such as hydropower, solar energy, wind, biomass (trees, plants, bagasse, agricultural and animal wastes), as well as lower cost imported resources such as coal. The cabinet level of the National Energy Commission has formally adopted, as the basis for development of national energy policy, a strategy recommended by the National Energy Assessment involving combined programs in energy conservation, large-scale hydro and coal utilization and development of renewable, indigenous resources.

Achieving energy conservation and substitution of other resources for imported petroleum will require major efforts on several fronts and bring the government face to face with a range of difficult issues. Some of the more important issues the government is currently dealing with in this effort are:

1. Pricing Policy. In an attempt to slow down gasoline consumption as well as defray increased costs, the government has allowed the refinery to pass on most of the price increases for imported petroleum, so that gasoline per gallon has risen from 51 cents in 1973 to $1.85 in 1979, $2.40 in 1980 and finally $2.57 in 1981. The public protests, demonstrations and general taxi cab strikes which accompanied the increases in 1979 and 1980 underscore the sensitivity of using pricing policy as an energy saving measure. Notably, the most recent increase in crude oil prices was for the first time distributed evenly among all finished products in order to keep the increase in gasoline prices to a minimum.

The Dominican Electricity Corporation (CDE) is also implementing a series of gradual rate increases (2% per month) to penalize excessive consumption and help defray some of the increased costs of fuel oil, which is purchased both from the refinery and directly from Venezuela. Even with stricter bill collecting policies being introduced, however, CDE is experiencing operating deficits of about $4 million a month. At the same time, the rate increases, together with fuel adjustment charges, have led to protests on the part of industries, shop keepers and other consumer groups, who are probably not fully aware of the reason for - and necessity of - the increases. While the protests have been fairly mild so far, they also point out the political problems associated with realistic price increases.

High fuel costs are only part of the problem affecting CDE. Another major difficulty is that about 30 percent of all electricity generated is lost during transmission and distribution, in part because of poor maintenance and in part because of unmetered tapping of lines.

2. Hydropower Investments. The government has announced a policy of increased investments in hydroelectric facilities over the next decade to take advantage of the substantial water resources of the country. Several major projects are already in the design and feasibility stage. Large amounts of financing, however, will be required to implement CDE's hydro expansion plans, on the order perhaps of $100 million per year. CDE's history of financial and managerial problems has caused some concern among potential lenders which could adversely affect the availability of significant amounts of capital if financial and administrative reforms are not carried through. The IDB, for example, recently required that CDE initiate gradual rate increases as part of the Loan Agreement for the $64 million Lopez-Angostura dam project. World Bank financing for the Rio Blanco dam has also been delayed in part due to concern of Bank officials about CDE management and financial problems.

Another concern is mismanagement of watersheds above hydro-power reservoirs. Rapid sedimentation has adversely affected existing dams and, unless major steps are taken, could affect the feasibility of future large dam projects. The FY 81 $11 million Natural Resources Loan/Grant should help this problem by developing approaches to assisting small hillside farmers to reduce soil erosion.

3. Coal. Considerable interest has developed during the past year in converting some of CDE's oil burning facilities to use of coal or coal-oil mix. Fuel oil or gas oil now accounts for about ninety percent of all Dominican electric generation and coal is not used at all. Coal, however, is currently about half the price of oil per equivalent b.t.u. value on the international market and in abundant supply. CDE has already redesigned the 125 MW plant under construction at Itabo for use of coal rather than oil and has decided to construct all future thermal generating plants for coal, rather than oil utilization. The National Energy Commission, in collaboration with CDE, contracted the Bechtel Corporation in the summer of 1980 to carry out a feasibility study for a national oil-to-coal conversion program, including

large industries as well as CDE. Based on the Bechtel Study, CDE has decided to convert its three largest thermal generating plants (Haina 3, 4 and 5) to coal utilization by 1983. Construction and conversion of coal using plants, however, will also require significant amounts of capital and will continue to imply a dependence on imported resources unless Dominican coal can be produced in quantity. Under all circumstances, the issue of coal versus other energy sources will continue to be an important one in Dominican energy policy.

4. Transportation. To conserve gasoline in the transportation sector, the government has prohibited the importation of automobiles costing over $4,000. Enforcement of this measure, however, has proved difficult and the government has recently approved a measure to restrict the importation of cars on the basis of engine size (2,400 cc) rather than invoiced value. A temporary ban on all importation of vehicles now in effect as a balance of payments measure is not expected to have any significant effect on total fuel consumption. The government has also begun to purchase minibuses and remove from circulation individually owned taxis. Commercial and inter-city transportation still represents a major problem which will have to be dealt with.

5. Mexican-Venezuelan Oil Agreement. The agreements recently signed by the GODR with Venezuela and Mexico could involve significant benefits for the Dominican Republic. Under the agreements, Mexico and Venezuela will each supply half of the oil imported by the GODR. (GODR, i.e., refinery, imports are currently about 28 million barrels per day out of a total 42 million barrels imported by private as well as public entities.) Each supplier will finance 30 percent of its sales at 4 percent over 5 years, or 2 percent over 20 years if the credit extended is used for economic development projects, particularly in the area of energy. This arrangement should relieve to some degree the balance of payments burden of oil imports, which will be beneficial as long as the objective of reduced dependence on petroleum is not lost sight of or the motivation to carry out unpopular but necessary measures is not reduced.

The first project to be financed with Venezuelan credit under the arrangement was recently approved by the GODR - upgrading of the Santo Domingo electric distribution system at a cost of $30 million.

The agreements also involve certain costs and disadvantages, particularly in terms of the lower quality crude to be supplied by Mexico. While the national refinery is now capable of processing the heavier Mexican crude (after initial modifications costing about $600,000), the end products will be somewhat "heavier" than in the case of Venezuelan crude, with the result that the country will probably have to import more lighter products such as gasoline and LPG.

The option of expanding the refinery, including an upgrading of technical capacity to process Mexican crude more efficiently, could cost as much as $80 million and would take a minimum of 18 months. Such an expansion

is no longer under serious consideration, in part because the Ven-Mex Agreement assures only as much crude as the refinery is currently importing.

6. Development of Indigenous Resources. Local resources such as small scale hydro, solar energy, wind and biomass are recognized as having significant potential for helping with the energy problem. Although renewable resources are not now utilized on a significant scale, with the exception, of course, of firewood and charcoal, some preliminary steps have been taken toward their development. Several private manufacturers, for example, have begun to market low cost solar water heaters and the Energy Commission and National Housing Bank are developing a program to prohibit mortgage financing for houses with electric water heaters to encourage adoption of solar heaters. The State Sugar Council has just completed a voluminous study on the possibility of producing alcohol rather than sugar from state owned sugar lands. Further movement by the Sugar Council in the direction of alcohol production, however, will depend in large part upon what happens to sugar prices during the coming years.

One of the obstacles to wider utilization of local energy resources is lack of knowledge or uncertainty about the economic, technical and social feasibility of renewable energy technologies, specifically in a Dominican setting. For this reason, it appears that pilot programs to test and demonstrate the feasibility of renewable technologies will be necessary. The National Energy Commission has recognized this and has already done considerable groundwork, in collaboration with other government and private institutions, for pilot programs in areas such as mini-hydro development, wood-fuel production, biogas, solar and wind. Each of these energy sources has potential for meeting a substantial portion of the increase in national energy consumption expected over the next decade and also for increasing the availability of affordable energy to rural areas.

C. USAID Energy Assistance Strategy

The goal of the Mission's energy assistance strategy continues to be to help the GODR reduce the nation's dependence on imported petroleum and increase the availability of affordable energy to all Dominicans. We believe this goal can best be achieved by supporting the government's efforts in national energy planning and to encourage energy conservation and development and utilization of indigenous and alternative energy resources.

It is recognized that certain aspects of the energy problem can be dealt with only through large scale capital financing, for example, the construction of major conventional power generating facilities. One objective of AID assistance is to encourage and facilitate financing of this nature by the World Bank, IDB and private sources. We do not, however, intend to devote resources directly to conventional power generation.

USAID strategy, in contrast, focuses on activities which are relatively low cost and appear to have potential for significant pay-off. The principal areas of AID activity include:

i) Assisting GODR capacity to assess current and projected energy problems;

ii) Improving the GODR's institutional capacity to plan and implement energy policies and programs;

iii) Support for specific programs with significant potential for energy conservation and for alternative energy production and utilization.

We believe that AID has a unique capability to achieve results in each of these areas - a kind of comparative advantage - because of the innovative, and in some cases experimental nature of the activities involved. AID, for example, has already taken a leading role in helping the GODR to plan its response to the energy problem through the National Energy Assessment and Energy Policy Development Projects and has financed experimental research and development in energy farms and solar bagasse drying. This is not to say that limited capital investments by AID will not be undertaken if they are deemed appropriate. Indeed, limited investments in mini-hydro facilities and industrial conservation equipment are proposed in this project for the purpose of encouraging wider scale efforts in these areas (see Project Description).

Overall, the guiding objective in USAID energy assistance strategy is the potential for a significant contribution to conservation or non-petroleum resource utilization, whether in the near, medium or long term. Projects financed thus far by AID have been selected with this overall objective in mind, as have the activities proposed for financing under this project.

Energy projects undertaken thus far include:

1. National Energy Assessment Project (FY 80 - $250,000)

The National Energy Assessment project completed in the fall of 1980 provides a comprehensive statistical picture of current and projected energy supply and demand in the Dominican Republic. The Final Report of the Assessment identifies major energy problem areas, presents a range of broad strategies for dealing with the problems and recommends specific areas of activity over the near, medium and long term. The Assessment Report has been reviewed carefully by the GODR and the strategy involving combined programs in energy conservation and development and utilization of renewable resources, as well as coal, has been adopted by a cabinet level meeting of the National Energy Commission as the basis for development of national energy policy. Overall, the Assessment provides the basic framework within which national energy strategies can be now identified and initiated. It represents a major step forward in comprehending and dealing with the energy problem in the Dominican Republic.

2. Energy Policy Development (FY 80 - $1,024,000)

This project follows up the Energy Assessment by establishing a computerized Energy Information System to provide Dominican decision makers with continuous, updated data necessary for developing sound energy policy. It also involves training and technical assistance to upgrade the management and technical skills of public and private agencies involved in the implementation of energy programs. An important objective of the project is the development of a capability to produce National Energy Plans.

3. Solar Bagasse Drying (FY 79 - $475,000)

The purpose of this project is to design and install on a pilot basis a solar facility for pre-drying bagasse and increasing the efficiency with which it is burned in sugar mills. Since bagasse represents about 19 percent of all energy consumed in the country, its more efficient utilization for both boiler operation and electricity production should result in significant energy and economic benefits. The first phase of this project -- feasibility study and preliminary design -- is complete and construction of a pilot facility is now being carried out under the second phase of the project. Stimulated by the potential benefits of the project, the State Sugar Council and the Dominican Electricity Corporation are now discussing the possibility of installing large electric generating units in or adjacent to sugar mills which would be powered exclusively by bagasse.

4. Energy Farm Study (FY 79 - $30,000)

The study, viewed as a first step toward development of an energy farm program, assesses the potential for fast growing trees in the Dominican Republic to be used for both charcoal and electricity generation, and presents a preliminary design for an energy farm producing 5-50 MW of electricity. The study has been used by the Energy Commission and the Superior Agricultural Institute (ISA) in development of the wood fuel research program currently proposed for AID financing.

5. Hurricane Reconstruction (FY 80 - $7,080,000)

In addition to the above projects which fall within AID's energy assistance program, the Mission has also financed three hurricane reconstruction projects totaling $7.1 million for repair of electric transmission lines and distribution systems destroyed by Hurricane David. The projects have played an important role in the effort to restore electric power to both rural and urban areas of the country.

D. Other Donor Activities

Because of the large amounts of capital needed to deal effectively with the energy problem in the Dominican Republic, the role of other donor organizations such as the World Bank and the IDB is a very important one. USAID/DR has coordinated closely with representatives of the World Bank and IDB

about their on-going and planned energy programs. We have developed our energy programs, including this project, in part to encourage and facilitate large scale financing on the part of other donors by upgrading planning and institutional capabilities in the government and by undertaking pilot activities to demonstrate the feasibility of energy resources which could be utilized on a broad scale.

The financing of other major donors in the energy area is generally concentrated on large infrastructure related projects. The World Bank, for example, is considering a $90 million loan package for construction of a 25 MW hydro electric facility at Río Blanco and for upgrading the Santo Domingo electric system. As part of the loan, the Bank is also considering a study of the legal and institutional framework for the electric power sector as well as possible technical assistance to CDE.

The Inter-American Development Bank (IDB) recently approved financing for a $64 million hydro-electric and water regulating facility at Lopez-Angostura with a capacity of 18 MW. The project will be completed in 1985. The IDB is also implementing two experimental activities in solar energy. The first involves a feasibility study for a solar pond in the western part of the country. The pond, which would eventually have an installed capacity of 5 MW, would also be constructed by IDB under a future project if feasible. The second activity involves a small grant to INDOTEC for the research and demonstration of solar applications such as solar drying, solar distillation, solar hot water heaters, solar cookers and solar power.

The IDB has also provided a recent grant of $550,000 to the National Transportation Office for study of improvements in the transportation sector, including better energy efficiency in intra and inter city public and commercial transportation. The IDB study appears to obviate the need for AID assistance in this area.

Beyond the projects mentioned above, neither the World Bank nor IDB is planning additional funding for energy projects in FY 82. The World Bank is considering for possible future financing an expansion of the Haina port facilities for handling of imported coal and upgrading the Santo Domingo electric distribution system. Future involvement of the World Bank in the electric sector, however, is predicated upon improved performance of CDE (see CDE Technical Assistance Program below).

The IDB is considering a possible loan to CDE in FY 83 for mini-hydro development and future financing for large scale hydro-electric facilities.

The governments of the Republic of China, France and West Germany are each providing limited technical assistance to CDE in specialized areas, such as planning and hydro design.

The government of West Germany has helped repair some of the damage to CDE's hydro-electric facilities caused by Hurricane David. The Ebert

Foundation of West Germany has also undertaken studies for a combined alcohol producing/electric generating plant in Barahona and several other projects to utilize agricultural wastes, which are now being evaluated by the German government for possible financing.

The United Nations has recently financed a study of energy use throughout the sugar industry. Japan is assisting CDE in design work for upgrading the electric distribution system of Santo Domingo.

The Canadian International Development Agency and Apropriate Technology International (ATI) are each financing limited activities in micro hydro development.

The Organization of American States (OAS) has financed a series of mini courses for government personnel in energy project evaluation. The courses were conducted at the Energy Commission.

The Latin American Energy Organization (OLADE) is continuing a study of geothermal potential, and has assisted in preliminary experiments in biogas at the Superior Agricultural Institute (ISA).

The Mission's energy assistance program is being developed in such a way as to avoid duplication with, and wherever practical, to complement these on-going and planned activities of other donors.

II. PROJECT DESCRIPTION

A. Goal, Purpose, Outputs, Inputs

The goal of the Project is to help reduce the dependence of the Dominican Republic on imported petroleum and to increase the availability of affordable energy to all income groups in the country. The subgoal of the Project is to develop the institutional and policy base necessary for achieving energy conservation and non-petroleum resource utilization on a wide scale.

The purposes of the project are to 1) develop a comprehensive national energy investment plan, 2) initiate a continuing program of industrial energy conservation, 3) develop the institutional capacity to exploit small scale hydro and wood fuels as alternative sources of energy, and 4) upgrade the management and planning capabilities of the Dominican Electricity Corporation.

The outputs of the project are:

1) a National Energy Investment Plan and improved capability in the GODR to develop, revise and update national energy plans;

2) establishment of an institutional capability in industrial energy conservation to carry out energy audits, recommend appropriate conservation measures, assist industries in the implementation of those recommendations, and encourage a broader effort on the part of the private sector in industrial conservation;

3) five pilot projects in industrial conservation to demonstrate the feasibility of energy saving measures which could be replicated on a large scale;

4) a credit mechanism established for assisting industries of all sizes in financing energy conservation measures;

5) establishment of a mini-hydro institutional capability to identify and analyze potential mini-hydro sites, supervise the construction/installation of mini-hydro facilities, and assist benefited communities in the operation and maintenance of installed mini-hydro and electric grid systems - in effect, to promote mini-hydro development on a broad scale;

6) 3-4 mini hydro pilot projects of different sizes to test and demonstrate the economic, social and technical feasibility of mini-hydro utilization in a rural Dominican setting and help develop the institutional capability described above;

7) a wood fuel research program to determine the most appropriate tree species for energy purposes in the Dominican Republic and the most efficient technologies for converting wood to different energy end uses; and

8) initiation of a program of technical assistance to the Dominican Electricity Corporation to upgrade management and planning capabilities.

The inputs of the project include:

By project component:

		($ 000) AID	GODR	TOTAL
1.	National Energy Planning	250	50	300
2.	Industrial Conservation Program	8,584	4,852	13,436
3.	Mini-Hydro Development Program	3,800	868	4,668
4.	Wood Fuel Development Program	1,598	470	2,068
5.	CDE Technical Assistance Program	700	50	750
6.	Project Administration and Evaluation	1,000	-	1,000
	TOTAL	15,932	6,290	22,222

By nature of input:

1.	Technical Assistance	3,114	-	3,114
2.	Materials/Equipment	4,685	475	5,160
3.	Financial Programs	5,000	4,000	9,000
4.	Local Personnel	220	1,815	2,035
5.	Project Administration and Evaluation	1,000	-	1,000
6.	Inflation and Contingency	1,913	-	1,913
	TOTAL	15,932	6,290	22,222

AID will provide $10,818,000 in loan funds and $5,114,000 in grant funds to the project.

The project will be implemented over five years.

B. Project Strategy

The specific activities proposed for financing in this project represent a carefully considered, diversified approach to dealing with key aspects of the energy problem in the Dominican Republic. After careful observation of the energy situation here for two years, including close consultation with other donors and Dominican agencies, the Mission has concluded that there are a number of key activities which need to be initiated now if the situation is to improve over the medium and longer term. These activities are considered to be important "next steps," within the context of the current situation here, toward more efficient energy planning, broad scale conservation and development of alternative energy resources. These activities are priority recommendations of the National Energy Assessment which are not being considered for financing by other donor organizations and for which the GODR needs outside expertise and financial assistance.

In selecting the specific activities proposed, the Mission has undertaken, with outside consultant assistance, a careful analysis of the economic and other benefits of a broad range of possible interventions in the energy area based upon recommendations of the National Energy Assessment. The entire range of Assessment recommendations was initially considered, but certain recommendations were dismissed as being inappropriate for AID financing because of the large sums of money required (major hydroelectric installations, financing of major conversions from oil to coal fired energy generation, etc.). Other recommendations were considered inappropriate for AID financing because of relatively limited long term impact or because AID procurement regulations would preclude financing of preferred equipment (such as large numbers of minibuses to improve energy consumption efficiency in urban transport).

Over twenty possible AID project activities have been evaluated according to a set of criteria, including number of barrels of oil saved annually by 1990 and 2000, value of total energy imports saved, internal rate of return, employment created, environmental impacts, etc. The activities selected for financing under this project are those which have demonstrated the highest potential benefits over time according to the above criteria. Furthermore, the economic analysis has demonstrated that the magnitude of potential overall benefits from relatively small but timely AID investments can be very substantial. For example, a relatively small investment now in national energy planning could, by identifying the relative costs, benefits and financial attractiveness of alternative investments, lead to more rapid and efficient energy investments and save an estimated $100 million annually in imported oil by 1990. (See Annex G.1 for details on potential benefits of proposed AID activities.)

The project which has emerged is heavily oriented toward institutional development and initiation of key activities in energy conservation and non-petroleum resource development. At all times it has been assumed that larger resources for energy than those available to AID will be forthcoming from other donor organizations. This project lays the

institutional basis and initiates key activities which other donors can follow up with larger resources in the near future.

The project also recognizes the important role the private sector will have to play in bringing about energy conservation and alternative resource development on a significant scale. The project has been designed to encourage and support private sector efforts in areas such as industrial conservation, mini-hydro development and wood fuel utilization.

The long-term training component for $2 million presented and approved in the PID has been deleted from the project as presented here. Long term training was to be incorporated in the project based upon a detailed study of energy training needs and training opportunities to be conducted during intensive review. The work was contracted to a U.S. firm which, after various delays, was unable to produce an acceptable report within the contract time period. Nor was it anticipated that their final report, even with several more months of effort, could be relied upon as a basis for a substantial training component. he Mission, therefore, has decided to delete the long term training component from this project, recontract the work and add an energy training component to the proposed agricultural training project which is being developed for possible financing later in this fiscal year. It should be pointed out that both long and short term training considered essential to the implementation of the different project components proposed is included and budgeted for in those different components.

Finally, it should be emphasized that this project is being developed within the context of USAID's overall energy assistance program and that much of the groundwork for the project has already been laid by previous projects. It is proposed that the project be channelled through and coordinated by the National Energy Commission, in order to support and strengthen the important overall coordinating role of the Commission in the energy area. Some of the components of the project, such as Investment Planning, Industrial Conservation and the Wood Fuel Program, will be implemented directly by the Energy Commission staff, whereas other project components will be implemented by other agencies with the assistance of the Commission staff. In all cases, the implementing institutions are members of the National Energy Commission.

C. Project Activities

1. National Energy Investment Planning ($250,000)

The National Energy Assessment presents a range of broad energy strategies which could be followed over the next decade and makes recommendations regarding possible areas of investment which warrant more detailed consideration. The Energy Policy Development Project now underway is collecting and assembling additional information on energy supply and end use patterns as part of a computer based energy information system. This will be a valuable tool in helping the GODR to explore the effects of alternative energy strategies on its future energy supply/demand situation. The next step

in the national energy planning effort is development of a national energy investment and price planning capability which will serve as a means for evaluating specific investments by the government, private and international institutions in the energy sector.

In addition to the Energy Assessment, several attempts have been made to establish a framework for long term investments in energy. CDE, for example, has had a French engineering firm (SOFRELEC) prepare an "expansion plan" for the electric sector which matches generating capacity with projected increases in demand until the year 1992. The plan calls for a major shift in electricity generation away from petroleum to coal and large scale hydro resources. Falconbridge Dominicana, which operates a large nickel mine in the Dominican Republic, has also prepared a plan for expanding the electric sector while shifting away from use of imported petroleum. The plans developed to date, however, are not in any sense comprehensive national energy investment plans. They tend to limit their scope to a single sector of the energy supply-demand picture such as electricity production. This narrow focus disregards other important areas of investment such as energy conservation and non-electricity energy usage in transportation, industries, and agriculture, as well as the macro-economic impacts of energy investments. (Public electricity generation, for example, currently accounts for less than 20 percent of all energy consumed in the Dominican Republic.) Because of the large capital investments involved, the SOFRELEC and Falconbridge plans are undergoing considerable debate and revision. As a result, the basis on which to form a consensus for multi-year energy investments has yet to be achieved.

The limited access of the Dominican Republic to investment capital, makes it imperative that only the most cost effective energy investments be financed over the next decade. The relative benefits, costs, timing of capital requirements, and feasibility of alternative investments plans should be carefully evaluated to determine, for example, whether a $30 million investment in a centralized coal fired electric plant makes more overall sense, both in energy and economic terms, than an equal investment in small scale hydro development or in a more efficient public transportation system.

Other donor organizations have also recognized the need for careful evaluation of alternative energy investments and development of comprehensive energy investment plans. The World Bank, for example, has requested a CDE commitment to a seven year investment program, based on the SOFRELEC study, as a condition for the Rio Blanco loan. The Bank is clearly more interested in financing the first piece of multi-year expansion program than an isolated dam project. The idea of A.I.D. support for national energy investment planning has been discussed with both the World Bank and IDB and is look upon favorably by both institutions.

This project proposes to finance technical assistance to the National Energy Commission for a period of up to 12 months for development of a national energy investment planning capability. Technical assistance to commence the energy planning effort was recently contracted by the Energy

Commission with LAC Regional funds ($72,560). This project will finance a continuation and conclusion of this effort.

Specifically, the Commission will be assisted in evaluating alternative investments in energy conservation, resource development, and centralized and descentralized electricity generation on the basis of economic, social and technical criteria. Priorities among all investments over a 10 year period will be established and for each recommended investment an annual schedule of foreign and domestic capital requirements will be developed. Preliminary financial analyses for recommended investments will also be included as a first step for facilitating discussions with potential private and public funding sources. Finally, recommendations will be made by the Commission regarding specific changes in GODR fuel-pricing and rate structure policies to ensure maximum efficiency of investments undertaken. By the end of the technical assistance effort it is expected that the Commission will have developed a proposed energy investment plan for consideration by the GODR as well as the capability to carry on investment planning efforts on a continuing basis.

The proposed investment plan for the period 1981-1990 will be presented in a comprehensive report prepared by the Energy Commission staff and followed up by a cabinet level workshop of the Energy Commission. The report will include:

- A comprehensive set of recommended time-phased energy investments and realistic sources of financing for such investments;
- A master schedule showing the time-phasing of project commitments, project startup and operations, and associated funds flows;
- Recommendations regarding government pricing and other policies necessary to support the national energy investment plan;
- Analysis of the likely effect, over time, of the national energy investment plan -- including both the investment projects themselves and the supporting capital financing program and energy pricing measures and other government policies -- on national energy balances, energy imports, and projected macroeconomic aggregates (balance of payments on current account, level of servicing costs of external debts, etc.).

The proposed plan will serve as the basis from which to proceed with development of multi-year donor assistance programs as well as with initiation of specific energy pricing policy and investment actions. It is expected that the plan will also help to achieve a consensus within the government on energy investment activity and serve as a guideline for budget allocations to different implementing institutions.

By specifying the benefits of specific investments, including preliminary financial analysis, and by placing individual investments within the context of a rational, multi-year-program, it is expected that national investment plans will attract financing from the World Bank, IDB and private sources which otherwise would not be forthcoming. This additional financing is estimated at $138 million over 10 years which together with higher efficiency of non-additional investments, could result in $101 million of imported oil saved annually by 1990. The direct and indirect employment which could be generated by improved investment planning is estimated at 23,000 by 1990. (See Annex G.1 for details.) These are substantial potential benefits at a relatively small cost.

The Energy Commission is the appropriate institution for developing national investment plans not only because this is what it has been tasked to do by mandate, but also because it is in a position to look at the entire energy situation, not just at certain sectors, and can assess objectively the relative value to the nation as a whole of a full range of alternative investments. The Energy Information System now being established in the Commission will be a valuable tool in the analysis required for development of investment plans. Data collection and processing efforts under the System are now underway, 2 Commission staff persons have been trained in operation of the AL-EDIS computer program upon which the system is based, and the mini computer and associated computer hardware will have been fully installed in the Commission by the end of December, 1981.

Of course, for comprehensive energy investment planning to be useful, there will have to be broad consensus among different government agencies regarding its purpose and overall utility. It must not be viewed by individual agencies as an attempt to undercut their individual planning efforts. USAID has discussed the idea of energy investment planning extensively with Energy Commission staff and also with the heads of CDE, the National Planning Office, the Secretariat of Industry and Commerce and the Technical Secretariat of the Presidency, and it has generally met with favorable reactions. Placement of the Energy Commission under the Technical Secretary of the Presidency, who has responsibility for overall national budgeting and investment decisions, will increase the Commission's ability to assure that key institutions participate in the energy planning process and that plans developed are indeed utilized by individual institutions in their investment activities.

To assist the Commission in developing an energy investment planning capability and proposed national investment plan, approximately 25 person months of technical assistance in economics, financial analysis and technical areas will be required over a 9-12 month period, in addition to that already contracted with LAC Regional funds. The cost of additional technical assistance required is estimated at $250,000.

2. Industrial Energy Conservation Program ($13,436,000)

2.a. Introduction

In the area of energy conservation, this project will focus on the sector of the economy which consumes almost 40 percent of all energy in the country - industry. There is at present no systematic program of industrial conservation underway in the Dominican Republic. Of course, with the cost of fuels and electricity continuing to rise, the economic incentive for individual industries to save energy is increasing. The fact that very little has actually been done in the way of industrial conservation, however, can probably be attributed to the following principal constraints: lack of awareness in industries about appropriate energy conservation techniques and available technologies; reluctance to assume the cost and risk of introducing new technologies; and lack or inaccessability of credit for financing conservation measures. In short, before industries can begin to conserve energy effectively, they will need assistance in identifying ways in which energy is currently used and wasted, in understanding how wastage can be reduced, and in implementing and financing specific conservation measures.

This project will initiate a continuing program in industrial conservation aimed at the above constraints. In general, the project will support government efforts, through the National Energy Commission, to conduct energy analyses of Dominican industries, to identify opportunities for increasing energy efficiency in the industrial sector, to provide direct assistance to industries for this purpose, and to encourage a broader based effort on the part of the private sector in industrial conservation. Specifically, the industrial conservation program includes the following five activities:

(1) Energy audits of industrial establishments:
The Energy Commission staff will carry out a limited number of audits of plants in an effort to encourage a broader effort in energy audits on the part of industries. These will range from 2 or 3 day "short" audits to "extended" audits taking a month or more for the most complex plants. Training in audit techniques and the use of portable instruments is covered in the program.

(2) Assistance to industries in development of conservation programs:
In order to implement the findings of audits, conservation programs for individual plants will have to be developed. These programs will range from simple "housekeeping" to major capital investments.

(3) Promotional and training activities:
The maximum benefit with respect to the national energy balance can only be obtained through the extension of audits and conservation throughout the industrial sector. The widespread dissemination of the techniques applied and results obtained in activities 1 and 2 of the program is, therefore, viewed as essential to the success of the overall program. For this reason, a significant promotional effort on the part of the Commission is included in the program. The effort will include establishment of Energy Coordinators in industries, training of private sector individuals in audit techniques and specific conservation measures, and setting up of a technical information center through which plants and individuals can obtain advice and assistance on industrial energy matters.

(4) Demostrations through pilot projects:
In order to demonstrate the technical and economic benefits of conservation measures, it is proposed to conduct a limited number of pilot projects in operating plants. These demonstrations will serve to illustrate the potential benefits of such measures within the Dominican industrial context, and are expented to lead to the broader introduction of proven measures throughout Dominican industry.

(5) Financial assistance:

One of the major aims of the industrial conservation program is to encourage Dominican plants to undertake audits and develop capital investment plans for the installation of energy-efficient equipment and processes. Financial assistance will be provided to industries up to a certain amount for carrying out audits. Audits and pilot projects, and associated promotional activities, are in turn expected to result in a need for credit for minor and major investments. An industrial Conservation Credit Fund will be established in the Central Bank for this purpose.

These activities are described in more detail in section 2.b.

It should be emphasized at the outset that the proposed program envisions an essential role for the private sector in achievement of large scale energy savings in industry. Government activities to be supported under this program are designed less to achieve conservation directly than to encourage and facilitate efforts on the part of individual industries and of

private firms in assisting industries to carry out conservation measures. The Energy Commission is considered the most appropriate government institutions for taking the lead in this outreach effort to the private sector. It has an Industrial Conservation Department with a capable staff of six professionals (to be expanded under the program) and has recently completed a brief survey of energy consumption in 100 industries. While other institutions such as INDOTEC will provide support to the Commission in implementing the program, no other government agency appears to be as capable or willing to take the lead in promoting industrial conservation. Through detailed data gathering and analysis of individual industries, this program should also contribute to the overall capability of the Commission in national energy planning.

In an environment of limited human and financial resources, it is not practical to define a program which can cover all industries, at least at the outset. It has been decided, therefore, not to direct this program initialy towards the sugar industry, mining, the oil refinery and CDE, which are clearly important energy consumers but are considered cases involving special circumstances not apprpriate to this program.

The state sugar industry, for example, is already the subject of considerable outside assistance, including technical assistance from Cuba and a proposed financial program from the World Bank. Energy efficiency, including such items as bagasse drying, is already being studied. The private sugar plants are operated by major companies (e.g. Gulf & Western) which should have adequate financial resources and access to technical expertise.

Mining operations are similarly dominated by major multinationals (e.g. Falconbridge and Alcoa) which can call on resources far greater than those of this program. The oil refinery can call upon the resources of the international Shell group.

CDE is in a different category. A review of its operations has already established that there is significant potential for energy efficiency improvements. However, other major programs to improve CDE's performance are being developed already. (See CDE Technical Assistance Program later in this PP.) These programs will address a broad range of CDE problems and are not limited to energy efficiency. It is judged that this energy conservation program should not include CDE until satisfactory progress is achieved by the other CDE programs.

In summary, this program is directed towards the building materials (including cement), food/beverage, glass, paper, textiles, chemicals, iron and steel and miscellaneous small to medium <u>manufacturing</u> industries. Both private and state owned industries are included.

Based on the experience of a number of other countries, it is safe to conclude that for these industries in the Dominican Republic there exists a realistic potential energy savings of about 20 percent. Approximately half this potential savings should be achievable through <u>housekeeping measures</u> - improvement in the operating efficiency of existing

processes and equipment which result in little or no capital investment and can be effective in the very short term. The other half of potential savings should be achievable through both minor capital investments - relatively simple modifications to plant or equipment, such as improving insulation of pipes and tanks and installing additional instrumentation for better process control, and major capital investments - substantial replacement or modification of plant (e.g. boilers) with the latest energy efficient technologies which give savings in the medium to long term. The industries covered under this program are therefore estimated to have an "ultimate" potential savings of around 715 kboe/year (20% of the 1978 consumption). Assuming that 90% of the potential savings are of petroleum products, this represents a foreign exchange saving of around $22 million per year at the current international crude oil price of $35/barrel.

The foregoing should not be interpreted as claiming that this conservation program alone will achieve a savings of $22 million/year. A much larger national effort extending for an indefinite period is required if this is to be approached. For example, the industrial sector consists of around 1,500 separate establishments. This program will at best be able to carry out in depth analyses of the energy situation at about fifty establishments. However, the program is designed to initiate systematic energy conservation activities by the Dominican Government and to provide the impetus for self-help activities by industries and increasing private sector services to industry. Indeed, as this program will result in direct help to only a small percentage of manufacturing establishments, the future involvement of the private sector will be essential if most of the potential savings are to be achieved.

2.b Program Activities

2. b. 1. Energy Audits

Purpose and Scope of Energy Audits

At the individual industry level, an effective energy conservation program has to be related to a numerical target or objective. To define company and plant targets for the reduction of waste or the improvement of energy efficiency, each plant needs to know exactly what energy it uses and how. Such a procedure is provided by an energy audit, which includes:

(1) monitoring the type and quantity of fuels and electricity consumed;
(2) relating energy consupmtions and costs to the output of the plant;
(3) identifying the activities and major processing stages where energy is used;
(4) identifying the activities where energy savings can be effected.

The purpose of the energy audits to be initiated by the industrial conservation program is thus to provide plants with accurate means of recording energy consumption and costs and identifying real opportunities for energy savings, and to provide the Energy Commission with comprehensive and accurate data appropriate for national energy planning activities.

An initial "short audit" for a plant will probably take about 2-3 days on average, depending on the complexity of the plant and the availability (and accuracy) of data on existing operations. This kind of brief audit cannot be very sophisticated, but is most useful in revealing inadequacies in metering and measurement. Obvious examples of waste, such as steam and fluid leaks, and a lack of insulation, will be found in the course of even the most elementary check of a plant. Such deficiencies should be attended to at once, as a few quick results serve as an encouragement to further action, and will demonstrate to even the most skeptical plant management the value of audit work. The aim of the brief initial audit is to obtain data and energy savings quickly. It must be accepted that data forms, and procedures, may have to be redesigned several times to best suit the needs of a specific plant.

A more comprehensive "extended audit" usually follows the first brief audit. Depending on the nature and complexity of the plant, an extended audit can take from several weeks to several months to complete. It will include a detailed examination of energy and material balances for specific plant activities and equipment. Whenever possible, checks of plant operations are carried out over extended periods of time, at night and at weekends, as well as during normal daytime working hours, to ensure that nothing is overlooked. An audit report is prepared which includes a description of energy inputs and product outputs by major activity or processing function, and which evaluates the efficiency of each step of the manufacturing process. Means of improving these efficiencies will be listed, and at least a preliminary assessment of the cost of the improvements will be made to indicate the expected payback on any capital investment needed. The audit report should conclude with specific recommendations for detailed engineering studies and feasibility analyses, which must then be performed to justify the implementation of those conservation measures that require investments.

Selection of Plants for Audits

Much useful work on data collection has already been accomplished by the staff of the Energy Commission. Brief surveys of 100 plants were conducted at the end of 1980, and the analysis of results is already complete. The surveys concentrated on obtaining energy consumption and production data. The audit work to be conducted within this program will build upon the excellent start made by the Commission and will extend the data collection aspect to include review of plant operating practices and efficiency. Where necessary, portable instruments will be used to assess the operating performance.

Under the program, it is proposed that about 50 plants be studied, some for short audits only, some for extended audits of up to one or two months duration. The criteria for selecting plants to be audited are:

(1) the plant is similar to many other plants in the industrial sector, and therefore its energy consumption pattern is likely to be representative of many others of its kind, and conservation measures/programs may be replicated widely (e.g. bakeries);

(2) the plant itself consumes a significant amount of energy (especially oil-based fuels);

(3) the plant includes one or more unit operations which occur widely in the industrial sector, offering the opportunity for replication, as well as for training engineers in widely applicable techniques.

The final selection of plants to be audited should be made of course by the Commission. Both state owned (CORDE) plants and private plants will be considered. While auditing of CORDE plants may present some political problems in some cases, and require that the Commission proceed with some caution, both the Mission and the Commission believe that as many state owned plants should be audited as possible. The government, after all, should be expected to demonstrate that it is indeed serious about industrial conservation.

Training in Audit Techniques

To be able to carry out energy audits effectively, Energy Commission staff will require a good deal of training. The Energy Commission is already committed to increasing the staff of its Industrial Conservation Departament from 6 professionals to 15. By the end of the project it is expected that 10 commission engineers will be fully trained in audit techniques. Training will be provided through a combination of classroom lectures, practical on-the-job training in the performance of actual energy audits and special overseas training.

The topics for the classroom lectures will include:

(1) Energy consumption patterns in the Dominican industrial sector;
(2) Energy audits - what they are, data forms, conversion factors, etc.;
(3) Basic unit operations - combustion principles, calculation of efficiencies, heat transfer, heat recovery, drying, evaporation, distillation, boiler operation, water treatment, steam systems, control of electrical demand, combined heat and power systems (cogeneration);
(4) Industrial lighting;

(5) Space conditioning of industrial buildings and offices;
(6) Generally-applicable conservation measures;
(7) Measures applicable to specific industries;
(8) Company and plant conservation programs - how to set up, energy efficiency monitoring, development of targets for efficiency improvement;
(9) Economics of energy conservation, oil prices, electricity tariffs; and
(10) Practical aspects of plant audits, use of portable instruments.

Classroom lectures will continue for the first four years of the proposed program. It is anticipated that two "cycles" of lectures will be given each year, enabling a total of about 8 to 10 engineers to receive this training annually. Initially, it is recommended that participants be exclusively from the Commission, but that "outside" participants be accepted in subsequent years from such institutions as INDOTEC, CDE, CEA, and the private sector. In this way, priority will be given to building the resources of the Commission but due recognition will be given to the need to broaden the base of qualified audit engineers available to serve the entire Dominican industrial sector, both public and private.

Practical on-the-job training will be carried out under the short and extended audit programs described below.

It is also proposed that Commission engineers receive special training in audit work outside the Dominican Republic. Groups of 2-4 engineers at a time will be assigned to work within audit teams engaged in energy conservation work in the United States or elsewhere. In the course of a two months assignment, Commission engineers would be expected to participate fully, as working team members, in comprehensive audit projects for commercial clients including development of practical and economic recommendations for plant improvement. A maximum of ten Commission engineers would receive training abroad. This practical experience in audit techniques, including cost-benefits analyses, and exposure to a variety of industrial plants in other countries, is recommended as an essential complement to their on-the-job training in the Dominican Republic itself.

To help upgrade the capability of local universities to train Dominicans in audit techniques in the future, up to 6 faculty members from the engineering departments of UCMM in Santiago and UNPHU in Santo Domingo will be included in both the in country training courses and the on-the-job training abroad.

Short Audit Program

In the first year of the program, it is proposed that up to 10 short audits be performed by Commission engineers in conjuction with foreign experts.

These short audits will serve several functions:

(1) as training exercises for CNPE staff in audit techniques and the use of portable diagnostic instruments;
(2) as a means of obtaining accurate energy-related data for the plants examined;
(3) as a means of identifying appropriate plants for extended audits;
(4) as a means of identifying opportunities for pilot projects to demonstrate conservation technologies.

In subsequent years of the program, it is anticipated that Commission staff will carry out up to 15 short audits each year, for a total of approximately 50 over 4 years, assisted to a lesser and lesser extent by foreign experts as their own expertise and confidence improves. It is important, however, to ensure that the quality of work at all times remains high, in order to foster the credibility of the program and of the Commission as a responsible organization in the field of audits.

The short audits will consist of visits by teams of engineers, approximately four from the Commission and two instructors (industry/audit specialists). Questionnaires and proposed work plans will be sent to selected plants in advance, and the teams will subsequently spend up to 3 days on site, collecting data and examining the manufacturing plant. A further 3 days will be required for data analysis and one or two days allowed for a return visit to the plant to discuss the audit findings with plant personnel.

The information to be collected during the short audits is detailed in Annex G.2. The precise form of data collection will depend on the size of the plant, its functions and its complexity. Appropriate questionnaires will be developed as part of the program.

The portable instruments to be used in the training of Commission engineers and in all subsequent audit work is also detailed in Annex E.2.

In order to transport the complete sets of instruments from plant to plant, it is proposed that each team of three or four engineers be provided with a small van or minibus, with special storage space for instruments and supplies. The audit team can then be a self-sufficient unit, capable of operating in plants whose own instrumentation may be deficient to the extent of being virtually non-existing, as is all too often the case.

Extended Audit Program

As a further stage in the training of Commission personnel, and in order to identify and evaluate real oportunities for energy savings in plants, it is proposed that two extended audits be performed in the first year of the program and a total of about 10-12 extended audits during the first four years of the program. It is recommended that one large plant

and one small plant should be selected to serve as models for the extended audit procedures in the first year. The two plants to be covered by extended audits in the first year will be selected following the completion of the short audits mentioned above.

Large plants (e.g. a glass factory) are expected to require about 4-6 weeks on site by a team of up to four Commission engineers accompanied by three process/audit experts, followed by 4 weeks of data analysis and report writing, and up to one week for review with plant personnel.

Smaller plants (e.g. fruit and vegetable canning) are expected to require about 2 weeks on site, followed by 2 weeks for data analysis and report writing, and up to one week for review with plant personnel.

The participation of foreign experts in the extended audits is expected to remain necessary throughout the first four years of the program, but the level of their participation will be gradually reduced as Commission staff become better able to work independently.

Audit Reports

An important element of any industrial energy conservation program is the communication of techniques and achievements throughout the industrial sector. Preparation of comprehensive reports on the brief and extended audits is therefore included as a specific task in the program. Obviously, care will have to be taken to exclude sensitive confidential data from published reports. The Program Advisor (see Technical Assistance below) will help the Commission to establish guidelines on what information should be made public and what should remain confidential.

The plants themselves must, of course, receive full reports directly from the audit teams, and preparation of these reports is included within the tasks described above.

In addition, there are at least two "types" of report which can be produced for widespread distribution outside the plants actually subjected to audit:

(1) General reports of the short audits, which seek to present a picture of the aggregated energy consumption patterns in specified industries (cement, textiles, chemicals, etc.). These reports can also present the "energy efficiencies" of the plants audited, so that similar plants will be able to compare their own performance. A list of energy saving opportunities applicable to the plants can also be provided as a guide for other plants.

(2) Specific reports on the extended audits, which serve as models of audit procedures. These will include details of energy consumption, and should examine the manufacturing processes used in the particular plant. The potential for energy savings should be reviewed in detail, and needs for further research, development or demonstrations should be identified.

The general reports should be prepared at least annually, and can be up-dated regularly to provide industry-wide aggregated statistics. These reports should aim to act as a stimulus to the industrial sector to conserve energy. The specific reports will be prepared following the completion of each extended audit, and should aim to be as comprehensive technically as possible. They should be useful to other companies in the same industry that are prepared to undertake their own extended audits.

2. b. 2 Assistance to Industries in the Development of Conservation Programs

As a result of audits, both short and extended, a variety of activities and conservation measures will be identified for individual plants. It is proposed that the staff of the Commission, with the help of conservation experts, provide informal assistance to industries which have completed audits in developing their own conservation housekeeping and investment programs. It is not recommended that the Commission provide engineering design services on a regular basis to industries, as this is viewed as an activity for the private sector in the Dominican Republic. The activities of the Commission should be limited to an advisory role, which would include assisting plant management in defining targets for energy efficiency improvement and developing, in general terms, a corresponding investment program. Engineers from the Commission should be available to review energy matters regularly at the request of the plant.

The Commission staff could also play a major role in helping plants to monitor their energy consumption following a first audit. Comprehensive data should be taken regularly to allow comparisons of performance against targets for improvement, reveal previously unidentified areas of waste, assist plants in budgeting for capital expenditures, identify areas of training need, and quantify peaks in energy consumption, as these are important for both individual and national planning purposes. The participation of Commission engineers in regular monitoring of plant energy demands will thus prove useful both to the plants and to the Commission itself in its responsibilities for developing national policies.

Under the program, Commission staff will provide the types of assistance outlined above primarily to the 50 plants for which short audits are performed, thereby developing a capability to provide such advisory services to industry on a wider scale following the formal end of this program.

2. b. 3. Promotional and Training Activities

Private Sector Audits

In order for the maximum national benefit to be obtained from this conservation program, it is essential that industries themselves be encouraged to undertake audits and to implement their own conservation programs. The Commission will prepare and disseminate throughout the industrial sector manuals and reports on appropriate audit techniques, conservation measures and equipment, and results of conservation efforts in specific industries. The ready availability of information to all plants will undoubtedly help to encourage plants not able to benefit directly from the Commission audit work to undertake their own audit and conservation programs, and will stumulate the development of private sector engineering companies capable of conducting audits on a commercial basis.

After the first year of the program, during which priority will be given to developing the Commission's own audit work, it is proposed that the Commission actively promote the use of private sector audit services, as these must ultimately serve the needs of the industrial sector outside the limited scope of this program. Beginning in the second year, therefore, the Commission will begin to identify the private sector capability to undertake audit work, assist the development of that capability through promotional and training activities (see below), and develop a register of individuals and companies approved as being competent to perform plant audits.

Energy Coordinators

It is proposed that the Commission also actively promote the appointment of "Energy Coordinators" in all plants. The duties of an Energy Coordinator will be primarily:

(1) To generate interest among plant management and personnel in energy conservation and sustain the interest with new ideas and activities;
(2) To identify where major energy waste is occurring, to quantify the losses in physical and financial terms, and to develop practical targets for improvement;
(3) To maintain accurate records of all energy purchases and consumptions;
(4) To ensure that, in making improvements in energy efficiency, health and safety are not adversely affected;
(5) To maintain contacts with other industries, research organizations, equipment manufacturers and professional bodies to ensure that he is up-to-date on significant developments in the field of energy conservation;
(6) To remain up-to-date on national energy matters and to advise senior company management on such topics, as well as cooperating with government departments with responsibilities in energy-related matters.

The concept of "Energy Coordinators" has been vigorously promoted in countries such as the United Kingdom and has met with notable success. The idea is based on the recognition that the crucial decisions on conservation are not taken in government agencies but in shops, offices and factories around the country. The success of a country in achieving significant energy conservation is in fact the sum total of individual decision taken by those responsible for using energy to use it more efficiently. Plant Energy Coordinators can influence those decisions by encouraging all kinds of energy efficiency, ranging from simple housekeeping to the use of sophisticated new technology. However, the support of government is clearly not sufficient; the plant Energy Coordinator needs firm committment and support from the most senior levels of his own company. This will ensure that adequate resources are available to implement conservation measures, and that conservation will have its rightfull place in overall company strategy.

The creation of an Energy Coordinators Association, which could meet every 3-4 months, would bring together plant Energy Coordinators for an exchange of views and information with each other and with the Commission. Presentations by Commission staff, and by Coordinators themselves, on practical aspects of their work on energy conservation and on national energy matters could be made regularly. Both the Energy Commision and private groups, such as as the Consejo Nacional de Hombres de la Empresa, could provide support to a Coordinators Association. Through the dissemination of advice on conservation techniques, and the communication of successful results, it is anticipated that the benefits of the Commission audit and training programs could be extended to a much larger audience than could ever be reached directly at the plant level. In addition, valuable insights into the needs of the industrial sector, and how government might meet those needs, will undoubtedly be obtained through the informal interchange of ideas and experiences at the Energy Coordinators meetings.

Training

Beginning in the second year of the program, it is proposed that the Energy Commission, again with outside technical assistance, conduct a series of formal courses for private sector personnel in the following areas:

(1) Energy Management in the Industrial Sector;
(2) Plant Boiler and Furnace Operators Course;
(3) Courses on Energy Conservation Investments.

A description of the content of these courses appears in Annex G.2.

Technical Information Center

The Energy Commission will also establish a Technical Information Center through which information can be made available readily to private inquirers on the latest techniques and equipment in the field of

industrial energy conservation. The Center will include a library of recent reports on conservations topics and subscriptions to a number of technical journals in the field. The establishment of such a center will be facilitated by the Technical Information Transfer component of the Energy Policy Development Project.

2.b.4. Pilot Demonstration Projects

Purpose of Pilot Projects

The objective of this part of the program is to encourage the widespread adoption of energy conservation technologies by demonstrating their technical and economic effectiveness in working situations in Dominican industry through a selected number of pilot projects. By demonstrating the feasibility of conservation techniques, processes and equipment, it is intended to accelerate their adoption throughout Dominican industry. The pilot projects to be chosen for the program should therefore be capable of replication in a number of other industries, and the results of each pilot project will be monitored closely to establish a sound basis of technical and economic data which will contribute to this replication.

Approximately five pilot projects will be implemented under the program. The Energy Commission will be responsible for identifying and selecting the projects, monitoring project implementation, and evaluating subsequent energy and economic savings. Technical assistance will be provided to the Commission staff in carrying out these responsibilities. The role of plant owners and operators is also important in the pilot projects. The plant owner must make the decision to accept a pilot project in his plant, and must then be given ultimate authority in all aspects of plant operation, modification, etc. The projects will involve both costs and risks to plant owners, in the sense that production may have to be temporarily slowed or curtailed, plant personnel may be diverted temporarily from normal functions, and new and unfamiliar equipment or processes may be involved requiring new maintenance procedures and training of personnel. Given these possibilities, as well as a general resistance on the part of private industries to outside, particularly government, interference, it is believed that an incentive will be required to encourage plants to participate in the pilot projects. The program therefore proposes to bear the costs of services and equipment provided to plants as part of the pilot projects. Plant owners, in effect, will be given the pilot project equipment in exchange for their cooperation in installing and operating demonstrations in their plants.

Selection of Pilot Projects

Based on the Short and Extended Audit Programs, candidate demonstration projects will be identified and subjected to a prefeasibility analysis, a suggested format for which appears in Annex G.2. Final selection of plants for pilot projects will be made on the basis of the following selection criteria:

(1) Potential for Replication on a National Scale

The pilot projects are aimed at promoting the most efficient use of energy in industry. Any pilot project should therefore by capable of replication in other factories or industries, thereby resulting in energy savings on a national scale.

(2) National cost-effectiveness

The project should provide a cost-effective way for the Commission to encourage energy savings on a national scale. The national benefit-cost ratio is one way of measuring this cost-effectiveness. It may be defined as the ratio of expected national annual energy savings (in terms of foreign exchange requirements) to the cost of the project.

(3) Economic Viability

The project should be economically viable at current energy prices, as this is likely to have a strong influence on the extent to which the proposed energy saving measure is adopted by others. The payback period is one indicator of economic viability. The anticipated payback period of the proposed measure (or any other criterion of economic viability which is used) should be comparable with the value used for other types of investment in the industrial sector.

(4) Degree of risk

Projects may contain some element of risk. For example, there may be associated technical and economic uncertainties, especially where modified or novel technology is involved. The higher the risk is, the greater the national energy saving potential will need to be before a project is selected. Conversely, low risk projects will often be more likely to achieve a good degree of replication; consequently, selection of low risk projects would be justified even in cases where the national energy saving potential is lower.

(5) Effect on Dominican Suppliers

Promotion of the results of a pilot project demonstration may have a stimulating effect on local equipment suppliers or construction contractors. Consideration should be given to the effect of demonstration in fostering the manufacture of equipment in the Dominican Republic, in increasing employment, and in promoting the growth of a local, energy service-oriented capability.

(6) Experience value

Projects which are marginal on other grounds deserve consideration if they are in a field where experience in a particular conservation technique could be valuable in a very broad cross-section of Dominican industry, especially where it is thought that examples of attractive economic viability may exist, but have not been properly identified to date.

It is expected that a majority of the pilot projects will by conducted at plants which have undergone short and extended audits, and for which comprehensive energy demand data are readily available. There may, however, be good reasons for taking an idea from one plant and applying it in another which was not audited. For example, the plant management in one location may be unable or unwilling to install the necessary equipment in their plant following their audit, or it may be excessively expensive to shut one particular plant down for the required time for equipment installation.

The first pilot project will be selected and initiated toward the end of the first year of the program. All pilot projects should be underway by the third year.

Pilot Project Implementation

Having selected a pilot project, it will be necessary to proceed promptly with implementation. Engineering design services, and procurement and installation of equipment in the plant will be carried out by contractors to be selected by the Energy Commission helped by the technical assistance personnel.

Monitoring of equipment installation, operating performance and project costs is essential to provide full information on the technology being demonstrated. In particular, a clear assessment of the energy saved as a result of the equipment or process being demonstrated is an integral part of the project. This monitoring and evaluation will be performed by Commission staff in conjunction with foreign audit specialists.

Another important component of the pilot project demonstration is the promotion and publication of the results. This is a necessary part of encouraging others to invest in the techniques, processes or equipment which have been demonstrated. Full reports on all pilot projects will therefore be prepared by the Energy Commission, assisted by foreign audit specialists, for widespread distribution throughout the Dominican industrial sector. It is also necessary that the factories in which pilot projects are implemented be prepared to allow visitors to inspect the equipment or process when operating. There may, of course, be some situations where the plant is employing processes or equipment unconnected with the demonstration, which the plant management would not wish to be disclosed. In such cases all reasonable measures will be taken to ensure that such disclosure does not occur, for

example, during visits or by publication of results arising from the demonstration. Furthermore, all information on the plant and its business (other than that directly relating to energy saving) ascertained during the course of a pilot project will be treated as strictly confidential.

Illustrations of Typical Pilot Projects

To gain a better understanding of the nature and cost of possible pilot projects to be carried out under this program, visits were made to a number of industrial plants in and around Santo Domingo and illustrative pilot projects were developed for three plants with representative energy problems. The illustrative pilot projects are described in detail in the Technical Analysis and are summarized very briefly here.

i. Salt Refinery

The salt refinery processes crushed rock salt, obtained from Dominican salt mines, into table salt by dissolving the raw materials in water, removing insoluble impurities, and recrystallizing salt from the solution. The process is quite simple, but is interesting because it includes a number of industrial operations which are common to a wide range of industrial plants. For this reason, measures applied in the salt refinery should have wide replication potential in the Dominican industrial sector, even though there is only one other salt refinery as such (now under construction).

The refinery currently has an expenditure of about RD$500,000 per year on energy, about 50 percent of which is for fuel oil, 10 percent for LPG and the balance for electricity. A brief audit of the plant identified the following potential conservation measures and their estimated cost:

Site Cleaning	$ 2,500
Insulation of pipes and heated tanks	15,000
Valves and piping repair	5,000
Instruments, gages	20,000
New drier	20,000
New salt storage/ packing system	10,000
Boiler area repairs, equipment	12,000
Fuel oil tank	2,000
	86,500
15% contingency	13,500
	$100,000

It is reasonable to expect energy and material savings of 40 to 50 percent from the limited measures identified. Based on the annual energy bill of $500,000, the savings from the pilot project should amount to about RD$200,000 a year, all of which corresponds to foreign currency savings through reduced oil imports. The payback period would thus be about 6 months.

ii. Textile Mill - Power Factor Correction

A private Textile Mill (name withheld upon request) in the Herrera Industrial Park imports yarn and weaves it into cloth using 500 electrically-driven machines. The cloth is then dyed and printed. A large boiler generates process steam for heating dye baths. The total annual electricity consumption of the plant is about 2 million kilowatt-hours, equivalent to a cost of about RD$200,000.

Power factor correction equipment, such as capacitors, could significantly increase the efficiency of the electrical machinery at a fairly low cost. In effect, the "useful power" or efficiency of the electricity consumed could be increased. The cost of capacitors for this purpose is estimated to be about $10,000; a total project cost of $30,000 should be allowed for equipment costs, freight and installation. The improvement in power factor would be equivalent to about a 20 percent savings in the present electricity demand, or about $40,000 per year. The payback period for the power factor correction equipment would thus be approximately one year.

iii. Bakery - Combustion Control

The Pan Pepín bakery in Santo Domingo has three large gasoil-fired bread ovens, in addition to several smaller electric ovens for special product lines. The cost of gasoil to the bakery is about $70,000 per year. Losses during fuel combustion arise from incompletely burned fuel and heat in the flue gases. It is therefore important that the amount of air introduced into the furnaces for combustion be carefully controlled, both to provide sufficient air to burn all the fuel and to avoid excess air which will serve to increase the flue gas losses.

The provision of a small oxygen analyser for use on each of the gasoil-firing ovens could be expected to lead to an improvement in the average combustion efficiency of at least 3 percent, based on experience in similar plants overseas. The savings in fuel consumption would thus amount to at least $2,000 per year, and much greater savings may be obtainable. One analyser would cost under $5,000 to install. At worst, a payback of about 2 years could therefore be expected for the bakery.

Since there are over 200 bakeries in the Dominican Republic, the potential for replication in the bakery industry alone is significant, and the demonstration results would be equally applicable in a very large number of other industrial plants. Nevertheless, it is recommended that a combustion control pilot project be designed to include at least ten fully-instrumented demonstrations of different types of furnaces in selected industries. The total cost for this project would therefore be $80,000 to $100,000.

The illustrative examples described above involve medium or small-sized plants. Similar projects might involve kiln redesign in brick making industries, solar water heating or refrigeration in food processing industries or use of waste products as fuel in paper factories. It is also likely that at least one pilot project will be installed in a large factory, such as the state-run glass factory in San Cristóbal. A brief visit to that plant indicated several opportunities for energy saving, and the result of an extended audit could well result in a large pilot project involving perhaps furnace repair or replacement. For this reason, a total budget of $1 million for pilot projects is proposed to ensure that one or more large projects can be included, in addition to the smaller projects of the nature indicated above.

2.b.5. Financial Assistance Program

Financial assistance for industrial conservation will involve two separate programs, one for the grant financing of energy audits and the other for making available credit for industrial conservation investments.

Audit Assistance Program

The limited number of energy audits carried out by the Energy Commission directly will be provided to plants at no cost.

Beginning in the second year of the program, plants will be encouraged to use the private sector for carrying out audits on a commercial basis. A fund of $1,000,000 will be established to help finance these. The fund will be administered by the Energy Commission and will involve the following main features:

(1) Short and extended audits will be performed by individuals or companies on an approved register of energy consultants which will be maintained by the Commission.

(2) The short or extended audit consultant will be engaged directly by an industry. The Commission or other government agency authorization will not be required.

(3) On completion of the audit, the industry will apply to the Commission for reimbursement of its costs up to a limit of RD$500 for short audits and $2,500 for extended audits. The Commission will make reimburse- ment subject to receipt of proof of payment by the company and receipt of a copy of the approved consultant's audit report.

(4) Extended audit assistance will be made only after the completion of a short audit.

(5) The Fund should be sufficient to help finance about 1,000 short audits and about 200 extended audits during the 4 year life of the program.

The limits of $500 for short audits and $2,500 for extended audits are estimated to be the average cost of undertaking the audits. Depending on the nature and size of the plant, the cost of the audit will of course vary and in some cases the industry itself will have to contribute to financing the audit (more likely in extended than short audits).

The rationale behind government grants to help finance audits is that they are the key to industrial conservation - absolutely essential to achievement of significant energy savings in the industrial sector. The fact is that audits are not now being carried out by Dominican industries to any significant degree. Some kind of financial incentive, in addition to promotional efforts, is considered necessary. In other countries, such as the United Kingdom, where the government provides grant assistance for audits, the response of industry has been very positive. The potential energy and economic savings to be achieved as a result of audits in the Dominican Republic would outweight many times the cost of the audit assistance program.

Industrial Conservation Credit Fund

Two years ago, the Economic Development Fund of the Central Bank (FIDE) included among its elegible activities for lending energy conservation

in industries. Since that time, however, FIDE has made only two small loans for industrial conservation. The principal reason for this lack of demand to date has been an inability on the part of industries to identify suitable opportunities. Thus, the first priority of this program, as explained above, is to encourage energy audits. At the same time, the encouragement of audits should result in a rapidly increasing demand for investment capital. A hundred surveys of Dominican industries recently completed by the Commission, as well as a dozen plant visits by USAID staff and consultants, have clearly established that Dominican industrialists are prepared to undertake investments in energy conservation once the investment opportunities are identified and demonstrated to be financially attractive, but that additional sources of investment capital, beyond those available through private or commercial channels, are required. It is important that provision be made for this if a significant number of conservation projects is to be implemented.

For the purpose of encouraging investment in energy conservation, the project will establish an $8.0 million Industrial Conservation Credit Fund within FIDE. A.I.D. will provide $4.0 million in loan funds for initial capitalization of the Fund and the Central Bank will provide the remaining $4.0 million.

The $8.0 million is considered sufficient to cover the growing demand for conservation credit during the five years of the program. The anticipated demand for credit is based upon the number of audits expected to be accomplished - approximately 1,000 short audits and 200 extended audits. An average of one loan application is expected to result from every fifth short audit and every other extended audit. At an average capital requirement of $25,000 per loan (this will vary greatly from one loan to the next) approximately $8 million will be required during the project. (Rate of disbursement of the Fund is explained in the Financial Analysis and Plan.)

The Fund would be revolving and would continue beyond the life of the project. As demand for credit continues to increase, FIDE would be in a position to seek resources from other institutions for expansion of the Fund.

A primary advantage of the Fund is that for promotional purposes, it would demonstrate to industries that credit specifically for the purpose of energy conservation is indeed available.

The main features of the proposed Energy Conservation Credit Fund are as follows:

(1) Loan applications would be considered for companies wishing to invest in energy conservation projects and for the development of private sector energy conservation services.

(2) Acceptable projects would be financed by FIDE loans up to a ceiling of 75% of the total project cost. The remainder of the finance required would be from the borrowers own resources or from intermediary bank sources. Interest rates from FIDE to intermediaries would be at FIDE's maximum of 10 percent. Rates from intermediary institutions to industries would be the maximum allowable by law, 12 percent, plus a 2 percent commission for an effective rate of 14 percent. The rates will remain at the maximum allowed by law and will increase if the legal limit on interest rates is raised.

(3) Loans would be made according to normal commercial criteria. In other words, projects should be economically viable and the financial performance and outlook for the company should be sound.

(4) All loan applications would have to be supported by a detailed feasibility study describing the technical and economic basis of the project and the returns on investment forecast. All feasibility studies would be reviewed by both the Energy Commission and FIDE before acceptance. A feasibility study relating to the installation of energy conservation equipment should also include at least a short energy audit. An extended audit could be requested by the Commission if considered necessary to a satisfactory definition of the project. The Commission could also request to observe the installation and initial operation of conservation equipment, subject to any confidentiality restrictions.

2.b.6. Technical Assistance

In order to train Energy Commission staff and assist in implementation of the different activities described above, a good deal of long and short term technical assistance will be required. The following summarizes the T.A. to be provided:

(1) Resident Program Advisor - $400,000

Level of effort: 48 months, primarily resident in the Dominican Republic.

Activities: Overall management and coordination of the program in-country, working closely with Energy Commission staff. Active participation in all project tasks with particular emphasis on the following:

- execution of energy audits;

- practical training of local personnel in audit techniques;
- organization of formal training courses;
- identification and management of suitable pilot projects;
- initiation of promotional activities;
- coordination of financial assistance program with the Commission and FIDE.

(2) Short Term Technical Experts (in-country) - $500,000

Level of effort: 15 person months in each of the 1st and 2nd years reducing to 10 person months in the 3rd and 4th years. Duration in country to be variable, ranging from two weeks to several months per visit, depending on the specific work to be performed. The effort is expected to involve a total of approximately 6-8 experts during the program duration. This participation by a relatively large number of personnel is considered necessary as the range of specialized expertise required is broad and unlikely to be available from one or two long term resident personnel.

Activities: Each expert will participate in specific program activities under the coordination of the Program Advisor. The main emphasis for short term experts' participation will be on the following activities:

- execution of the energy audits (particularly "extended" audits);
- delivery of specialist training courses (e.g. furnace/-boiler operations, energy conservation investment projects);
- specialized assistance in pilot demonstration projects;
- analysis of major loan applications to FIDE.

(3) Overseas Training Consultant - $88,000 (included in budget under overseas training costs)

Level of effort: 10 person months in consultant's home office and overseas industrial facilities.

Activities: Coordination of the out of country training of Dominican personnel in practical audit techniques.

2.b.7. Summary Budget - Industrial Conservation Program

($000)

	A.I.D.	GODR	TOTAL
Long Term T.A.	400		400
Short Term T.A.	500		500
Portable Instruments (including calibration and maintenance)	124		124
Vehicles (including operation & maintenance)	75		75
Publications and Materials	225		225
Overseas Training	140		140
Pilot Projects	1,000		1,000
Audit Finance Program	1,000		1,000
Credit Fund	4,000	4,000	8,000
Local Personnel		852	852
Inflation & Contingency (15%)	1,120	-	1,120
TOTAL	8,584	4,852	13,436

A breakdown of expenditures by year appears in the Financial Plan.

3. Mini-Hydro Develpment Program ($4,668,000)

3.a Background

Mini-hydro resources are considered to be among the most promising possibilities for alternative energy utilization on a wide scale in the Dominican Republic. The Energy Commission and the National Water Resources Institute (INDHRI) have already identified 78 potential mini-hydro sites in the country with capacities under 5 MW. Almost all of these sites are located in rural areas where electricity is not now widely consumed, but where demand is expected to grow significantly over the next decade. The CDE SOFRELEC study estimates that consumption of electricity in areas outside of Santo Domingo and Santiago will triple between 1980 and 1990 - an increase of about 250 MW, or about half the current capacity of CDE. To the extent that this increased demand for electricity in rural areas can be met from mini-hydro resources, substantial savings in terms of reduced oil or coal costs, shorter transmission lines, reduced maintenance, etc. will result. A rural mini-hydro development strategy would also help insure that more isolated rural communities in need of electricity are likely to get it in the next decade, even as the costs of conventional power generation and transmission continue to increase prohibitively.

Despite the growing interest in mini-hydro in the D.R., actual utilization of small hydro resources is still extremely limited. While in the past a small number of wooden water turbines and other "mini-hydro" units were constructed, at present there is only one operating small hydro power plant (270 KW) in the country, which was built over 30 years ago at Constanza.

This project proposes to initiate a comprehensive program of mini-hydro development in the Dominican Republic. Assistance for such a program has been requested by the government and we believe that at a relatively low cost AID can play an important role in moving the country toward wide scale utilization of this alternative energy resource.

The most important single issue in development of mini- hydro in the D.R. has to do with institutional responsibilities and coordination. At present, three institutions - the Energy Commission, INDRHI and CDE - are involved in mini-hydro activities and planning to expand their involvement in the future.

The Energy Commission, as part of its overall policy development mandate, has the responsibility for evaluating mini-hydro possibilities and promoting their development where appropriate. The Hydroelectric Unit of the Commission has prepared, along with INDRHI staff, a National Inventory of Hydroelectric Resources, which includes information on all known hydroelectric projects in different stages of development, ranging from identification of possible sites through reconnaissance studies, evaluation, design, construction and operation.

The Commission is also supporting several projects which focus on development of micro-hydro resources less than 100 KW. For example, it is assisting the University of Madre y Maestra in the fabrication, installation and operation of a 30 KW unit at Janey in the province of Santiago, The Commission is also collaborating with the Southwest Development Institute (INDESUR) in a reconnaissance of potential sites of less than 100 KW in the southwest of the country. With a $200,000 grant from the Canadian International Development Agency, the Commission has also contracted a local engineering firm (SERCITEC) for the design, construction and installation of a 70 KW pilot project at El Puerto in the province of El Seybo.

Finally, the Commission is considering the preparation of a National Plan for the Development of Mini-Hydro projects, which would cover one section of the country at a time in an attempt to identify and evaluate all potential mini-hydro sites.

INDRHI, by law, has the responsibility for assuring that the nation's water resources are utilized efficiently in accordance with national development plans. While most of INDRHI activities relate to irrigation, it also plays an important role in the design and operation of the country's major hydroelectric facilities, particularly those with multiple purposes.

With regard to mini-hydro development, INDRHI has worked with the Energy Commission on the National Inventory of Hydroelectric Resources and has prepared detailed designs for 7 projects in the southwest region of the country, which are intended for connection to the national grid. The projects range in size from 300 KW to 4,100 KW. INDRHI has received a financing commitment from the Kreditanstalt fur Wiederafbau (KfW) - the development bank financed by the Government of the Federal Republic of Germany - to construct two of the projects and is currently looking for financing for the remaining 5.

INDRHI also has under construction a mini-hydro project of 680 KW at Los Ranchitos in the Ocoa Valley - the only project in the construction stage in the country. The project will utilize water that is being transferred by an irrigation canal. The canal is largely built and major work has been completed on the pressure case and the powerhouse. However, the project has been on hold since 1979 when Hurricane David caused major damage to the canal intake structure and to a small part of the canal itself. Further work on the project is being held up by lack of financing.

INDRHI is currently planning to undertake additional studies of potential mini-hydro sites in the upper and middle basins of the Yaque del Sur River.

CDE, of course, has responsibility by law for construction and operation of all public power facilities in the country. Electricity production for sale, from whatever source, can not take place without CDE approval.

CDE currently operates the only functioning small hydro power plant in the country - a 270 KW unit in Constanza. The unit was installed in 1949 and was managed by the Ayuntamiento de Constanza until 1980, when responsibility was turned over to CDE.

The Hydroelectric Development Department of CDE has recently initiated several additional activities in the mini-hydro area and has plans for expanding its involvement with mini-hydro in the future.

In 1980, for example the Spanish engineering consulting company, INTECSA, conducted a three-week reconaissance study for CDE of 14 sites in the upper Yaque del Norte and Bao River Basins intended for connection to the national grid. The site generating capacity ranged from 500 KW to 5 MW, with ten sites demonstrating a capacity of less than 1 MW. Cost for each site was calculated using gross formulae, which were not customized to conditions in the Dominican Republic. Unit costs ranged from RD$2,005/KW to RD$6,420/KW - a very high range. No explicit effort was made to evaluate any of the projects in terms of benefits and costs to local communities.

Under a recent agreement with the Republic of China, the Chinese firm Sinotech Engineering Consultants will conduct for CDE pre-feasibility studies of the 14 sites mentioned above. No provision has yet been made for design or construction of the sites.

As this brief review suggests, the responsibilities and activities of the three institutions involved in mini-hydro development overlap and in some cases even conflict. There is no clear definition of each institution's role in planning, selecting, designing, constructing, operating or maintaining mini-hydro installations. This situation is exacerbated by a lack of good coordination among the institutions, particularly between INDRHI and CDE. In the design and construction of large dams, for example, faulty coordination between INDRHI and CDE has resulted in some significant inefficiencies in the past. Lack of coordination is partly the product of interinstitutional turf fighting and partly the result of different overall objectives and values of the institutions involved. Recognizing the need for improved coordination, the Directors of INDRHI and CDE established a Joint Working Commission in August, 1980, which thus far has concentrated exclusively on developing operating norms for the big dams at Tavera and Valdesia.

There is no question that INDRHI or CDE, or for that matter the Energy Commission, could, with appropriate technical assistance and training, carry out by itself an effective mini-hydro development program. This is in effect what each of the institutions has been trying to do. From a national perspective, however, this makes no sense. It is bound to result in serious duplication of effort and inefficient use of limited financial and human resources, particularly as each institution gets further involved in its individual, uncoordinated program of mini-hydro development.

A basic tenet of this project is that efficient development of mini-hydro resources in the Dominican Republic will require greater coordination and collaboration among the Energy Commission, INDRHI and CDE. Unless significant legal changes are made in the overall mandates of the three institutions, which is not anticipated, each will continue to have an important role to play in mini-hydro development as well as valuable expertise to contribute (INDRHI, for example, in design and civil engineering works, CDE in electro mechanical works, the Energy Commission in planning and coordination).

3.b Program Purpose

The overall purpose of the mini-hydro program proposed in this project is 1) to develop the institutional capability for the selection, design, construction and operation of mini-hydro facilities throughout the D.R., including development of related community organizations, and 2) to test and demonstrate the economic, social, and technical feasibility of mini-hydro operations in different settings. The program will finance technical assistance and training in site evaluation, construction and operation as well as in community organization in order to help develop and support the institutional arrangements necessary for wide scale mini-hydro development in the Dominican Republic.

The institutional procedures to be supported under the program have been developed in close collaboration with the Energy Commission, INDRHI and CDE, which were brought together for the first time to discuss their respective roles in the mini-hydro area as part of this project development effort. It is expected that the arrangement initiated under this program will, if successful, be continued after the project in an expanding effort to develop mini-hydro resources.

The program will also finance the installation and operation of a limited number (3-4) of mini-hydro facilities. The purpose of these sub-projects is two-fold. First, they will help to upgrade the capabilities of the institutions involved through practical experience and set in motion a process of wide scale mini-hydro development. Second, they will demonstrate in a rural Dominican setting the technical, and more importantly, the social and economic feasibility of mini-hydro.

While it is clear that there is a potentially important role for mini-hydro in the Dominican Republic, the overall extent of that role cannot be determined until more operating experience has been acquired. Some areas in which more must be learned include: the performance characteristics and maintenance problems of mini-hydro equipment in an isolated setting; the extent to which community memebers can effectively be employed in the construction and installation of a mini-hydro and associated electric system (substations, transmission lines, distribution systems, etc.); the ability of a community to operate effectively and maintain a mini-hydro system; collateral water use possibilities including irrigation and potable water; and other social and economic effects of mini-hydro. It is possible that experience will demonstrate that the mini-hydro investment dollar has a

significantly higher payoff than the dollar invested in big dams or other energy sources. This might lead to a much expanded mini-hydro effort in the near future. On the other hand, experience may show that the practical scope of mini-hydro is limited by technical, social or institutional constraints. The answer to these questions can be gained only through direct experience.

The Mission's current assumption is that mini-hydro installations financed under the project will fall in the range of 100 KW to 1 MW. Other preliminary activities in the Dominican Republic have envisioned projects either smaller or larger than this size. Yet it is within this size range that the great bulk of mini-hydro potential in the country appears to lie.

It is also intended that sites constructed under this program will not be primarily for the purpose of supplying power to the national grid, which has been the focus of mini-hydro design in the D.R. thus far, but rather for the purpose of meeting the electricity needs of communities not currently connected to the grid. Of course in some cases communities may be able to sell excess electricity from mini-hydro to the grid, or substitute mini-hydro for electricity purchased from the grid or generated locally. In all cases, it is believed that the social and economic benefits of mini-hydro can be maximized if the value to local communities as well as to the national grid is taken into account.

Likewise, it is believed that the benefits of mini-hydro to a community can be increased by community participation in the construction, operation and maintenance of the mini-hydro facility. Of course the organization and capabilities of different communities will vary greatly, so that in some cases community participation may necessarily be limited. This program will encourage effective community participation in all aspects of mini-hydro development and operation to determine what role community participation should play in an expanded program.

3.c Program Activities

The program involves two phases of activity: Phase I - Site Selection and Design, and Phase II - Construction/Installation and Operation. INDRHI will have the lead institutional responsibility in Phase I, although as will be seen, much of the work will be carried out jointly with CDE. CDE in turn will have the lead responsibility in Phase II, including assistance to communities in organization, operation and maintenance. The role of the Energy Commission throughout the program will be one of supervising and coordinating all program activities, to assure that they comply with both project and national policy objectives. The head of the Hydroelectric Unit of the Commission will be the overall Program Coordinator. It is agreed, however, that the Commission neither can nor should play a principal implementing role in this project or in mini-hydro development in general. Its staff in the hydroelectric area is very limited (currently 3 professionals, expanding to 5). Furthermore, the role of overall policy guidance and program coordination is a very important one for the success of

this project and can best be played by the Commission. Since funds for this program will be channeled through the Energy Commission, all activities will in effect have to meet with its approval. The Commission will also be directly responsible to AID for the success of the program.

Table III.1

Mini-Hydro Program Organization

Overall Program Coordinator
National Energy Commission

Phase I Site Selection and Design	Phase II Construction/Installation and Operation
Program Manager INDRHI	Program Manager CDE

3.c.1 Phase I - Site Selection and Design

For site selection and design, a joint INDRHI-CDE working team will be established, consisting of the following personnel:

Energy Commission Program Coordinator

Electro-Mechanical Engineer (Team Leader - INDRHI)

Civil Design Engineer (INDRHI)

Electro-Mechanical Design Engineer (CDE)

Cost Engineer (INDRHI or CDE)

Geologist (INDRHI or CDE)

Survey Brigade (INDRHI or CDE)

Sociologist (CDE)

Environmental Scientist (INDRHI or CDE)

Draftsmen (INDRHI or CDE)

While the working team may not need to function on a daily basis, it will provide a format for continuing interchange between INDRHI and CDE technical personnel and assure that the interests of both

institutions are considered and expertise utilized in the evaluation and selection of mini-hydro sites. The team will work under the overall supervision of the Energy Commission Program Coordinator. The team leader and Program Manager for Phase I will be an employee of INDRHI.

Reconnaissance Screening

The first task of the working team will be to make a brief "reconnaissance pass" of the 40-odd sites already identified in the National Inventory which fall within the range of 100 KW to 1 MW. While there are probably many potential mini-hydro sites in the D.R. which have not yet been identified, for purposes of this project it is necessary to begin with a manageable number of possible sites. Therefore, the scope of the project is confined to those already identified in the National Inventory. A brief fly-over or drive-by should be sufficient for purposes of screening out sites which are obviously unsuitable, whether because of location, lack of water, surrounding terrain, etc. It is estimated that reconnaissance screening will eliminate a number of the potential sites listed in the National Inventory. The full working team will not be required for each reconnaissance pass, but can split up to accomplish the reconnaissance more rapidly. All reconnaissance should be completed within a few weeks.

Site Evaluation Studies

For the approximately 20 sites which pass the reconnaissance screening, site evaluation studies will be performed. Sites will be evaluated according to basic technical, economic, financial, social and environmental criteria and eventually ranked or grouped according to overall attractiveness. In evaluating and selecting sites, the working group will follow a detailed site selection methodology prepared by an NRECA consultant team during project preparation in collaboration with Commission, INDRHI, CDE and AID staff. The Site Selection Methodology is explained in detail in the Technical Analysis and appears in full in Annex G.4. The principal steps in the site Selection Methodology are:

1. Compilation of Existing Information;
2. Site Visit and Field Survey;
3. Processing of Hydrological Information;
4. Social, Institutional and Environmental Analysis;
5. Demand Calculation and Forecast;
6. Alternative Layout Schemes;
7. Estimation of Power and Energy;
8. Technical Evaluation of Alternative Schemes;

9. Conceptual Design of Preferred Scheme;

10. Project Cost Estimation;

11. Economic and Financial Analyses;

12. Preparation of Site Report.

It is estimated that about one month will be required for completing each site evaluation study. To accelerate the site selection process, it is proposed that a second INDRHI-CDE working team be formed as soon as possible. The second team could share many of the members of the first team who are not needed full time, such as the draftsmen, the surveyors, the environmental analyst and so on. All site evaluation studies should be completed by early in the second year of the project. (See Table III.2.)

Technical assistance will be provided to the working teams throughout the site evaluation and selection process, both in general application, and revision if necessary, of the Site Selection Methodology, and in specialized areas such as hydrometeorology, environmental considerations and processing of generated information. (See Technical Assistance Section below.)

Feasibility Studies

Three to four sites will be selected for detailed feasibility study and eventually design and construction.

The procedure for conducting the feasibility studies will be similar to that employed in conducting the site selection studies, but will provide a greater level of detail for arriving at more precise cost estimates. For example, major equipment pricing will be developed on a more formal basis that in evaluation studies. Additional areas that will be looked at in greater detail than in the site selection studies include:

- Layouts and preliminary designs;
- Availability of access;
- Environmental issues and resolution of problem areas;
- Preliminary schedules for construction and funds allocation.

Whereas site selection studies will generate costs within a 25 percent range, the feasibility studies costs should be dependable, using appropriate contingency costs.

Table III.2 Activity Chart for the AID-CNPE-CDE-INDRHI Small Hydro Program

		ACTIVITY	TIME (MONTHS) 0	12	24	36	48	60
PHASE I	1	DESIGNATION OF PROGRAM PERSONNEL						
	2	SITE SELECTION STUDIES						
	3	FEASIBILITY STUDIES						
	4	DESIGN/PREPARATION OF BID DOCUMENTS						
PHASE II	5	PROCUREMENT OF ELECTRO-MECHANICAL EQUIPMENT						
	6	CIVIL WORKS CONSTRUCTION						
	7	PUTTING IN PLACE OF TRANSMISSION AND DISTRIBUTION SYSTEMS						
	8	INSTALLATION OF ELECTRO-MECHANICAL EQUIPMENT						
	9	COMMUNITY TRAINING						
	10	MONITORING OF THE SHPPS OPERATION						

The feasibility studies, which can to a degree be conducted simultaneously, should be completed within 4-6 months.

Final Design and Preparation of Bid Documents

Preparation of final design and bid documents will take an additional 4-6 months. One set of bid documents will be prepared for all electro-mechanical equipment, which will likely be procured off-shore, and another set of bid documents will be prepared for local construction and installation services. Up to two months of technical assistance will be provided in preparation of the final design and bid documents to assure conformance with AID procurement regulations.

Completion of the final design and bid documentation marks the end of Phase I of the program, which should be completed before the end of the second year of the program.

3.c.2 Phase II - Construction/Installation and Operation

CDE will have principal responsibility for supervision and management of Phase II of the program, again under the overall coordination of the Energy Commission. The Program Manager for Phase II will be an employee of the Hydroelectric Development Department of CDE. Of the five specific tasks involved in Phase II - civil engineering works, procurement and installation of electro-mechanical equipment, construction of transmission and distribution lines, community organization and training, and project operation and monitoring - all but one (civil works) are areas in which CDE has more experience than any other institution. Also, given the need to schedule and coordinate closely the detailed activities of Phase II, it is important that one institution have overall management responsibility. Because the objective of Phase II is ultimately the production of electricity, it is most appropriate that this responsibility lie with CDE.

Civil Engineering Works

Two possible methods have been discussed for execution of the civil works, which include excavation and construction of the dam, canal penstock, headworks, tailrace, and powerhouse and switchboard. The first involves a CDE contract with a local construction firm, of which there are several considered capable of carrying out the work involved. In this case, CDE would provide from its staff a construction supervisory engineer. Local labor would be utilized by the construction contractor as practical.

The second involves execution of the civil works by INDRHI, which has considerable experience in irrigation and other types of civil works, under force account, that is, using its own equipment and personnel. INDRHI would also utilize local community labor where practical. Construction supervision could be provided either by CDE or by a supervisory engineering firm contracted by CDE.

It is virtually impossible to tell in advance which of these methods would be most rapid and economical. It may therefore be appropriate to follow a different method of civil works construction in each of the 3 or 4 sub-projects in order to determine which appears more appropriate for replication on a wide scale. Unless a conclusive consensus is reached otherwise, this is how the project will proceed.

Civil works construction for mini-hydro sites should take from 6 to 12 months per site, depending upon the specific site characteristics.

Procurement and Installation of Electro-Mechanical Equipment

Procurement of all necessary electro-mechanical equipment will be done by CDE in conformance with AID procurement regulations. It is expected that most equipment will come from the United States. Procurement of equipment for each site should take approximately 8 months and installation and additional 4 months.

Technical assistance will be provided to CDE in the installation, testing and start up of the equipment.

Putting in Place of Transmission and Distribution Lines

Transmission and distribution lines will be put in place under the supervision of CDE, which has considerable experience in this area. Local labor will be utilized in this task, where appropriate.

The necessity of transmission and distribution lines will of course vary, depending on the distance of the mini-hydro site from the local population center, whether a distribution system is already in place, and the distance of the site from the national grid, if sell back to the grid is going to take place.

In the 3-4 pilot projects to be undertaken, the initial costs of transmission and distribution lines, including consumer hook-ups, will be financed by the project. Future expansion of the distribution system and additional service connections will be financed by the community.

Community Organization and Training

Community participation in the design, construction, operation and maintenance of the mini-hydro installations is, as mentioned earlier, an important objective of the program.

CDE will provide assistance and training to community members in the following important areas related to mini-hydro: operation and maintenance procedures; tariffs, billing and collection methods; initial service charges; watershed protection; and productive uses of electricity. An Electricity Board will be established in each community served by mini-hydro to assume responsibility for these activities. The Board will be comprised of at least the following members:

i) The Mayor or other pertinent administrative figure;

ii) A person who has the respect and confidence of all members of the community (such as a local school teacher, a social worker, a priest or nun);

iii) A representative of CDE (initially the CDE Program Manager).

The legal structure of the Board (whether a private or public entity, for example,) will be left to the decision of the individual community involved.

In his dealings with the Electricity Board, the CDE Program Manager will be assisted by sociologists of the CDE Planning Department who have considerable experience dealing with communities under rural electrification programs.

Training of local mini-hydro operators should take about 6 months (3 months of theoretical training and 3 months of on the job experience).

Under the Program, 10 months of technical assistance will be provided to CDE in designing and carrying out training and organizational efforts in the communities. (See Technical Assistance Section below.) This is considered to be a key part of the whole program, as the objective eventually is to have individual communities operating, maintaining and benefiting from mini-hydro facilities with minimal support or interference by CDE or other government agencies.

Operation and Monitoring

Operation and monitoring of the 3 or 4 sub-projects should begin in the third year of the program, and will continue for at least one full year before final evaluation. During most of this time CDE training of community members will continue. Otherwise, the role of CDE will be primarily one of trouble shooting major repair or maintenance problems. The Hydroelectric Development Department of CDE will be supported in this effort by the Production Department, which is responsible for operation and maintenance of all CDE major generating facilities.

Final evaluation of the sub-projects will cover all technical, economic and environmental issues as well as questions relating to community organization and participation and the success of the overall institutional arrangement for implementing the projects. The two main questions to be answered will be (1) whether mini-hydro appears to be a truly feasible energy source for Dominican communities and (2) whether the institutional arrangement supported under the program appears appropriate for development of mini-hydro on a broad scale.

For carrying out the above tasks, a total of 5 vehicles will be procured under the project, 3 in the first year for the site evaluation work and initial civil works supervision and 2 additional vehicles in the third year for community training and monitoring of the sub-projects.

3.c.3 Technical Assistance

A total of 54 person months of technical assistance will be provided under the Mini-Hydro Program as follows:

Program Advisor - 30 months

The Program Advisor will work with the Energy Commission, INDRHI and CDE throughout all aspects of implementation. He/she will have an M.S. in electrical engineering and 10 years experience in the design and management of power systems, including small hydro power plants. He/she will be fully fluent in Spanish and will coordinate shorter term technical assistance. A vehicle will also be procured under the project for the Program Advisor.

Short Term Technical Advisors - 10 months

Planning expert to assist the Energy Commission at the beginning of the program in national planning efforts in mini-hydro development (3 months).

Expert in environmental assessment of mini-hydro projects, soil conservation and water resources management. Will assist in application of site selection methodology and in stages of design and construction of specific sites (3 months).

Expert in stream flow measurement and location of hydrometerological and runoff gauging stations (2 months).

Computer programmer to assist principally INDRHI in development of appropriate computer software for efficient management of all existing and future pertinent hydrometeorological and hydrological records (2 months).

Technical Assistance to CDE in Community Training - 10 months

Specialist in mini-hydro operation and maintenance to assist CDE in developing and implementing appropriate training for community operators (4 months).

Specialist to assist CDE in determining appropriate policy for tariffs, billing and collection methods for areas served by mini-hydro (2 months).

Specialist to assist CDE in community organization for watershed conservation and improvement (2 months).

Promotional specialist to assist CDE in the design of a training program for the promotion of the productive uses of electricity (2 months).

Preparation of Bid Documents - 2 months

Project Evaluation - 2 months

3.d Illustrative Sub-Projects

To gain a better understanding of the nature and cost of possible sub-projects to be financed under this program, two illustrative projects were developed by an NRECA consultant team working closely with staff from the Energy Commission, INDRHI and CDE. One illustrative project is at Constanza, the other at El Pinar on the Rio Banilejo near Ocoa. In each case, the site selection methodology was field tested and preliminary design with good cost estimates prepared. A full description of the illustrative projects appears in the Technical Analysis. A brief summary is included here.

Constanza

Constanza, a small city in the country's central mountain chain, lies in a rich agricultural valley isolated from the nation's electric grid system. The population of some 8,184 persons is mainly employed in commercial agriculture including the cultivation of flowers. Although there is an extensive irrigation system through aqueducts and canals, a large portion of irrigation is accomplished through the use of electric pumps. The existing electrical demand of Constanza is estimated at about 1000 KW. This demand is currently met from two diesel generators with a total installed capacity of 1300 KW. The 270 KW small hydro unit at Constanza is currently out of service because of blockage of the power canal and has been operating erratically over the past decade. The cost of producing electricity from the diesel units is very high, about 17 cents per kilowatt hour.

A possible project to substitute for some of the diesel production would take advantage of a natural waterfall site on the Rio Constanza just outside of town with a capacity of about 500 KW. The project would consist of a small dam about 5 meters in height, a canal of approximately 1 km. and associated civil and electromechanical works.

The following is a summary of the estimated construction and installation costs:

ITEM		COSTS (RD$)
1. New Dam and Spillway		54,700
2. Power Canal		125,200
3. Intake		7,000
4. Penstock		39,800
5. Power Plant and Electrical Equipment		372,000
6. Transmission line and Protection Equipment		52,000
7. Land clearing and Access		10,000
		660,700
Admin. and General Expenses	10%	66,100
Contingencies	15%	99,100
Equipment Transport	4.5%	29,700
	TOTAL	$855,600

The cost of electricity production through the mini-hydro facility would be about 1.3 cents/KWH, a considerable savings over the current system of diesel generation (see Economic Analysis for details).

Rio Banilejo

Another possible site for a sub-project is on the Rio Banilejo, about 3 km. from El Limón. El Limón is largely an agricultural community with no current source of electricity. Kerosene, firewood and charcoal are consumed for energy. The estimated electricity demand of El Limón is 50-100 KW.

The site on the Rio Banilejo is an attractive one with a capacity of 726 KW, well beyond the immediate needs of El Limón and surrounding communities. A small dam of 3 meters and a 2 Km. canal would be required. A transmission line could be run to the national grid 7 kilometers away for the purpose of selling excess electricity back to the grid, which would be beneficial from both the community's and CDE's point of view.

The following is a summary of estimated construction and installation costs:

ITEM		COSTS (RD$)
1. New Dam and Spillway		105,000
2. Power Canal		198,700
3. Power Intake		24,000
4. Penstock		56,000
5. Power Plant and Electrical Equipment		450,800
6. Transmission line, Transformer and Protection Equipment		102,000
7. Land clearing and Access		14,000
		950,500
Admin. and General Expenses	10%	95,100
Contingencies	15%	142,600
	TOTAL	$1,188,200

The cost of producing electricity through the mini-hydro system would be about 1.1 cents/KWH, substantially cheaper for the community than diesel generation or purchasing electricity from the grid. Additional benefits would accrue to both the community and CDE from the sell back of electricity to the grid, at a price higher than the mini- hydro cost of production but lower than CDE's fuel cost of production of 6 cents/KWH, say about 4 or 5 cents/KWH. (See Economic Analysis for discussion of economic benefits.)

The above examples give a good idea of what it will cost to construct mini-hydro sub-projects under this program - $855,600 for a 500 KW unit and $1,188,200 for a 726 KW unit, or an average cost of about $1,600 per installed KW Based on these cost estimates, it has been decided to provide $3,000,000 ($2,600,000 in A.I.D. construction and installation funds and $400,000 in GODR counterpart) for construction of sub-projects under the program. This should be sufficient to assure that 3 or 4 sites of different sizes and characteristics, with different immediate objectives (substitution of grid or other sources or electricity, introduction of electricity to an isolated community, sell back to the grid), will be included in the program.

3.e Section 611(b) Compliance

Section 101 of the Foreign Assistance and Related Appropriations Act, 1979, requires that AID apply to certain water and related land resource construction projects that it supports the standards and criteria used in determining the feasibility of similar federally funded projects in the United States. Section 611(b) of the FAA, as amended, requires the application, insofar as practicable, of the Principles and Standards (1973) of the Water Resources Council.

The Mission will ensure that these requirements are met in substance. The economic cost-benefit analyses to be prepared for all sub-projects which involve construction will show discounted total benefits greater than discounted total costs. The form and result of these analyses will constitute accomplishement of the substantive economic analysis requirements of section 611(b). In addition, the two site selection studies performed as part of the intensive review, demonstrate the capability of both CDE and INDRHI to use the site selection methodology described in this PP. Environmental considerations in project concept and general design have been addressed in the Initial Environmental Examination and will be fully integrated in the detailed planning and implementation of project activities. This will constitute fulfillment of the substance of the environmental concerns portion of Principles and Standards.

The Mission concludes that adherence to the sub-project analysis methodology will ensure that the principles embodied in the applicable legislation will be met for each sub-project.

Summary Budget - Mini-Hydro Development Program
($000)

	AID	GODR	TOTAL
Technical Assistance	540	-	540
Vehicles (6)	165	-	165
Mini-Hydro Sub-Projects	2,600	400	3,000
Local Personnel Costs	-	468	468
Inflation and Contingency (15%)	495	-	495
TOTAL	3,800	868	4,668

4. Wood Fuel Development Program ($2,068,314)

a. Introduction

Firewood and charcoal are among the most widely used energy sources in the Dominican Republic. Methods of growing, cutting and converting wood to energy, however, are not very efficient and have resulted in serious deforestation and wastage of this valuable resource. There is currently no rational program of fuelwood production in the Dominican Republic. Trees are cut randomly by individual families as well as "carboneros" or small charcoal producers. Methods of converting wood to charcoal are primitive and highly inefficient, generally involving earth mound techniques. A 1967 statute prohibiting the cutting of trees for any purpose, without special permit, has had only a limited effect on reducing tree cutting for fuelwood.

There are several possible approaches to developing wood efficiently as a fuel source in the Dominican Republic. One approach might involve wood and charcoal production by small farmers as a cash crop. Another approach might involve village or community wood lots. A third approach, which has been examined by USAID in more detail in the Energy Farm Study completed in 1980, involves large scale energy farms for production of charcoal or wood fired electricity. The Energy Farm Study has generated considerable interest inside and outside the government in the possibility of energy farm development and fuelwood production.

Before the potential for energy farms or other approaches to wood fuel production and utilization can be realized, however, a good many questions will have to be answered regarding the most appropriate types of trees for different energy purposes, as well as the most efficient technologies for converting the trees grown to different energy end uses. For example, what species are best suited for fast growth in Dominican dry forest conditions? What growth performance can reasonably be expected? Will natural rainfall suffice or will irrigation be required for efficient performance? What nutrients or fertilizers, if any, will be required to maintain productivity of the soil? What planting, cultivating and harvesting patterns are most appropriate on a large scale? What trees are best suited for interplanting with other small farm crops? What is the best method for harvesting, transporting, drying and storing the wood before conversion? What kind of pre-drying will be necessary? What is the most efficient and appropriate method for converting wood to charcoal on either a small or a large scale? If the purpose of the wood grown is electricity production, what kind and size of conversion/generation technology will work reliably in a rural area?

This project will finance a program of research and demonstration to be carried out by the Superior Agricultural Institute in Santiago (ISA) in collaboration with the Energy Commission in the following areas: 1) tree production for energy; and 2) technologies for converting wood to energy. The program is designed in such a way that at the end of five years sufficient information will have been obtained in each of these areas so

that large scale efforts in fuel wood production and utilization (involving energy farms, small scale tree production, or perhaps both) can be gotten underway.

It is recognized that other issues will also have to be dealt with eventually in the implementation of fuel-wood programs, such as the organization and management of a large number of workers required for large scale, labor intensive energy farm operations and appropriate methods of promoting small scale production of fuel wood by individuals or communities. Before these operational issues can be dealt with effectively, however, fundamental questions about the characteristics of the trees to be grown and the nature and efficiency of end use technologies will have to be answered. For example, the growth rate of a particular tree species, together with the efficiency of a particular conversion technology, will determine the amount of land required for producing wood for a particular end use. The amount of land required will in turn influence the size and organization of the labor force and other operational aspects of the effort.

b. Program Activities

i. Tree Production Research Program ($1,014,189)

The tree research program will involve five closely related activities to be carried out on approximately 400 hectares of land owned by ISA near Mao. The land is largely representative of the dry forest area of the Dominican Republic and includes several types of terrain and soil conditions. A professional forester from ISA will serve as overall Manager for the tree research program. While ISA staff will have primary responsibility for implementing the program, it is proposed that technicians from FORESTA and the Natural Resources division of the Agriculture Secretariat (SURENA) be "loaned" to the program for periods of up to a year to ensure involvement and support of these key institutions as well as a wider dissemination of technical training in tree research. Discussions among the Energy Commission, ISA, FORESTA, and SURENA have resulted in general agreement on the participation in the program of technicians from these latter institutions.

Nursery Operation

The first activity involves establishment and operation of a nursery for the production of seeds and seedlings to be used in the program. ISA has already initiated a small nursery operation on the Mao site capable of producing 5,000 - 10,000 seedlings a year. Under the program, up to 200,000 seedlings per year will have to be produced, so the existing nursery will be upgraded and expanded. Basic seed handling equipment and nursery supplies will be provided (see Program Budget), as will technical assistance in seedling preparation, transplanting and other nursery techniques. For example, present practice with large black plastic bags and the digging of large planting holes will be tested against use of smaller containers and less drastic and costly planting procedures. In this aspect of

the work, contact will be established with "Doubleharvest" and the Baptist Mission in Haiti, which is undertaking similar experiments. An ISA technician will be the full time nursery supervisor and the nursery will employ from 3 laborers in the first year of the program to 5 in the fifth year. The nursery will require a total of 2 hectares.

Main Species Trials

Basic growth and yield tests will be performed for the following 6 species which appear to have promise for good performance in the Dominican Republic:

- Leucaena leucocephala. This species is native to the D.R. For the main species trial, however, the "Hawaian Giant" selection K-8 will be used.

- Euycalyptus camaldulensis. This species adapts to a wide range of site conditions and is one of the 2 most widely planted Eucalyptus species around the world.

- Azadirachta indica or neem. This species survives 120° F temperatures and rainfall as low as 400 mm/year with an 8 month dry season.

- Casuarina equisetifolia. This species was chosen for its ability to grow under conditions of low fertility and rainfall as well as salty environment. It yields excellent firewood and charcoal.

- Calliandra calothyrsus. This species also performs well under conditions of low rainfall and yields excellent firewood and charcoal.

- Prosopis juliflora or cambron. This is a native species proven in the DR and is chosen to serve as the standard species in all trials.

(See the Technical Analysis for a full description of these principal tree species.)

The main species trials will be conducted on two different types of soil at Mao (wetter, richer vs. drier, poorer). A third trial on significantly drier soil will be undertaken at Azua in the southwest of the country, in collaboration with a regional development organization (Oficina para el Desarrollo Integral Agropecuario del Valle de Azua).

At each site, a randomized block design with at least 4 replications will be used for planting, and spacing will be 2.5 x 2.5 meters. Each plot will consist of 121 trees if square and 128 trees if rectangular. This will provide a 2-row isolation strip and a central measurement plot of 49 trees and 48 trees respectively. A total of about 6 hectares (2 at each of the 3 trial sites) will be required. The following diagram illustrates the design intended for main species trials.

Planting Pattern

...A...	B	C	B	D	F
D	E	F	E	A	C
C	F	A	D	E	B
B	D	E	C	F	A

150 meters

150 meters

The main species trials will begin in the first year of the program. Technical assistance will be provided in land clearing, planting and cultivating as well as in growth measurement and yield calculations. Data on tree performance will be collected on a regular basis and prepared for storage and access through the mini-computer at the Energy Commission procured under the Energy Policy Development Project.

Spacing Trials

Spacing trials of the 6 main species will be undertaken to determine the optimal spacing pattern for tree performance. Using the same random block planting pattern described above, spacings of 1.5 x 1.5, 2.5 x 2.5, 3 x 3 and 4 x 4 meters will be tested. The spacing trials will be performed on only 2 sites at Mao representing higher and lower quality soil. A total of about 18 hectares will be required. The spacing trials will begin in the second year of the program.

Secondary Species Trials

Secondary comparisons of species within a genus and some independent comparisons will be undertaken to refine the information obtained from the main species trials, and determine whether performance can be further improved by particular species or sub-species. The secondary comparisons to be carried out are described in detail in Annex E.5.

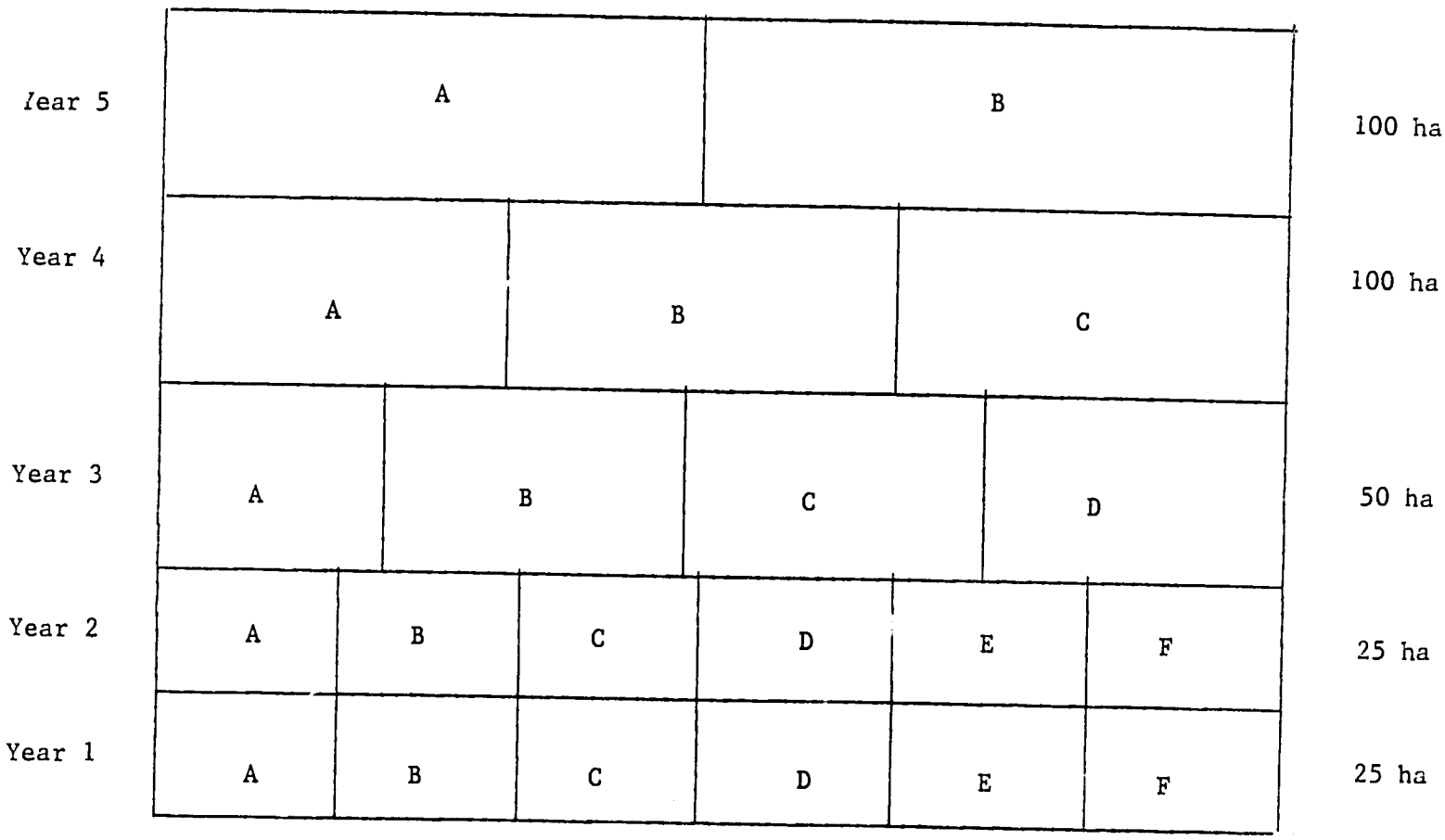
The planting pattern and spacing will be the same as under the main species trials. Two sites of 8 hectares will be required, one at Mao and one at Azua. The secondary species trials will begin in the second year of the program.

Each of the three trials (main, spacing and secondary) will be supervised by an ISA technician. Labor for land clearing, planting, etc. will be contracted locally. Technical assistance will be provided throughout all trials in planting, tending, measuration, and data analysis. Data from all trials will be stored and accessed through the Energy Commission mini-computer.

Plantation

To provide experience in larger scale planting and harvesting techniques, as well as to produce wood for use in the Wood Conversion Program (see below), an area of about 300 hectares will be planted under the program. Methods of land clearing, fencing, building of access roads, harvesting and hauling of cut wood will be experimented with. The total area will be cleared, fenced and planted in increasing increments, beginning with 25 hectares the first year and increasing to 100 hectares in each of the last two years. All 6 main species will be planted the first year. As information is gained on the performance of the different species in successive years, only the more promising ones will be continued, as the following diagram illustrates.

Plantation



300 hectares

An ISA technician will supervise the establishment and operation of the plantation. Technical assistance will be provided in this effort. As most of the species included in the program are known for very fast growth rates, it is expected that during year 3 of the program harvesting of trees from the plantation can be gotten underway.

By the end of the 5-year tree research program, reliable information should be available for making decisions about what type of tree to plant under different soil and climate conditions, how to grow the seedlings and how to plant them, what spacing to use, and when to coppice the stand. There will be enough information available upon which to base the start of wide scale fuelwood production programs. Testing and demonstration, however, should continue on a modest scale beyond the program to keep improving and refining the whole process of growing trees for energy.

The following is the budget for the Tree Research Program:

	Per Annum	Entire Project
1. Dominican Personnel		
Program Manager (professional forester)	$ 10,000	$ 50,000
Supervisor (Nursery)	8,000	40,000
Supervisor (Trials)	8,000	40,000
Supervisor (Plantation)	8,000	40,000
Labor 112 man/years at	1,500	168,000
Total		$338,000
2. Local Materials/Logistical Support		$ 25,000
3. Equipment and Supplies		
Measuring Devices		
4 diameter tapes at 25		$ 100
1 Haga Altimeter & Rangefinder		240
2 Height measuring poles at 180		360
		$ 700
Handtools		
25 axes at &17.80		$ 425
12 bow saws at $15.00		180
6 crosscut saws at $40.00		240
25 spades at $15.00		375
25 pick axes at $36.00		900
25 machetes with sheaths at $22.50		500
		$ 2,670
Nursery Supplies		
Plastic bags		$ 10,000
Hoses		500
29 Watering cans at $16		320
Markers, Tapes, etc.		400
Styrofoam Trays		275
Rootrainers		350
10 Special Planting tools at $42		420
Seed, 24 lbs. (see appendix)		785
		$ 13,050

Seed Handling Equipment	
1 Dybvig Seed Cleaner with variable speed motor	$ 890
1 Oliver Model 30 Gravity Separator w/motor	3,150
2 Upright 110-12 cuft capacity refrigerators	1,400
1 Stulz Sr. Duplex Model 48 Cabinet Germinator	9,300
Purity Analysis equipment	108
1 Sample Divider	205
1 Low Power Microscope	565
	$ 15,618
Miscellaneous	
Barbed Wire	$ 30,000
Bulldozer rental	10,000
Nursery toolshed	300
Miscellaneous	17,500
	$ 57,800
Total Equipment and Supplies	$ 89,838

4. **Vehicles**

2 Pickup vehicles	$ 24,000
Gas Maintenance	36,000
	$ 60,000

	Man/Months	Cost
5. **Technical Assistance**		
Full time general forester with 3-4 years' experience in plantation management and some knowledge of container nursery operations. Fluent Spanish	18	$180,000
Intermittent assistance from an experienced researcher in plantation management	4	40,000
Intermittent assistance from an experienced nursery and seed specialist	4	40,000
Intermittent assistance from a specialist in mensuration and biometrics	4	40,000
Total Technical Assistance	30	$300,000

	Time	Total Cost
6. Training		
Practical Training		
Visit by a forester and a forestry technician to Haiti to observe "Double-harvest and Baptist Mission nursery practices and planting methods.	2 weeks each	$ 1,500
Visit by a forester and a forestry technician to Brazil to observe production of eucalyptus wood for conversion to charcoal.	1 month each	8,000
Visit by a forester and forestry technician to U.S. to observe container-nurseries in operation, planting of continer seedlings. Also to observe methodology of field plot research in tree planting.	1 month each	8,000
Academic Training		
One year of graduate study for Masters degree with emphasis on plantation management for 4 Dominican Republic nationals with an undergraduate degree in Forestry.		72,000
Seminars		5,000
	Total Training	$ 94,500
Inflation and Contingency (15%)		106,850
Total Program Cost		$1,014,189

ii. Wood Conversion Program ($1,054,125)

The principal purpose of the wood conversion program is to test and demonstrate improved technologies for converting wood to charcoal and to train a limited number of Dominicans in the construction and efficient operation of those technologies in preparation for a wide scale promotion effort. Testing and demonstration of new, low cost technology for converting wood to electricity on a small scale is also included in the program.

All testing and demonstration will be carried out by Energy Commission and ISA personnel at the same site near Mao where the tree research program will take place. Wood for the conversion program will come initially from the areas cleared for the different tree planting programs and later, beginning about the third year of the project, from harvesting of wood from the plantation.

Activities under the conversion program will include transportation of felled wood from the roadsides where it will be collected under the tree research program to a site of about 1 hectare prepared especially for the conversion program. Site preparation will include land clearing, fencing, water well digging, access road construction, pouring of concrete slabs at the test sites (largely for working convenience) and renovation and expansion of an existing workshop/storage house. Various hand tools and instruments will also be required. The cost of these is detailed in the program budget below.

The wood conversion program will be implemented by four technicians from ISA, one of whom will serve as Program Manager, and two technicians from the Energy Commission. Local labor will be hired as necessary to assist in site preparation, construction, wood handling and other operational activities.

Actual dissemination and promotion of wood conversion technologies will not be financed under the program. However, once technologies are developed and proven under the program, it is expected that their dissemination will be handled through several channels. The extension service of the Secretariat of Agriculture, for example, is used for the dissemination of products and information developed at the Secretariat's appropriate technology research installation at La Vega. It may also be an appropriate method of dissemination of information concerning small scale charcoaling methods. INDOTEC is also a source of technical assistance and information to a variety of users in both the public and private sectors. INDOTEC will be kept informed and invited to make use of the results of the wood conversion research under this program.

The preferred channel of dissemination for larger scale charcoal and electricity production will be private entrepreneurs interested in manufacturing and installing conversion equipment. To this end, the project will be coordinated with the forthcoming Small Business Development project financed by A.I.D., with institutions lending to farmers, including the Agricultural Bank and DDF, and with industry associations in the Dominican Republic. The Mission believes that once one or two entrepreneurs begin to produce and distribute wood conversion devices on a profitable basis, normal profit seeking behavior in the market place will rapidly promote dissemination.

Small Scale Charcoal Production

While a considerable amount of charcoal is now produced in the Dominican Republic, the method used is largely one of earth mound burning of wood in small quantities. Research and experience elsewhere indicates that this is not a very efficient method of converting wood to charcoal. ISA and the Energy Commission will, therefore, test and demonstrate more efficient methods for converting small amounts of wood to charcoal which could be employed by small farmers or entrepreneurs in the Dominican Republic on a wide scale. The testing will eventually be carried out with the different tree species being experimented with, so that any discrepancies in conversion efficiency can be determined.

Specifically, two methods of small scale charcoal production will be examined, each of which involves fairly straightforward technology and has demonstrated good efficiencies in operation in other countries. The first is the so called "Beehive" brick kiln, which was developed and has been operating now for several years in Brazil. The Beehive kiln can be built to almost any size (although some efficiency is lost in very small kilns) and can be operated either as an individual unit or in rows for larger volume production. It is a batch type kiln which is circular in shape, has a domed roof and is built of ordinary firebrick. The principal advantages of the Beehive kiln are:

- It is a low cost unit (a large kiln - 45 cubic meters - would cost about RD$3,000);
- It is simple to build. Two men can build such a kiln in 8 to 10 days;
- It gives excellent yields - approximately 62% by volume and 25% by weight. Yields from earth mound techniques are about half this;
- It has a long life span (up to 6 years);
- It can be dismantled at one place and rebuilt at another location without much loss of bricks;

It provides uniform carbonization, has uniform cooling and a short operating cycle (approx. one week).

Although the Beehive kiln is fairly simple to construct, if it is not constructed properly, it loses a good deal of its efficiency,

Under the program, six Beehive kilns will be constructed and operated. Three will be of a larger size, about 45 cubic meters, and three will be of a smaller size, about 30 cubic meters. All local materials will be used in construction.

The second method of small scale charcoal production involves the so called "Mark IV" metal kiln of the type developed in Uganda. The kiln is portable, that is, it can easily be dismantled in one location and assembled in another. It also gives excellent yields (approximately 60 percent by volume and 25 percent by weight), although it is somewhat more difficult and costly to construct - approximately RD$4,500 for a capacity of 45 cubic meters.

ISA staff have already constructed a metal kiln on an experimental basis. Under the program, the kiln will be refurbished and transported to the Mao site for operational testing and demonstration.

Technical assistance will be provided to ISA and Energy Commission technicians in construction techniques, operating procedures, wood handling (including drying and storage) and in analysis of operating performance and qualify of outputs (charcoal and gas). All kilns should be constructed or refurnished and operating by the second year of the program, at which time emphasis will be placed on analytical work and demonstration of construction and operating techniques to site visitors.

Large Scale Charcoal Production

Another attractive possibility for the D. R. is commercial production of charcoal on a larger scale, for example, on private plantations or large scale energy farms. The most efficient technologies for converting large quantities of wood to charcoal continuously differ from those used for small scale charcoal production, and usually require more capital expenditure. One type of large scale charcoal making kiln which has been proven effective in the United States is the Missouri kiln. The Missouri kiln in typically constructed of reinforced concrete with metal doors, fittings, etc. and has a capacity of 160 to 180 cubic meters per cycle. Each cycle is somewhat less than a month, as follows:

1 to 2 days for loading wood in the kiln;
5 to 6 days for the carbonization process;
10 to 14 days for cooling of the charcoal;
1 to 2 days for removing the charcoal from the kiln.

Charring time of course will vary with the wood type, its moisture content and with the skill of the operators. Yields are usually quite good - about 60 percent by volume and 25 percent by weight.

Under the program, one Missouri kiln will be constructed and operated. All local materials will be used. Technical assistance will be provided by a person fully familiar with construction and operation of Missouri kilns. The kiln should begin operation in the third year of the program.

For all the above kiln operations, an accurate assessment of operating efficiencies under different conditions and with different wood stocks will require some more sophisticated analysis of end products, particularly gas, than can be performed at site. Therefore, a small amount of funds are budgeted for laboratory analysis at INDOTEC. INDOTEC has all personnel and equipment necessary for the analysis required except for a gas chromatographer which will be provided by the project. (See Program budget below.)

Electricity Generation

The technology of generating electricity from wood is quite well established and is currently practiced in the United States as well as other places. Small scale generation appropriate for rural settings in the Dominican Republic, however, is something still quite expensive and very capital intensive. For example, during intensive review, the Mission examined several conventional systems for generating 150 KW of electricity - using either wood to steam generation or wood gasification - and found them to be prohibitively expensive, ranging from $391,000 to $690,000. (See Technical Analysis.) We have concluded, therefore, that a major effort in wood generated electricity would not be appropriate for this program.

The Mission has, however, received information about a new low cost product, manufactured by Gas Generators Inc. of Miami, Fla., for electricity production through gasification of wood or agricultural wastes which appears to be particularly attractive. The 50 KW unit is trailer mounted and includes all necessary components, i.e., gasifier with filter, gas cooler, starter unit, six cylinder engine and electric generator. (See Technical Analysis for full description.) The total delivered cost is $35,000 for a new unit, and under reasonable assumptions of labor and wood stock costs, the cost of producing electricity would be about .045 cents/KWH, which is very attractive indeed. The unit may be returned any time up to six months for a full refund less transportation costs.

Under the wood conversion program, this new technology will be further examined and demonstrated to determine whether it is appropriate for utilization in the Dominican Republic on a wide scale. A review will also be conducted of other existing, low cost technologies for electricity production from wood which appear appropriate to the circumstances of the D.R. Funds are budgeted for the procurement/fabrication, testing and demonstration of 2 or 3 of the more promising technologies encountered under the wood conversion program.

The following is the budget for the Wood Conversion Program:

1. Dominican personnel

Program Manager	$ 50,000
Technicians (5)	200,000
Labor (35 man/years)	52,000
	302,000

2. Local Materials/Logistical Support — 25,000

3. Charcoal Program

Site preparation

Levelling of ground & clearing of trees	2,000
Paving of access roads	2,000
Concrete slabs at test sites	2,000
Electrical hook-up	2,000
Water Main/Well Digging	10,000
Fencing	2,000
Building modification and renovation	15,000
	35,000

Kilns

Six Beehive Brick Kilns	15,000
One Mark IV Metal Kiln Refurbishing	2,000
One Missouri Kiln	20,000
	37,000

In[illegible]mentation

Platform scale (1 to 200 Kg)	1,000
Moisture Tester	1,000
Multipoint Temperature Recorders (2)	6,000
Assorted Thermocouples	2,000
	10,000

Tools and Equipment

Table Saws	200
Drills	500
Cross cut saws	300
Other Hand Tools	500
Drying Racks	200
Costs for Hauling	500
	,500

Analysis Expenses	
Laboratory Analysis Work at INDOTEC (Proximate Analysis Only)	10,000
Equipment Purchase for Gas Chromatography (Charcoal-Making Gas Analysis)	10,000
	20,000
Training	
On-the job training in USA charcoaling industry 4 Men for 3 Months Each	20,000
On-the job training in Brazil charcoaling industry 4 Men for 3 Months Each	20,000
	40,000
4. Electricity Program	
Equipment Procurement/Installation	150,000
Connection to Distribution System	25,000
	175,000
5. Vehicles	
2 Pickup vehicles	$24,000
Gas/maintenance	36,000
	$60,000
6. Technical Assistance	
Wood Conversion Program Advisor (18 months)	180,000
Short Term T/ A. - Charcoal Program (3 months)	30,000
Short Term T.A. - Electricity Program (3 months)	30,000
	240,000
Inflation and Contingency (15%)	101,625
TOTAL	1,054,125

SUMMARY BUDGET

WOOD FUEL DEVELOPMENT PROGRAM
($000)

	A.I.D.	GODR	TOTAL
I. Tree Research Program			
Dominican Personnel/Local Support	-	195	195
Contracted Labor	168	-	168
Equipment and Supplies	90	-	90
Vehicles	60	-	60
Technical Assistance	300	-	300
Training	94	-	94
Inflation and Contingency (15%)	107	-	107
Subtotal	819	195	1,014
II. Wood Conversion Program			
Dominican Personnel/Local Support	-	275	275
Contracted Labor	52	-	52
Charcoal Program			
Site Preparation	35	-	35
Kilns	37	-	37
Instrumentation	10	-	10
Tools and Equipment	8	-	8
Analysis	20	-	20
Training	40	-	40
Electricity Program	175	-	175
Vehicles	60	-	60
Technical Assistance	240	-	240
Inflation and Contingency (15%)	102	-	102
Subtotal	779	275	1054
Total	1,598	470	2,068

5. CDE Technical Assistance Program ($750,000)

5.a Introduction

The Dominican Electricity Corporation plays a central role in the energy situation in the Dominican Republic and will continue to do so for the foreseeable future. No solution to the overall energy problem here is possible without a solution to some of the problems of CDE.

CDE, basically, has a lot of problems. First of all is the crucial problem of rising fuel costs. Almost 90 percent of CDE's current electricity generation uses gas-oil or Bunker C fuel. The cost for this fuel has increased from $60 million in 1979 to $135 million in 1980 and is expected to go up to $175 million in 1981. Even with its gradual rate increases, CDE has not been able to keep up with the rise in fuel costs. It is estimated that CDE loses about $4 million a month in its overall operations, or about $48 million per year. To help cover this operating deficit, CDE receives a substantial subsidy from the government, which of course has negative implications for the rest of the economy. CDE is attempting to deal with the problem of rising fuel costs not only by raising rates but by shifting to cheaper, non petroleum sources of energy, such as coal and hydro.

Inefficiency in generation, transmission and distribution of electricity is another problem of CDE. Because of poor maintenance and poor planning, which has resulted among other things in the siltation of dams, much of CDE's generating capacity is not fully utilized. Of electricity which is generated, about 30 percent is lost through inefficient transmission and distribution, or theft. It is estimated that there are over 100,000 unmetered or unreported users of electricity, although this number is being reduced by a major new effort on CDE's part in theft detection.

It is generally recognized that CDE's management, planning and technical capabilities in the past have not been up to dealing with these and other problems. One reason for this may be the high turnover in CDE leadership - 13 Administrators in 15 years - and the crisis atmosphere prevailing in CDE because of financial problems, shortfalls in capacity, blackouts, etc. The deficiencies in CDE management, planning, and technical areas cause concern among other donor agencies and have unquestionably inhibited additional lending to CDE.

The new CDE leadership which took over at the beginning of 1981 has shown considerable interest in upgrading the capabilities of CDE personnel and improving overall operations. For example, a number of division chiefs have been replaced to improve efficiency and several in-house training programs have been started. A major program has also been started to detect and correct illegal tapping of CDE lines. Since January, 1981 over 72,000 non-metered users have been disconnected and over 15,000 reconnected legally to the grid. Nevertheless, there remain a great many problems and shortcomings throughout CDE's overall operations. To address these problems, and help improve CDE's technical and financial performance, the new CDE

Administrator has requested technical assistance from A.I.D. We believe a program of technical assistance is essential if CDE is going to deal effectively with the many problems and decisions it is facing. The costs associated with CDE inefficiency loom so large in the Dominican energy picture that serious questions arise about the feasibility of any major investment in energy without reasonable expectations as to improvements in CDE's performance. While fundamental improvements in CDE's institutional capability are not likely to come about quickly or easily, we believe that improvements can be made and should be attempted. It is expected that such improvements will help CDE to attract badly needed financing from other donors and private lenders.

During project development, the Mission has examined the question closely of whether A.I.D. should be involved at all in addressing the problems of the public utility, and if so, to what extent. We had originally assumed that the problem of improving CDE management and operations would be a task addressed by the larger donors in the context of major hydroelectric or other investments. We have therefore coordinated closely from the outset with other donors regarding their plans in this area.

The IDB, it appears, will not be providing technical assistance to CDE anytime in the near future. The World Bank, on the other hand, has been particularly concerned about CDE's management and operational deficiencies, particularly in light of the upcoming $35 million Río Blanco dam project. World Bank officials, however, have admitted that it would not be possible for a Bank financed technical assistance program to get underway before the summer of 1982 at the earliest, which would not be sufficient to address the more immediate needs of CDE. Therefore, USAID and World Bank staff have discussed the possibility of a comprehensive program of technical assistance to CDE, with A.I.D. focusing on the more immediate, priority needs of CDE in the short term and the World Bank addressing the broader, more costly requirements of CDE over the medium to longer term.

During intensive review, USAID and the World Bank jointly financed a 3 month study of CDE's overall operations for the purpose of identifying the most important problem areas and defining appropriate objectives for technical assistance. (See Annex G.6). The study identifies the urgent requirements of CDE in the near term and makes recommendations to A.I.D. to finance these activities. It also identifies important medium and longer term problems appropriate to be addressed by the World Bank, including issues related to the statutory and regulatory context in which CDE operates. USAID has accepted the findings and recommnedations of the study, which are considered to be sound and well reasoned, and has discussed them in detail with World Bank and CDE officials. They serve as the basis for the technical assistance program described below.

While the division of labor proposed between A.I.D. and the World Bank is viewed as an appropriate arrangement for dealing with the CDE situation, it is recognized that the World Bank has not made a formal commitment to provide follow-on technical assistance to CDE. We have no reason to believe that the Bank would not proceed with such assistance in accordance with the recommnedations of its technical staff. Even if the Bank

did not proceed, however, the technical assistance to be provided by A.I.D. is considered essential and worth doing in any event. It has been A.I.D.'s intention not to continue technical assistance to CDE beyond the completion of the work proposed in this Project Paper. If neither the Bank nor any other source of technical assistance financing comes forward to support the broad range of technical assistance outlined in the study, USAID may be forced to reexamine its position and consider additional technical assistance to CDE, particularly in view of the central role of CDE in the overall energy picture.

5.b. Technical Assistance Program

The following have been identified as priority problem areas in which CDE requires outside assistance urgently in the short term.

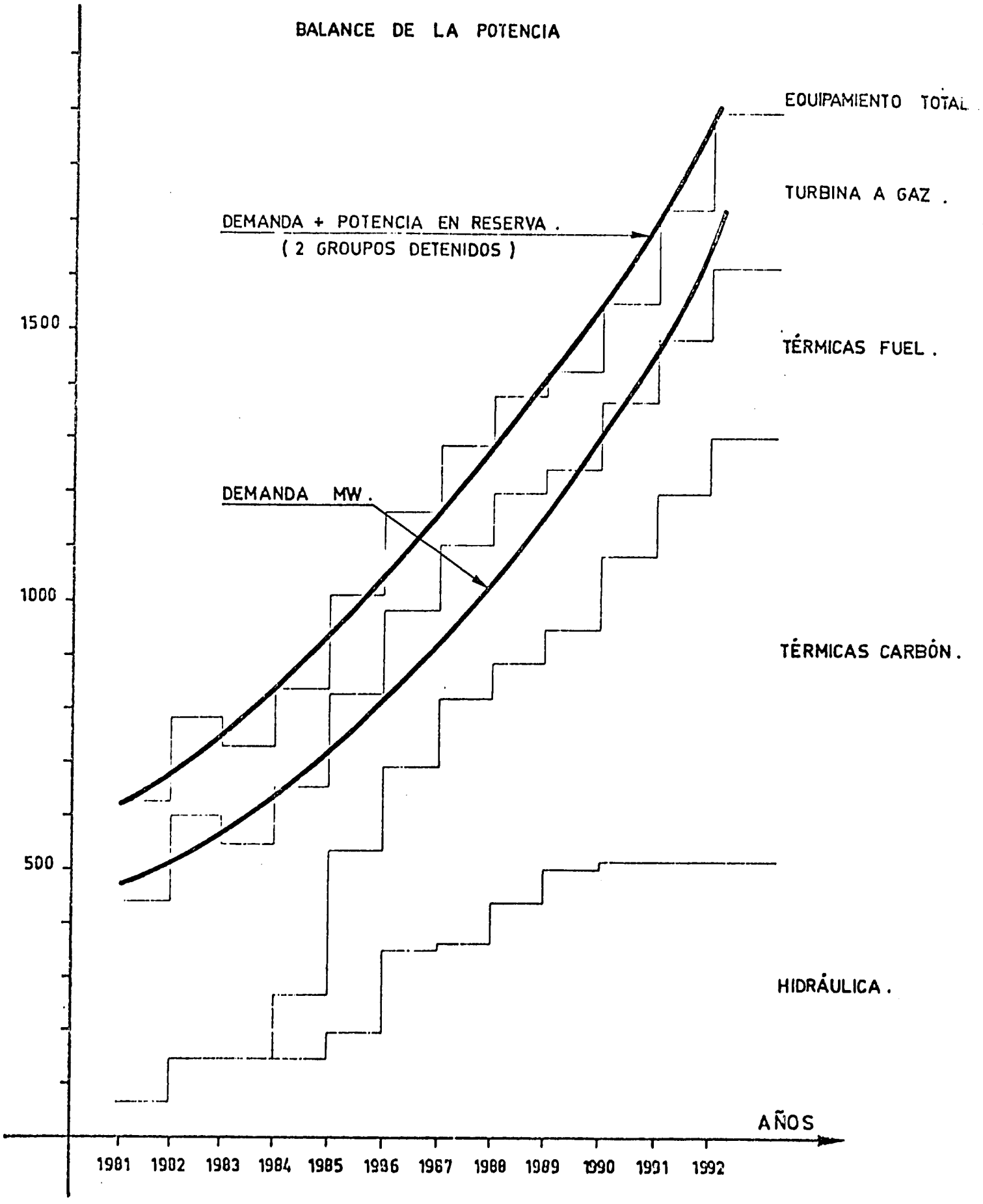
i) Coal Procurement

CDE's current expansion plans call for a major shift during the next decade away from petroleum as a generation source to coal. By 1990, coal will account for almost half of all electricity generated by CDE. (See Figure III.1.) Current plans call for the construction of four 125 MW coal plants at Itabo, near the port of Haina. The first of these, Itabo I, is already under construction and scheduled for initial operation in August, 1983. Hence coal must begin to be delivered in the spring of 1983 to allow adequate stockpiles to be formed. While the Itabo I unit will also be able to burn oil, a delay in coal firing would result in additional costs to CDE.

CDE personnel have no experience in coal procurement. Although the Bechtel study on coal conversion performed for the Energy Commission indicated a number of potential sources in the U.S., CDE has not yet initiated any coal procurement activities. The economic procurement of coal takes a long period of time, measured in years. Since coal probably will become one of the major costs of operating the CDE system in the future, it is imperative that coal and coal transportation contracts be obtained on as favorable a basis to CDE as possible. Evaluation of potential sources of coal and coal transport is a time consuming effort and should be initiated immediately.

The first step in purchasing coal is to determine the quantity and quality of coal required over as long a term as can be forecast. A strategy must be developed as to whether coal should be purchased on long term or short term contracts, the number of contracts required to assure diversity of supply and transportation, ownership or lease of transportation facilities, contract conditions, and other factors. Potential suppliers are then determined and a request for proposals prepared and issued. The request would be issued to a large number of suppliers, perhaps 50. Proposals received would be analyzed and reduced to a manageable number for more serious consideration. Visits should be made to the mines and land transportation facilities of those bidders selected for further consideration, to ascertain the validity of the proposals, discuss contract terms and conditions, and determine if a proper relationship can be established between the buyer and seller.

FIGURE III.1 CDE Expansion Plan



Coal purchasing activities do not terminate with signing of coal and transportation contracts. The administration and monitoring of the contracts is an on-going activity throughout the contract life.

The project will finance the costs of an experienced coal procurement consultant to assist CDE in evaluating potential sources of coal and coal transport and obtaining contracts on as favorable terms to CDE as possible. The consultant will provide on the job training to CDE personnel responsible for fuels procurement so that an institutional capability in this area can be developed. He will be retained as soon after project authorization as possible and will assist CDE for a period of 18 months - full time for the first 6 months and then on an intermittant basis for the next year. He will be assisted on an as needed basis by a lawyer specialized in coal contracts and by a transportation specialist. The total cost of technical assistance in this area is estimated at $160,000.

ii) Coal Strategy and Materials Handling

In addition to coal procurement, there are many issues relating to delivery, in-country transportation, storage, burning, waste disposal and environmental conditions in which CDE has virtually no experience and requires outside assistance. For example, the Haina port is currently a shallow water port incapable of handling larger coal transport vessels. Nor are there now adequate coal unloading facilities at Haina. This presents problems not only for the nearby Itabo plants, but also for the three large plants at Haina itself which CDE is planning to convert to coal.

Another issue deals with the availability of local coal. Once the quality and quantity of coal in the northeast of the country are firmly established, decisions will have to be made on the allocation and utilization of those resources. If the coal is indeed of low quality, then decisions will have to be made regarding possible adaptation of existing or planned coal plants.

A third important issue has to do with waste disposal. The burning of coal produces effluents which must be properly handled and treated to avoid undesirable environmental effects. Large quantities of ash are also released during combustion which must be collected and transported to a disposal area. Again, CDE has had no experience in dealing with these issues.

The project will finance the services of a Coal Strategist and Materials Handling Consultant who will help CDE to think through and develop alternatives for dealing with the entire range of issues related to coal sources, port facilities, transportation to Itabo and the Haina plants, storage, ash disposal and environmental concerns. He will review existing and ongoing studies, such as the Bechtel report on coal transport and utilization and the feasibility work currently being carried out by PRC Harris on expanded Haina port facilities, and evaluate their results within the overall context of coal utilization. The consultant will be assigned to the Engineering Department of CDE for a period of 12 months. The total cost for his services is estimated at $125,000.

iii) Transmission and Distribution Engineering Design

The growing demand for electricity, and the continuing expansion of the grid system which it implies, are placing considerable strains on CDE's in house engineering capability. Poor or faulty engineering of new transmission lines or distribution systems can be very costly in terms of maintenance, outages and possible reconstruction. To avoid such costs in the future, CDE engineers will required additional training in areas such as development of specifications and construction standards, cable tensioning, fuse coordination, automatic transfer arrangements and computerized techniques for transmission line and distribution system design.

Under the project, a specialist in these areas will provide on-the-job training to CDE engineering staff for a period of approximately six months. The total cost of his services is estimated to be $50,000.

iv) System Planning

The Planning Department in CDE is a relatively new organization, created in 1980. Its task of planning overall system expansion and operation is viewed as vital to improved performance on the part of CDE. CDE's current expansion plan for the 1980s was prepared by the French firm SOFRELEC, with very little technical transfer or training of CDE personnel. The SOFRELEC plan, of course, will have to be reviewed and revised on a continuous basis. Although the Planning Department has received sporadic assistance from French and German consultants, it appears that there is still a strong need for overall guidance as well as specialized training.

It is proposed that a specialist in system planning be assigned to the Planning Department for a period of one year, to provide guidance to Department management in overall approaches to system planning as well as on-the-job training to Department personnel for the following purposes:

- conducting generation planning studies, including development of planning criteria, analysis of production costs and economic evaluation of alternatives;

- conducting transmission and distribution planning studies, taking into account optimal land use, load center feeding and transferring, voltage conversion, and costing and evaluation of alternatives;

- use of computer programs in demand and load forecasting;

- performance of transient stability studies; and

- performance of cost of service studies and development of tariffs.

The Planning Consultant would be assisted for short periods of time on an as needed basis by specialists in computer programming and tariffs. The total cost of services in this area is estimated at $150,000.

v) System Protection and Hot Line Maintenance

The overall reliability of the CDE system is quite poor, with frequent disruptions of service and generally low power factors. There are a number of reasons for the poor reliability of the transmission and distribution system, including lack of maintenance skills, (only 14 of the 479 members of the Operations Department assigned to transmission, distribution and substation maintenance are qualified engineers), parts unavailability, limited number of vehicles, false circuit tripping, etc.

Although the Operations Department is undertaking several measures to improve maintenance performance, there are two areas in which it appears that additional training of CDE personnel is urgently needed if overall system reliability is to be improved. The first area is system protection, which involves primarily circuit breakers and relays. A specialist in system protection will provide three months of on-the-job training to personnel of the Operations Department in circuit breaker operation and maintenance, relay and reclosure setting and operation, and other tasks related to system protection. The cost of this in-country training is estimated at $30,000.

The other operational area in which CDE badly needs assistance is "hot line" maintenance. Three months training will be provided to personnel of the Operations Department in special techniques and precautions required in maintaining lines which are "hot", that is, still conducting electricity, not only for preventive maintenance purposes, but also to minimize the extent and duration of outages when they do occur. Training in "hot line" maintenance is estimated to cost $25,000.

vi) Lineman Safety

During 1980, CDE employees were involved in 120 accidents, resulting in 4 serious injuries (loss of limbs or vision) and one death. Although training programs in safety measures are available to CDE employees, their content and outreach clearly needs to be improved.

The project will finance 4 months of technical assistance to the Administrative Department of CDE for the purpose of reviewing existing safety policies and training programs, developing improved policies and programs as necessary and supervising the initial application of new safety measures and start up of new training programs. While this activity is not designed to affect directly the overall efficiency and economic performance of CDE, it is still considered to be an urgent requirement of CDE in the short term. The cost of technical assistance for this purpose is estimated at $40,000.

vii) Financial Reporting

The new heads of the Administrative and Commercial Departments of CDE are carrying out a number of measures to improve financial analysis and administration. One area in which assistance is badly needed, however, is financial reporting. Reports prepared by different Departments of CDE are

often inconsistent or incomplete. For example, the Office of Financial Management prepares reports on the financial position of CDE as well as financial projections which differ both in format and often in content from statements of purchases and collections prepared by the Commercial Department and budgetary reports prepared by the Controller, who reports directly to the Administrator of CDE. Reports by CDE to other government agencies or international institutions also follow a different classification of accounts than used in internal CDE reports. The problem is partly a result of the fact that different units within CDE perform different financial functions or are responsible to different internal or external authorities. Nevertheless, there appears to be a good deal of room for improving and standardizing financial reports and reporting procedures. It is expected that doing so would greatly improve the flow of vital financial information among different CDE Departments and offices and contribute to improved financial analysis, planning and budgeting.

Under the project, a Financial Consultant will assist the Director of Administration of CDE in reviewing all financial reports and statements prepared by CDE, and recommend improvements in the format, content and distribution of those reports. New reporting procedures or instruments will be introduced if appropriate, and specific guidance will be given in the area of financial reporting to current and potential lending institutions.

Technical assistance in this area will be provided over a period of 3 months at an estimated cost of $30,000.

SUMMARY BUDGET - CDE
TECHNICAL ASSISTANCE PROGRAM

($000)

	A.I.D.	GODR	TOTAL
1. Coal Procurement	160	-	160
2. Coal Strategy and Materials Handling	125	-	125
3. Transmission and Distribution Engineering Design	50	-	50
4. System Planning	150	-	150
5. System Protection	30	-	30
6. Hot Line Maintenance	25	-	25
7. Safety	40	-	40
8. Financial Reporting	30	-	30
Local personnel and Materials	-	50	50
Inflation and Contingency (15%)	90	-	90
TOTAL	700	50	750

IV. PROJECT ANALYSES

A. ECONOMIC ANALYSIS

1. Energy and the Dominican Macroeconomic Situation

Superficially, the Dominican Republic has done quite well economically in recent years despite the very large increase in its oil bill. Real GDP increased by 4.8% in 1979, by 5.4% in 1980, and early projections were for a 5.5% rate of growth in 1981. This last figure now seems far too optimistic in view of the apparent slowdown in economic activity resulting from a general tightening of credit by the monetary authorities. The overall picture, however, is one of continuing growth in the face of an increase in the value of petroleum imports from $199 million in 1978 to an estimated $502.5 million in 1981, representing from 4.2% to 6.3% of GDP.

Despite the short-term buoyancey, the longer term outlook reveals a more worrisome picture. The Dominican Republic's external accounts have been sustained through 1980 primarily by high export prices for its principle traditional exports, particularly gold and sugar. The country's export sector has long faced extreme volatility for virtually all its traditional exports and at the end of 1980 the index of export prices was 43% above its level of 1978. This increase actually outweighed the increase in import prices so that, despite the increase in petroleum prices in 1979-1980, the country's terms of trade actually improved during that two year period. As export prices have returned to more traditional levels during 1981, the full impact of the petroleum price increases are likely to be felt.

Despite the high level of export prices in the past year, the nation's balance of payments position has been weak. The current account deficit doubled in 1980 to a level of $720 million, equal to 10.7% of GDP. The Dominican Republic was able to finance this deficit in 1980 by an increase of $200 million in disbursements on loans to the private sector, through capital flows and remittances of undetermined magnitude and origin, and by a decline of $117.9 million in official reserves.

In 1981 and beyond, some assistance in financing petroleum imports will be available from the Venezuelan-Mexican oil facility. This will finance 30% of the petroleum shipments to the Dominican Republic's refinery (but not other imports of petroleum products) on concessional terms. While this will provide some relief in the short term, the use of medium and long-term credit to finance consumption expenditures, even on concessional terms, is clearly not a satisfactory long-term arrangement.

In addition to aggregate income and the balance of payments, the energy situation also has had an adverse impact on the GODR's fiscal position.

This results principally from the effect of CDE's operating deficit on the consolidated public sector budget deficit. Between 1979 and 1980, the central government's fiscal deficit declined by RD$95 million while the consolidated public sector deficit increased by RD$40 million. Significantly, CDE's 1981 deficit (before budget transfers from the central government) was recently projected by an IMF report at RD$50-60 million.

All of these considerations suggest that, despite the apparent buoyancy of the national economy, the country's continuing dependence on imported petroleum, and the apparent inefficiency with which imported petroleum is used, particularly by CDE, will be a source of serious problems and an obstacle to future growth unless effective solutions can be found.

2. Overall Project Cost Effectiveness

Before undertaking the analysis of the individual components of this project, it would be useful to consider the broad cost-effectiveness of the activities that have been selected for the project. Cost effectiveness, broadly conceived, requires that, quite apart from the determination that individual project activities meet minimum benefit-cost criteria, the project as a whole achieves its objectives at less cost (or with greater output per unit cost) than possible alternative projects. In other words, apart from determining that a given project is a good project, is it the best project that could be done?

In the development of this project, the Mission has attempted to develop and assess the widest possible set of potential project activities. Using extensive data developed for the energy assessment, the Mission contracted with Energy Development International to identify and evaluate, in a preliminary fashion, a wide range of potential project activities. Twenty potential activities were identified and subjected to a preliminary evaluation. The results of this evaluation are summarized in Annex G.1. In examining diferent options for inclusion in this project, a number of criteria were applied including rate of return, potential money and energy savings through further replication (so that the project would have a significant impact on the energy problems in the long run), impact on the poor, employment effects, interest of other donors, and general suitability for A.I.D. financing. This analysis formed the basis of the project as presented in the PID.

During the course of PP development, the project as presented originally in the PID was modified somewhat. Some options proved to be more attractive than previously thought, in particular minihydro and industrial conservation. The wood fuel component, it was decided, required a more extensive research phase which is reflected in the PP.

The transportation s ›posed in the PID is in large part being undertaken with IDB financing, therefore been dropped from the final projec design.

Thus the compone :his project have passed through a multiple filtering process: rgy Assessment; the EDI project identification economic analysis; a intensive review of each component.

As a result of this , the Mission is confident that this is not merely an economically attr ›roject, but that it is the most attractive project that systematic, car ıd flexible planning can produce for financing by A.I.D. in the energy

3. Economi ɜis of Project Components

a. Nationa / Investment Planning

A small but l component of the project, assistance in developing and prior the Dominican Republic's energy investments, is an important next step ;y planning following on the national energy assessment. An anal alternative project activities carried out as part of intensive review ɜ project provided estimates of the likely outcome of such a planning e . It estimated that the planning activity would initiate a continuin ɜs which would lead to ultimate incremental investments of $138 n in the energy area and that these investments could save some 2,37(ınd barrels of oil equivalent (KBOE) by 1990 and 3,225 KBOE by 2000. just on the incremental investment and the incremental petroleun s, this would imply a rate of return which is very positive indeed. Anc ıy of looking at the planning component is as a kind of insurance th ;y projects undertaken by the GODR are worthwhile and that the most wo ɜ projects are carried out first.

b. Industri ɜervation Program

i) Introductior

The industri ıervation program covers a very broad spectrum of activities which have ɜir ultimate objective savings in energy usage in return, usually, for ıcrease in recurrent expenditures (in the case of so-called housekeepi ıres) or some investment. The investment may either be embodied i e of equipment, in which case its useful life ends with the equipment's, may be disembodied as, for example, an investment in personnel trainin ›cedures. Even in the latter case, the investment will usually be spec a particular technology or production process so that future changes ıction techniques will eventually render the investment obsolete.

Despite the ıat industrial conservation investment in an existing plant typic a limited useful life, evidence from studies in the Dominican Republi ›ther Caribbean countries, especially

Jamaica, and elsewhere, strongly suggests that the return on such investments in quite high. In the course of PP de nt, a USAID consultant team undertook short visits to several actories, including a salt refinery, a textile mill, and a bakery and id investments with apparent payback periods of 6 months, 1 year, and respectively. These estimates are consistent with similar findings els n the Caribbean*.

In passing, some comments should be made uality of these and similar estimates of payback periods for investmen ll as on the appropriateness of using payback periods as invest teria. The use of payback periods rather than the more appropriate i rate of return (or other measures mathematically related to it) appea ve become deeply imbedded in the literature and practice of industr ervation. Nevertheless, energy auditors and other specialist d under this project will need to be made aware that for an investment eful to an entrepreneur, it is necessary to do more than mere the investment cost by the anticipated annual energy saving. Fir need to be aware of the additional one-time and recurrent costs which ures entail. These include, but are not limited to the cost of lost p n of shutting down a production line, or even an entire plant, while al s are made, as well as the additional personnel cost that may be invol aintaining and adjusting energy using processes. Installing a ga not save energy; that saving only occurs when someone reads the gag akes some action - a process which involves some additional recurrent co

Even when investment cost estimates includ osts to the firm, it is crucial for rational decision makers to arrive a estimate of the useful life of the conservation investment. At on e, if equipment is scheduled for replacement or likely to be scrappe orter period of time than the payback period, it is obviously not a wo t. private investment. Even when the expected useful life is longer than t ack period, the investment is not necessarily worthwhile. The rel between payback period, useful life, and rate of return is a compli e and is summarized in Table IV.1 This Table can be useful in decidin a proposed conservation investment is worthwhile or not.

*For example, in Jamaica, a study by D.K.Hale, "Er servation for Industry and Commerce in Jamaica" (Kingston, July timated that 15% of total energy usage could be saved by the implement measures having an average payback period of 1.5 years.

ii) Private Financial Feasibility

Because of the diverse nature of energy conservation activities, it is difficult to say a prioi what a typical investment and rate of return will be. The experience of the three plant visits mentioned above, as well as experience elsewhere, suggests that a typical payback period (when all costs and benefits to the firm are included) would be approximately 2 years, and the typical remaining useful life of equipment would be 10 years. As can be seen from Table IV.1, this implies a rate of return to the investment of approximately 49.1 percent. It is expected that most Dominican entrepreneurs will find this rate of return highly attractive.

iii) Economic Feasibility of Energy Conservation as an Activity

Although it is very likely that industrial conservation activity in itself will prove a very worthwhile investment from the point of view of the entrepreneur, it does not necessarily follow, because of divergencies of private from social costs, that it will prove equally attractive from the point of view of Dominican society as a whole, nor does it necessarily follow that any given project to promote industrial conservation is necessarily a worthwhile project. To look at the latter question first, it is necessary to look at what can be called project "overhead" costs, costs which are not directly involved in producing project outputs but which are necessary to carrying out the propram. These overhead costs include salaries of project personnel, technical assistance, commodities, training, and grants under the audit finance program. Table IV.2 summarizes these costs on the basis of preliminary project budget estimates. To the extent that these costs are reduced, as expected, in final budget estimates, the internal rates of return discussed below will be even higher. The amounts shown in Table IV.2 are expressed in local currency. Those that involve imports have been converted at the shadow foreign exchange rate (RD$1.36 = US$1.00).

Not all of the amounts in Table IV.2 are strictly project overhead. The personnel whose cost in the first line item will be engaged in both audits and pilot projects. Both the audits and pilot projects can be expected to lead to direct energy savings whose benefits are not included here solely because the amount of such direct savings is small and uncertain. Similarly, the audits which are grant-financed under the Audit Finance Program (the last line item) can be expected to lead not only to energy saving investments through the Industrial Conservation Credit Fund, but also to direct energy saving opportunities which do not involve signficant investments. Nevertheless, it is likely that the principal benefits of the project will result from the investments growing out of the energy audit process and financed, at least partially, from the credit fund. The estimated stream of economic costs and benefits from these investments is shown on Table IV.3.

In arriving at the costs and benefits shown on Table IV.3, certain assumptions and adjustments have been necessary. First, it has been assumed that 50 percent of both energy saving investment and the energy saving itself are foreign exchange costs. Petroleum imports are, at the present time,

TABLE IV.1
PAYBACK PERIOD AND RATE OF RETURN
(Assuring Level Payback)
PAYBACK PERIOD - (YEARS)

		0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
	1	100.0	0.0	-33.3	-50.0	-60.0	-66.7	-71.4	-75.0	-77.8	-80.0
	2	173.2	61.8	21.5	0.0	-13.6	-23.2	-30.4	-36.0	-40.4	-44.2
	3	192.0	83.9	44.6	23.4	9.7	0.0	-07.3	-13.1	-17.9	-21.8
Remaining	4	197.5	92.8	55.2	34.9	21.8	12.6	5.6	0.0	-04.6	-08.4
Useful	5	199.2	96.6	60.4	41.4	28.6	19.9	13.2	7.9	3.6	0.0
Life	6	199.7	98.3	63.2	44.5	32.7	24.3	18.0	13.0	8.9	5.5
(Yrs)	7	199.9	99.2	64.6	46.5	35.1	27.1	21.1	16.3	12.5	9.2
	8	200.0	99.6	65.5	47.8	36.8	28.9	23.2	18.6	14.9	11.8
	9	200.0	99.8	66.0	48.6	37.8	30.3	24.6	20.3	16.7	13.7
	10	200.0	99.9	66.3	49.1	38.5	31.1	25.7	21.4	17.9	15.1
	∞	200.0	100.0	66.7	50.0	40.0	33.3	28.6	25.0	22.2	20.0

imported through the official market so that they are adjusted at a rate of 1.36:1, while imports of industrial machinery are made through the parallel market where the adjustment for the shadow price of foreign exchange is approximately 1.088:1.

Allowance also has to be made for the costs of loan administration incurred by the intermediary commercial banks processing conservation loans. Although this cost is not paid directly by the project, it nonetheless is a use of resources entailed by the project and thus a true economic cost. This has been estimated from the spread between the bank's lending rate and its cost for funds from FIDE, which is 4 percent. This spread is presumably intended to compensate the bank both for its costs of loan administration and for its default risk. However, the latter is not a true economic cost but rather a transfer payment. In the absence of non-specific information, it has been assumed that one-half of the spread is loan administration costs and that it is equal to 2 percent of the average amount of the principle outstanding during the life of the loan.

Next it has been necessary to make some assumption about the effects of inflation on the real value of the conservation credit fund. It should be emphasized that once investments are made, the benefits in the form of cost savings are real benefits and are presumed to be unaffected by changes in price level. However, inflation between the beginning of the project and the time that investments are undertaken will reduce the real value of the fund and consequently the size of estimated costs and the stream of benefits associated with it. It is likely that investment funds from other sources will be made available to compensate for this. However, these have not been taken into account here.

Finally, it has been necessary to make some assumptions about what will happen to the lending activity in the period following the project. The fund is intended to be revolving. However, it is clear that in the immediate post-project period, reflows will not be sufficient to maintain the real value of lending at anything like the rate established in the project. It has been assumed that FIDE will make sufficient funds available to maintain the real value of lending at the rate established in the last year of the project. It has also been assumed that Dominican personnel, vehicle maintenance, and certain other costs will be continued for at least 10 years after initiaton of the project.

It can be seen from Table IV.3 that under this set of assumptions, the conservation program has an internal rate of return of 36.1 percent and a net present value of RD$25.11 million.

TABLE IV.2
INDUSTRIAL CONSERVATION PRELIMINARY OVERHEAD COSTS ($000)*

	YEAR 1	YEAR 2	YEAR 3	YEAR 4
Dominican Personnel	125	225	238	238
Technical Assistance (adjusted for foreign exchange)	340	340	272	272
Instruments	136	11	11	11
Vehicles	41	20	20	20
Publications and Materials	34	68	102	102
Overseas Training	-	200	325	475
"Overhead Costs"	839	891	968	1118

iv) Sensitivity Analysis

Sensitivity analyses have been performed on two major areas of uncertainty in this subproject, the average "payback period" of industrial conservation investment, and the degree of post project conservation activity. Table IV.4 considers the former. In this case it has been assumed that the average payback period is four years rather than the two years previously assumed. Again, a ten year useful life of investment has been assumed. The private financial rate of return under such circumstances is 21.4 percent. This is probably about the minimum rate of return which entrepreneurs are likely to accept. With the other assumptions unchanged, the program has an IRR of 16.0% and a net present value of RD$3.43 million at a 12 percent discount rate. Thus, it is still an acceptable project activity.

Finally, Table IV.5 examines project feasibility if there is no continuation of investment in the post project period. This is an extreme case of the very real possibility that there could be some fall off in conservation investments if financing availability should prove to be a constraint. Table IV.5 demonstrates that even in this extreme case, the program remains highly worthwhile with an IRR of 29.2% and a net present value of RD$6.88 million.

* Final budget estimates for project "overhead costs" are in fact considerably lower: 799, 625, 589, 589. Internal rates of return for this project component are therefore even higher than presented here.

TABLE IV.3

NET ECONOMIC COSTS AND BENEFITS FROM ENERGY CONSERVATION PROGRAM AND SUBSEQUENT REPLICATIONS

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Overhead Costs	-839	-891	-968	-1118	-266	-266	-266	-266	-266	-266	-266										
	1 Benefits			684	684	684	684	684	684	684	684	684	684									
	Costs		-1211	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11									
Costs	2 Benefits				1189	1189	1189	1189	1189	1189	1189	1189	1189	1189								
and	Costs			-2105	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20								
Benefits	3 Benefits					1552	1552	1552	1552	1552	1552	1552	1552	1552	1552							
from	Costs				-2745	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26							
Invest-	4 Benefits						1552	1552	1552	1552	1552	1552	1552	1552	1552	1552						
ments	Costs					-2745	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26						
Under-	5 Benefits						1552	1552	1552	1552	1552	1552	1552	1552	1552	1552	1552					
taken	Costs						-26	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26					
in Year	6 Benefits								1552	1552	1552	1552	1552	1552	1552	1552	1552	1552				
	Costs							-2745	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26				
	7 Benefits									1552	1552	1552	1552	1552	1552	1552	1552	1552	1552			
	Costs								-2745	-26	-26	26	-26	-26	-26	-26	-26	-26	-26			
	8 Benefits										1552	1552	1552	1552	1552	1552	1552	1552	1552	1552		
	Costs									-2745	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26		
	9 Benefits											1552	1552	1552	1552	1552	1552	1552	1552	1552	1552	
	Costs										-2745	-2745	-26	-26	-26	-26	-26	-26	-26	-26	-26	
	10 Benefits												1552	1552	1552	1552	1552	1552	1552	1552	1552	1552
	Costs											2745	-26	-26	-26	-26	-26	-26	-26	-26	-26	-26
		-839	-2102	-2400	-2001	357	1883	3409	4935	6461	7987	9513	14050	13377	12208	10682	9156	7630	6104	4578	3052	1526

Financial IRR of Activity = 49.1%
Economic Rate of Return of Project = 36.1%
Net Present Value of Subproject = 25.110 million

TABLE IV.4

SENSITIVITY ANALYSIS
AVERAGE PROJECT HAS A 4 YEAR PAYBACK PERIOD

	Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Overhead costs	0	-839	-891	-968	-1118	-266	-266	-266	-266	-266	-266											
	1		-1211	331	331	331	331	331	331	331	331	331	331									
Benefits	2			-2105	575	575	575	575	575	575	575	575	575	575								
from	3				-2745	750	750	750	750	750	750	750	750	750	750							
Investments in	4					-2745	750	750	750	750	750	750	750	750	750	750						
Year	5						-2745	750	750	750	750	750	750	750	750	750	750					
	6							-2745	750	750	750	750	750	750	750	750	750	750				
	7								-2745	750	750	750	750	750	750	750	750	750	750			
	8									-2745	750	750	750	750	750	750	750	750	750	750		
	9										-2745	750	750	750	750	750	750	750	750	750	750	
	10											-2745	750	750	750	750	750	750	750	750	750	750
		-839	-2102	-2742	-2557	-1355	-605	145	895	1645	2375	3411	6906	6575	6000	5250	4500	3750	3000	9750	1500	750

Financial IRR of the Activity = 21.4%
Economic IRR of the Project = 16.0%
Net Present Value of the Project = RD$3.431 million

TABLE IV.5

SENSITIVITY ANALYSIS

PROJECT ACTIVITIES CEASE AFTER PROJECT
(RD$000)

	Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Overhead costs	0	-839	-891	-968	-1118									
Benefits from	1		-1211	673	673	673	673	673	673	673	673	673		
Investments in Year	2			-2105	1169	1169	1169	1169	1169	1169	1169	1169	1169	
	3				-2745	1526	1526	1526	1526	1526	1526	1526	1526	1526
		-839	-2102	-2400	-2021	3368	3368	3368	3368	3368	3368	3368	2695	1526

Financial IRR of Activity = 49.1%
Economic IRR of Project = 29.2%
Net Present Value of Project = RD$6.883 million

This second case also provides some insight into the problem of how long energy conservation opportunities can be expected to continue. There is presumably an ongoing process by which older plant and equipment is replaced by newer equipment embodying more energy efficient precesses and in which energy conserving procedures become commonly accepted. In other words, there almost certainly will come a point where equipment financed under the project will become superfluous. Even before that date, the most favorable energy conservation opportunities may be exhausted so that the average payback period will begin to lengthen, and the expected rate of return to decline below those projected at the outset. The case presented in Table IV.5 suggests what the lower bound might be of this effect on the economic viability of the program.

Only a combination of these two assumptions, an average payback period of four years and no investment continuing after the project were found to produce an unacceptable rate of return of 10.1 percent (details are not listed here). This adverse combination of circumstances is considered highly unlikely.

c. Mini-Hydro Development Program

i) Costs and Benefits of Small Hydro Installations

The costs of small hydro installations are fairly straightforward in principle. They are calculated based on engineering estimates of the costs of construction and delivered prices of equipment. It is necessary to make two adjustments to these financial costs. First, for the items which are imported, the dollar prices must be multiplied by the shadow price of foreign exchange (RD$1.36 = US$1.00), which reflects the true scarcity value of foreign exchange. Second, to the extent that the labor employed in construction would otherwise be idle, the wages paid for the labor may overstate the opportunity cost of the labor and some adjustment may be appropriate to obtain its true economic cost.

While calculating the costs of small hydro installations is simple, calculating the benefits is relatively complicated. This is because the nature and distribution of the benefits will vary depending on the circumstances and on what is expected to be the situation in the absence of the project. For example, if electricity would be supplied absent the project, the benefit of minihydro is the total cost saved by not generating it by other means. Consumer welfare is unaffected (consumers do not care where their electricity comes from). If electricity would not be supplied in the absence of the project, the benefit of minihydro is the amount which consumers would be willing to pay for the electricity generated.

In sum, four different circumstances are envisioned in which minihydro may be appropriate, as follows:

1. Minihydro replaces some amount of electricity which is either currently being supplied to a community or soon to be supplied from another source, such as the national grid or a local diesel generating unit. In this case, the benefit is the cost saved by supplying the electricity from minihydro rather than from the other source.

2. Minihydro is introduced to a community which would not otherwise be electrified. In this case, the benefit is the value which consumers place on the newly supplied electricity. This can be measured by the amount they actually do pay plus some estimate of the excess over this which they would be willing to pay rather than do without (consumer surplus).

3. Minihydro replaces electricity from another source as in case 1 but, because of its lower cost, consumers demand a greater amount of electricity. The benefit of minihydro in this case is, in effect, a combination of the benefits described in the first two cases. The first benefit is the cost avoided by generating electricity from mini-hydro rather than by other means. The second benefit is the value of the net additional consumptions which can be approximated by the average of the pre and post-hydro prices multiplied by the additional consumptions.

4. Minihydro is introduced into a community which would not otherwise be electrified and the installation produces excess power which is sold back to the grid. The benefits of the project are, first, the value which local consumers place on the power they consume (as in case 2 above) plus the cost which CDE avoids by not generating the power it buys back itself.

Evaluating benefits in case 2 (and the part of cases 3 and 4 which represent local consumption) is fairly difficult, as is illustrated in Figure IV.1. The task is complicated because electric generating capacity is installed in discrete lumps.

Figure IV.1

Price
of electricity

Quantity of Electricity
Consumed

The amount that consumers pay for electricity is PAQO, but the amount they would be willing to pay, rather than do without electricity, is BAQO. Therefore, BAQO is the value (to the consumers) of providing electricity to the isolated community rather than not provide it. The problem of estimating the size of BAP (sometimes called "consumer surplus") or alternatively, specifying the functional form of D in order to measure $_0Q$ D (Q) d (Q) are difficult but not insolable.

Before moving on to the evaluation of the two sites specifically evaluated for development of this project paper, the importance of estimating price responsiveness of consumer-demand and consumer surplus (which are two different aspects of the same question) should be emphasized. If consumer demand is highly price responsive, then ignoring the degree to which lower prices will stimulate additional demand will lead to an underestimation of the benefits of switching from grid or isolated thermal to hydro. If demand is relatively price inelastic, this effect will be small. However, at a given price and level of consumption, the more inelastic demand is, the larger consumer surplus in an isolated site case will be, relative to revenue. A failure to estimate what consumers would be willing to pay in such a case would lead to a serious and inappropriate bias against isolated sites in the site selection process. Therefore, estimation of consumer surplus and analysis of the relationship between price and demand in potential mini-hydro communities, has been included as an important aspect of the site selection process.

In preparing the project, two possible mini-hydro sites were examined in detail. These will not necessarily be the sites selected for construction under the project. Rather, they are included here to illustrate applications of the site selection methodology and to demonstrate that, in specific instances, mini-hydro is economically feasible.

ii) Economic Analysis of El Pinar (Río Banilejo)

The chief characteristic at the El Pinar site is that the majority of the power generated by the proposed installation would be sold to the grid with a small but steadily growing component being consumed locally. This corresponds to case 4 described above.

The construction, maintenance, and operating costs for the site were developed from data supplied by CDE and INDRHI. For those items of equipment imported from abroad, the shadow price of foreign exchange of RD$1.36 = US$1.00 was applied. No attempt was made to estimate the effect of indirect foreign exchange costs or possible overevaluation of labor due to a possible excess supply of labor in the region at the time construction might be undertaken. The economic value of construction costs was estimated to be RD$1,230,870 and by use of a CDE rule of thumb operations and maintenance costs were estimated to be RD$13,670 per year. (See Table IV.6).

The benefits from the El Pinar site are of two types, the cost saving by CDE in not having to generate electricity by other means, and the value to El Pinar area consumers of the electricity they consume.

TABLE IV.6
COSTS AND BENEFITS
EL PINAR (RIO BANILEJO)

Year	Economic Cost	Grid Benefits Kwh x 0.1234	Local Benefits Kwh x 0.05
1	13,670	3,557,000	298,000
2	13,670	3,548,000	307,000
3	13,670	3,539,000	316,000
4	13,670	3,530,000	325,000
5	13,670	3,520,000	335,000
6	13,670	3,510,000	345,000
7	13,670	3,499,000	356,000
8	13,670	3,488,000	367,000
9	13,670	3,478,000	377,000
10	13,670	3,466,000	389,000
11	13,670	3,455,000	440,000
12	13,670	3,442,000	413,000
13	13,670	3,430,000	425,000
14	13,670	3,417,000	438,000
15	13,670	3,404,000	451,000
16	13,670	3,391,000	464,000
17	13,670	3,371,000	478,000
18	13,670	3,362,000	493,000
19	13,670	3,348,000	507,000
20	13,670	3,332,000	523,000
21	13,670	3,317,000	538,000
22	13,670	3,301,000	554,000
23	13,670	3,284,000	571,000
24	13,670	3,267,000	588,000
25	13,670	3,249,000	606,000
26	13,670	3,231,000	624,000
27	13,670	3,212,000	643,000
28	13,670	3,193,000	662,000
29	13,670	3,173,000	682,000
30	13,670	3,153,000	702,000

IRR = 35.6%
Net present Value = RD$2.268 million
Benefit Cost ratio = 2.69

The benefits associated with the electricity sold to CDE consist of the resource use avoided in not generating that electricity thermally. This is not necessarily the same as the cost to CDE of generating that same electricity. In the absence of more specific information, the estimates done have been based on CDE's reported 1980 operation and maintenance cost (i.e. excluding capital and overhead costs) per Kwh of RD$0.967. Of this, RD$.07/Kwh is fuel cost, of which RD$.0577 is petroleum content and the remainder refining and distribution costs. The estimated shadow price of foreign exchange was applied to the petroleum content. In order to convert the non-petroleum value to 1981 pesos, the non-petroleum content of the O&M costs was adjusted for the estimated inflation between 1980 and 1981 of 15%. Since, in fact, international petroleum prices did not change appreciably in this period, no inflation adjustment is applied to the petroleum content. the resulting economic cost saving per Kwh is RD$0.1234.

There are two reason to believe that this figure somewhat understates the true value of the cost saving. First, there may be some potential capital cost saving to CDE in addition to O&M savings. Second, the foreign exchange content of non-petroleum O&M expenditures has been ignored. The effect of these is probably small.

In valuing the electricity consumed in the El Pinar area itself, the estimated tariff rate of 5 centavos per Kwh has been used. Initially, the benefit cost analysis has been performed on the assumption that consumer surplus is zero. However, a sensitivity analysis is performed using an alternate value.

Tables IV.6 and IV.7 summarize the benefit cost analysis as well as the results of the sensitivity analysis. Under the assumption of no consumer surplus, and constant real petroleum prices, the project shows an internal rate of return of 35.6% and a net present value of RD$2.268 million. Case 2 considers the effect of a 15 percent cost overrun, a common occurence in this type of project. The effect is to reduce the IRR to 30.9 percent and the NPV to RD$2.083 million. Case 3 addresses the valuation of consumer surplus from locally consumed electricity. It assumes that consumer surplus is equal to the value of revenue from sales. In other words, that consumers would be willing to pay precisely twice what they will, in fact, pay. This is a totally arbitrary assumption but as good as any other. In this case, the IRR rises to 36.9 percent and the NPV to RD$2.420 million. Combining the two previous cases, the cost overrun with the assumption about consumer surplus, yields and IRR of 32.1 percent and a NPV of RD$2.235 million. The final case examines the effect of changes in real petroleum prices. The previous cases have assumed that energy prices will remain constant in real terms during the period of the analysis. Case 5 shows that if petroleum prices rise by 3 percent per year, this program has an IRR of 39.6 percent and a NPV at RD$3.299 million.

In conclusion, it is clear that, under a broad range of assumptions, the El Pinar-Río Banilejo subproject has an acceptable internal rate of return.

TABLE IV.7
SENSITIVITY ANALYSIS
RIO BANILEJO - EL PINAR SITE

CASE	ASSUMPTIONS	IRR	NET PRESENT VALUE
1.	Costs as estimated, constant real fuel prices, consumer surplus equal to zero	35.6	RD$2.268 million
2.	Construction cost overrun at 15%	30.9	RD$2.083 million
3.	Consumer surplus equal to amount paid for electricity	36.9%	RD$2.420 million
4.	Consumer surplus equal to amount paid and 15% construction cost overrun	32.1%	RD$2.235 million
5.	Cost of estimated consumer surplus equal to zero and real petroleum price rise by 3% per year.	39.6%	RD$3.299 million

Cost Effectiveness

It is fairly obvious, since the proposed installation has a total economic cost per Kwh of 4.3 centavos* and the average fuel cost alone for CDE's termal installation is 7 centavos per Kwh, that mini-hydro is more cost effective than a thermal plant in this particular case.

*The construction cost of RD$1.231 million is equivalent to an annual payment of RD$152,805 over 30 years at 12% discount rate. Adding to this the operating and maintenance cost of RD$13,670 gives an annual equivalent cost of RD$161,475. Annual generation is estimated at 3855 Kwh which gives an economic cost of generating of 4.3 centavos per Kwh.

However, the study of the Banilejo site carried out during intensive review went beyond this and looked at five alternate configurations of mini-hydro for the site and computed a benefit cost ratio for each configuration. Although the ratio was computed using financial rather than economic costs, the ranking of the projects is not altered. The configuration with the highest benefit cost rate was selected.

Financial Feasibility

Since 90 percent of the output of the project is initially to be sold to CDE, the price which CDE pays for this excess generation is clearly crucial to the project's financial viability. CDE currently buys excess power from Falconbridge at 5 centavos per Kwh and this "buy back" price has been assumed in much of the preliminary analysis for the Banilejo site. However, the financial cost per Kwh generated in the subproject is 3.8 centavos per Kwh. Since CDE's avoidable cost appears to be much higher than either figure, a price of 5 centavos per Kwh would distribute benefits more to CDE than to the residents of El Pinar.

If a higher buy-back rate approaching CDE's avoidable cost is established, it would appear that the optimum tariff for local consumption would be equal to the buy-back rate. If the community has the option of selling electricity to CDE at 10 centavos or 12 centavos per Kwh, for example, it would be less than optimal to sell it to the local residents for less.

Regardless of this, it is clear that at a tariff of 5 centavos or more, the project is financially feasible. The following table summarizes the necessary factors:

Capital Cost (Financial)	Equivalent Annual Payment At 12%	Annual Operation and Maintenance Cost	Annual Generation (Kwh)	Financial Cost per Kwh
RD$1,067,723	RD$132,551	RD$13,670	3,855	RD$0.038

At a 12 percent financial discount rate, a capital cost of RD$1,067,723 is equivalent to an annual payment of RD$132,551 (i.e. that annual payment would amortize a loan of RD$1,067,723 over 30 years). Adding operation and maintenance expenses gives a financial cost per Kwh of 3.8 centavos. At any tariff above this level, the project is financially feasible given all the assumptions.

iii) Economic Analysis of the Constanza Site

The Constanza site involves the replacement of existing electricity generation from diesel generators by minihydro. Thus, it corresponds to case 1 described earlier. Since the minihydro facility would not generate sufficient power to meet peak demand, the existing diesel installation would be maintained in service. Consequently, the economic benefits from minihydro

are essentially the avoided operating costs of the existing diesel units. These operating costs -- essentially the fuel costs-- were reported to be RD$0.17/Kwh. Of this, RD$0.11 represents the petroleum content, while the remaining RD$0.06 represents refining, transportation and storage costs. Ignoring any foreign exchange content that the latter may have and applying the shadow price of foreign exchange to the petroleum content gives an economic cost of supplying diesel power at Constanza of RD$0.2096/Kwh.

The site capital construction construction costs were divided into direct foreign exchange, estimated at US$484,476, and local costs of RD$345,235. Again, any indirect foreign exchange costs contained in the latter as well as any possible divergence of actual labor costs from their scarcity values were ignored. Applying the shadow price of foreign exchange to imported items yields an economic cost of construction of RD$1,004,123. Annual operating and maintenance costs were estimated at RD$11,037 per year.

Table IV.8 summarizes the economic analysis of the Constanza site. The benefits of the project consist of the cost avoided of 0.2096/Kwh for the estimated annual generation of 2,410,000 Kwh, or annual saving of RD$505,136. This yields an IRR of 49.2 percent and a net present value of RD$2,975,926.

Sensitivity analysis was again performed on a number of variables subject to uncertainty. A 15% increase in construction costs reduces the IRR to 42.8% and reduces the NPV by about RD$150,000. A 3% annual increase in petroleum prices increases the IRR to 53.6% and the NPV by almost RD$1 million. A sensitivity analysis using a considerably shorter life of 15 years for the facility was also done. This would cover the case of a hurricane putting the facility out of commission permanently in year 15. Table IV.9 shows that such a shortening of the expected life of the facility has a very minor effect on the IRR but would reduce the project's net present value by about RD$100,000.

Cost Effectiveness

Since the Constanza plant has an economic cost per Kwh generated of RD$0.056 and the average CDE fuel cost per Kwh is RD$0.07, it is intuitively clear that minihydro will be more cost effective than CDE generated electricity. What is not as clear however, is whether the minihydro configuration is the most cost effective one that could be chosen. An analysis similar to that done for Banilejo would have to be done to determine this and will be done under the project for any site ultimately selected.

TABLE IV.8
ECONOMIC ANALYSIS OF CONSTANZA SITE

YEAR	ECONOMIC COST	BENEFITS 2,410,000 Kwh x RD$0.2096
0	RD$1,004,123	
1-30	11,037	505,136.

IRR = 49.2%
NPV = RD$2,975,926
B/C = 3.66

TABLE IV.9
SENSITIVITY ANALYSIS OF CONSTANZA SITE

	IRR	NPV
1. Cost overrun of 15% in construction	42.8%	RD$2,825,317
2. Siltation or obstruction rendering facility unusuable after 15 years	49.1%	RD$2,361,118
3. 3 percent annual increase in real world petroleum prices	53.6%	RD$3,952,504

Financial Viability and Level of Tariffs

It is difficult to talk in concrete terms about the financial viability of a particular site when specific financial terms have not been worked out, particularly the level of tariffs. It can clearly be demonstrated that a project which involves a financial cost saving on existing electricity generation of RD$0.12 per Kwh can be made financially viable. The minimum tariff which would accomplish this would be calculated as follows:

Capital Cost (Financial)	Equivalent Annual Payment at 12%	Annual Operation and Maintenance Cost	Annual Generation (Kwh)	Financial Cost per Kwh
RD$855,605	RD$106,218	RD$11,037	2,410,000	RD$0.049

The present value of all financial costs is RD$944,510. At a 12% discount rate (assuming that this is an appropriate financial discount rate) annual payments of RD$117,255 would be required over 30 years. With a tariff of 4.9 centavos per Kwh, the present value of revenues (discounted at a financial discount rate) would be precisely equal to the present value at costs so that, if money were to be borrowed (at 12% interest) to finance the project, the project could meet its operation costs and retire the loan at the end of 30 years.

However, in considering tariffs in the Constanza case, it should be kept in mind that peak load demand would continue to be met at a marginal social cost of more than 20 centavos/Kwh. This has two implications. First, obviously, the tariff at Constanza would have to be high enough to cover the costs of both diesel and hydro generation. Second, and less obvious, there is a strong economic argument for not pricing electricity significantly below its marginal cost, and the marginal cost of generation in this case would continue to be, apparently, quite high.

d. Wood Fuel Research Program

This project component differs from that of the other project components in that it is not directed primarily at improving the efficiency of petroleum utilization, but rather at increasing the availability of energy from the source most commonly used in rural areas - wood and charcoal. The cultivation of fast growing tree varieties for conversion into charcoal has been estimated in a recent project analysis in Haiti to have an internal rate of return of 23.7 percent in that country. The economic conditions and institutional constraints in the D.R. are different and, therefore, the returns are likely to be quite different. Nonetheless, there is no reason to believe that the economic feasibility of fuel wood development would be significantly less in the D.R. than in Haiti.

e. CDE Technical Assistance Program

Probably no single entity holds out greater potential for energy saving than does the national electric company, CDE. CDE at present imports one-third of all petroleum entering the country. It is estimated that CDE's generating efficiency is only about 26% (versus a more normal 30%). Furthermore, CDE experiences losses in transmission and distribution of about 27% of the electricity it generates (versus a more normal 17%). These transmission and distributions losses are a consequence of inadequate maintenance of equipment, poor operations management and administration, and illegal tapping of lines. The theft of electric power is not an economic cost (it is rather an income transfer from CDE to those stealing the power), but the adverse effects on CDE's cash flow reduces the company's ability to maintain generation and transmission facilities adequately. Another category of economic costs resulting from CDE's management and operating difficulties are the external costs imposed on CDE's customers, particularly its industrial customers, as a result of power outages. These costs commonly result in a need to maintain standby generating capacity to cope with outages, which often means higher fuel costs for equivalent power. In other countries, these "external" costs to consumers have been estimated to be as high as US$1-4 per Kwh.

It would be extremely difficult to estimate the rate of return of this project component. This is not so much because the benefits are difficult to quantify (although they are), but because the level of total investment and recurrent cost, which will be necessary to realize these benefits, is impossible to know prior to doing the project. What can be said with some confidence is that the rate of return to this component is almost certainly as high, and probably a good deal higher, than that of any other component.

B. TECHNICAL ANALYSIS

Introduction

The purpose of this Technical Analysis is to provide supporting technical material for each of the proposed project activities. During PP development, the Mission, with the assistance of several different consultant teams, prepared detailed technical reports on each of the project components, which are included as annexes to the Project Paper and provide background technical information in detail. The Project Description material also includes substantial technical information on each of the project components. The purpose here, therefore, is to present only limited technical information which is considered important to supporting the Project Description material.

1. Energy Investment Planning

Technical Scope of Work

Energy investments will be specified by the National Energy Commission at two levels of detail. For relatively near-term investments where substantial data exists, investments will be specified fairly precisely, including site-specific information where possible. Such specification will include:

-Proposed facility capacity (nominal maximum capacity and, where appropriate, expected maximum output and normal operating output levels);

-Projected facility useful life;

-Technical parameters (heat rates, energy and material balances, etc.) as appropriate;

-Investment by category (land and site development, buildings, machinery and equipment, supporting logistics systems, working capital, inventories, and other);

-Annual operating costs and revenues (or, for conservation or fuel-switching options, costs avoided) under alternative energy pricing assumptions;

-Manning tables;

-Mode and structure of ownership (private corporation, government corporation, government agency);

-Relationship to other existing or projected investments, with emphasis on prior actions or investments upon which the proposed investment depends;

-Financing structures typically employed for such facilities (long-term debt, short-and medium-term loans, suppliers, credits, private equity, outside grants, etc.) and potential sources of security for each; and

-Particularly important risk characteristics likely to affect financing of the proposed facility.

Where adequate data does not exist or where choice of specific investments will depend upon further research or upon future government or private sector decisions, investments will be characterized more generally. At a minimum, the scale of inputs and outputs, general magnitude and timing of investment and revenue streams, typical useful life, and other necessary parameters will be specified on the basis of reasonable assumptions regarding the level of investment over the course of the planning period (1981 - 1990).

2. Industrial Conservation Program

a. Illustrations of Pilot Projects

Several visits were made to industrial plants in and around Santo Domingo in order to obtain an impression of their general condition and level of operating efficiency. In addition, these visits served to identify areas in which energy savings might be made through the application of a broad range of conservation measures. For various reasons, these measures have not been implemented to date, and therefore the visits served to identify illustrative examples of the kind of pilot project which could be carried out under the Industrial Conservation Program. The descriptions which follow will give an idea of the savings obtainable and the costs required for three such projects, but it should be emphasized that the examples are illustrative only, and need not form part of the final program. Decisions on actual projects to be implemented will not be made until at least several audits have been performed, and the procedure of identifying pilot projects and conducting feasibility studies, as outlined in this section, has been completed by Energy Commission (CNPE) staff.

It should be noted that the criteria already discussed in no way require "novel" technology to be applied; indeed, it is often the most well-known conservation measures which lead to large savings in industry. For example, a study(1) of over 2200 factories in the UK indicated the most frequent opportunities for energy saving were in the categories of improved control of existing plant, and in insulation measures. In addition, these

(1) A Preliminary Analysis of the Potential for Energy Conservation in Industry, UK Department of Industry, 1977.

categories of conservation measure exhibited short payback periods, without exception. The study quoted the following paybacks for some common conservation measures:

Industrial Buildings	Typical Payback, years
Improve insulation of buildings	4
Improve/adjust thermostats, timeclocks	0.5
Control heat/cold loss through doors, loading bays	0.5

Services	Typical Payback, years
Insulate steam pipes, hot water pipes, air ducts, etc.	0.75
Maintain/adjust boilers	1
Replace lighting, improve switching	2
Clean lighting fixtures, paint walls in light color, etc.	4
Improve compressed air system (repair leaks, etc.)	1

Process Plant	
Insulation	0.75
Better control	0.75
Boiler and furnace maintenance	0.5
Heat recovery, recuperators, etc.	1.5

In spite of the attractive economics indicated by such short payback periods, the lack of awareness of UK industry for the potential benefits was very apparent. The scope for pilot projects is thus large, and the potential benefits which should accrue from wider application of even the simplest techniques fully justifies this part of the program.

A description of three potential pilot projects follows. In fact, it is anticipated that the actual pilot projects implemented in this program will be selected from ideas resulting from plant audits. However, this does not mean that all the pilot projects will be conducted in the same plants as those audited, as there may be good reasons for taking an idea from on plant and applying it in another. For example, the plant management in one location may be unable or unwilling to install the necessary equipment in their plant following their audit, or it may be excessively expensive to shut one particular plant down for the required time for equipment installation. Thus the final location of the pilot projects is not tied necessarily to those plants audited by CNPE. Nevertheless, it is to be expected that a majority of the demonstrations will indeed be conducted at plants which have undergone short and extended audits, and for which comprehensive energy demand data are readily available.

i) Improvement of Operations at the Salt Refinery

An example of a plant in which significant energy savings could be made is the salt refinery operated by the state enterprise CORDE located on Avenida Máximo Gómez in Santo Domingo. This plant refines crushed rock salt, obtained from Dominican salt mines, into table salt by a process of dissolving the raw materials in water, removing insoluble impurities, and recrystallizing salt from the solution. The process is quite simple, but is interesting because it includes a number of operations which are common to a wide range of industrial plants. These operations include:

(1) dissolving solids
(2) steam raising in a fuel-fired boiler
(3) distribution of steam and hot solutions through piping systems (insulation needs)
(4) processing in heated tanks and vessels (insulation)
(5) heat transfer in a shell and tube exchanger
(6) removal of liquid from a slurry by centrifuge
(7) drying solid particulates
(8) packing solids for distribution/sale
(9) fuel oil storage

For this reason, measures applied in the salt refinery will have wide replication potential in the Dominican industrial sector, even though there is only one other salt refinery as such (now under construction).

The plant currently has an expenditure of about 500,000 $RD per year on energy, about 50% of which is for fuel oil, 10% for LPG and the balance for electricity. The fuel oil is used in a boiler to raise steam for process heating, LPG is used for drying the finished product, and electricity is used for pumping salt solutions, operating solids handling equipment, and general services in the factory including lighting. Very little airconditioning is installed. The annual production of finished salt is about 24000 metric tons. The energy cost is thus equivalent to 10 cents per pound of product, which is approximately the price of salt in the market. Clearly, the profitability of the operation would benefit greatly from a reduction in the high energy costs. An examination of the plant showed that many measures could be applied to achieve significant savings, and therefore a pilot project to improve the energy efficient of the salt refinery would be an ideal illustration of the economic benefits of conservation.

The general condition of the plant should first be mentioned, as there is without doubt much improvement to be made in this respect. The whole site is littered liberally with scrap equipment and equipment awaiting repair, although the difference is by no means always apparent. There is also a great deal of salt and waste product left around the site. The process equipment and the structure of the manufacturing plant is generally covered in salt: indeed, much of the insulation of the evaporator consists of a two inch crust of salt, the original insulation having dropped off long ago. Other deficiencies will be noted later: in summary, the first step of the pilot

project would be to clean the site and equipment thoroughly. It is unlikely that major savings could be achieved or maintained in the current working environment.

The process begins with the dissolving of rock salt granules in hot water in a pit about 20 feet long by 10 feet wide by six to eight feet deep. The plant was shut down for centrifuge maintenance during the visit, but it was clear that the pit was blocked by salt deposits consisting of hardened incrustrations which had probably built up over a considerable period of time. As a rough estimate, 80% of the pit was occupied by salt deposits. The top of the pit, which is normally operating at around 90°C, was completely open, allowing steam to evaporate and heat to be lost from the surface during operation. Indeed, the rotted condition of the roof timbers gave evidence of significant losses here. In addition, the two accessible walls of the pit which were examined remained quite hot even though the plant was shut down, indicating further sources of heat loss.

The pump for solution circulation and lines from the pit to the next processing stage were uninsulated. The valve in the circulating line back to the pit appeared incapable of operation due to salt incrustration. The next vessel in the process, in which insoluble impurities settle out, had little insulation and insulation of the main evaporator was extremely poor, much of the outside surface being uninsulated or covered only by hardened salt deposits. The heat exchanger (reboiler) on the evaporator was poorly insulated also. The heat losses from these uninsulated and inadequately insulated pipes and vessels have to be made up by the steam from the site boiler, and this would account for much of the excessive fuel bill.

The slurry of salt crystals in water which is obtained from the main evaporator is pumped into centrifuges and most of the remaining water is removed. The damp salt crystals are then lifted to the top of the structure and dropped through a hole in the side of a vertical pipe about two feet in diameter. At the bottom of this pipe there is a propane burner, and this arrangement acts as a simple countercurrent drier. Hot combustion gases are drawn up the pipe by an extractor fan, while the damp salt crystals drop down by gravity. Losses of hot air through the entry hole cause salt crystals to be blown away, and it appears from the deposits of crystals in the area that the extractor fan also blows salt away. There is much room here for improvement both in heat transfer and in material losses.

The dry salt is finally mixed with additives and put into bulk storage, from which it is dumped into wooden boxes for packing by hand into small boxes. Some salt is packed in small drums which are made from cardboard sheet at the plant itself.

The crude method of packing salt leads to

(1) losses on the floor

(2) variable quantities of salt in the boxes.

Some improvements could obviously be made here.

A summary of measures which would be included in the pilot project is given in Table IV.10. Approximate costs involved are presented below. The savings to be expected from the project are considerable, but without a detailed audit of actual operating conditions it is not possible to provide a detailed analysis. However, it is known that complete replacement of the plant by modern technology for salt refining would result in energy savings of the order of 80%. The suggested pilot project could not claim these savings, but it is reasonable to expect savings of 40 to 50% from the limited measures proposed to reduce both energy and material losses. Based on the energy bill quoted by the CNPE of 500,000 $RD annually, the savings from the pilot project should amount to at least 200,000 $RD a year, all of which corresponds to foreign currency savings through reduced oil imports. The payback period is thus about 6 months.

Cost Estimate	Thousand Dollars
Site cleaning	2.5
Insulation	15.0
Valves and piping	5.0
Instruments, gages	20.0
New drier	20.0
New salt storage/packing system	10.0
Boiler area repairs, equipment	12.0
Fuel oil tank	2.0
	86.5
Allow 15% contingency	13.5
	100.0

Cost includes equipment, materials and labor. Approximate split will be 50% local currency, 50% foreign currency.

TABLE IV. 10
SALT REFINERY PILOT PROJECT

Process stage/equipment	Examples of Problems	Action
Plant site	-	Clean entire site
Dissolving pit and circulating pump	Open pit, blocked with salt, no insulation of pit or pipes, circulation valve jammed, control of salt concentration uncertain	Install lid, dig out pit, insulate walls and pipes, improve sampling and analysis procedures
Evaporator vessel with steam heated reboiler	Poor insulation, lack of instruments	Clean, insulate, install temperature and pressure measuring instruments
Centrifuges	Performance needs to be checked	May require changes to control procedures, RPM, etc.
Wet salt to LPG-fired drier	Loss of salt, no insulation to drier	Redesign drying system (use drum drier)
Salt mixing with additives, storage, packing	Mixing equipment to be checked, losses appear significant in packing area	System redesign
Boiler	Heavy deposits in tubes, inadequate insulation, poor instruments, no condensate recovery	Repair roof leaks, insulate, add instruments, clean tubes, repair internal boiler structure
Fuel oil storage tank	No effective lid, possibility of contamination, losses underground also possible	Check for leaks, install lid, install level measurement

ii) Power Factor Correction

To obtain the best possible economic advantage from electrical power, both the generating and consumer's plants should be operated at high efficiency. To achieve this it is essential to have a good power factor throughout the system. Most electrical machines draw from the supply apparent power in terms of kilovolt amperes (KVA) which is in excess of the useful power, measured in kilowatts (KW), required by the machine. The ratios of these quantities

$$\frac{\text{Useful Power}}{\text{Apparent Power}} \quad \text{or} \quad \frac{\text{KW}}{\text{KVA}}$$

is known as the power factor of the load and is dependent upon the type of machine in use. A large proportion of the electrical machinery used in industry has an inherently low power factor, which means that the supply authorities have to generate much more current than is theoretically required.

In addition transformers and cables have to carry this extra current. When the overall power factor of a generation station's load is low, the system is inefficient and the cost of electricity correspondingly high. To overcome this and at the same time to ensure that the generators and cables are not overloaded, most electric utility companies offer reduced terms to consumers whose power factor is high, or impose penalties for low power factor.

By taking advantage of these special terms, reductions in power costs can be made. At this time, however, CDE does not have such terms in their tariffs.

Any installation including the following types of machinery or equipment is likely to have a low power factor which can be corrected, with a consequent saving in charges, if a penalty tariff is in force.

(1) Induction Motors of all types (which form by far the greatest industrial load on a.c. mains)

(2) Power Transformers and Voltage Regulators

(3) Welding Machines

(4) Electric Arc Furnaces

(5) Choke Coils and Magnetic Systems

(6) Neon Signs and Discharge Tubes

Even if there is no such penalty, as is the present situation in the Dominican Republic, the factory cabling and supply equipment can still be relieved of a considerable "wattless" or "reactive load", which will enable additional machinery to be connected to the supply without enlarging these services. Additionally, the voltage drop in the system is reduced.

The method which can be employed to achieve the improvements outlined is by introducing "reactive kVA" (kVAr) into the system which is in opposition to the wattless or reactive current mentioned above and effectively cancels its effect in the system. This is achieved either with rotary machines (e.g. synchronous motors) or static capacitators.

The points to be considered in any installation are:

1. Reliability of the equipment to be installed
2. Probable life
3. Capital cost
4. Maintenance cost
5. Running costs
6. Space required and ease of installation

Generally, it will be found that for normal industrial installations the capital cost of rotating machinery makes its use uneconomical and, in addition, the wear and tear inherent in all rotary machines involves additional expense for upkeep and maintenance.

Capacitors have none of these disadvantages. Compared with other forms of correction, the initial cost is very low. Upkeep costs are minimal and they can be used with the same high efficiency, are convenient to install and lend themselves to individual, bulk or automatic methods of correction. These facts, coupled with the low initial cost, show conclusively that power factor correction by capacitators is by far the most satisfactory and economical method.

A pilot project to demonstrate the advantages of power factor correction could therefore be installed in a plant which has a poor power factor. According to the data obtained in the CNPE plant suveys, it is not uncommon for power factor of 0.75 or less to be observed, although good data are difficult to obtain because little attention is generally paid to the subject.

A typical power factor correction demonstration might be set up at a textile plant such as that operated by Textiles "K" at the Herrera Industrial Park in Santo Domingo. This plant imports yarn and weaves it into cloth using 500 electrically-driven machines. The cloth is then dyed and may also be printed. A large boiler is installed to generate process steam for heating dye baths. About 95% of production is polyester fabric, almost 3 million yards being produced in 1979 according to the CNPE survey.

The total electricity consumption of the plant in 1979 was about 2 million kilowatt-hours, equivalent to a cost of about RD$200,000. No power factor correction equipment is installed.

A visit to the plant was made and it appears that power factor correction for individual motors and other electrical equipment would be very expensive. Each weaving machine, for example, is fitted with a 0.5 HP motor. A system of "bulk" power factor correction could therefore be demonstrated.

The total installed electrical load for the factory is approximately 600 KW. To increase the power factor from 0.75 to 0.9, a total reactive capacity of about 240 kVA+ is required. The cost of capacitors for this duty is estimated to be $10,000: a total project cost of $30,000 should be allowed for equipment costs, freight and installation. The savings obtainable cannot be worked out directly because the CDE tariff has no power factor improvement incentive. However, as a rough guide, the improvement in power factor is equivalent to about 20% of the present demand, or about RD$40,000 per year. The payback period for power factor correction would be approximately one year, based on the efficiency improvement that should be achieved within the overall CDE generating and distribution system.

iii) Combustion Control Demonstration

Losses during fuel combustion arise directly from incompletely burned fuel and heat in the flue gases. It is therefore important that the amount of air introduced into a boiler or furnace for combustion be carefully controlled

(1) to provide sufficient air to burn all the fuel

(2) to avoid excess air which will serve to increase the flue gas losses.

The theoretical amount of air required to burn fuel is, in practice, not sufficient to ensure complete combustion, because perfect fuel-air mixing cannot be obtained in commercial equipment. A slight excess of air is therefore necessary, which results in a small amount of oxygen being present in the flue gases. By measuring the oxygen content and temperature of the flue gases it is therefore possible to monitor combustion efficiency closely.

Plant visits and discussions with many plant engineers in the Dominican Republic have indicated that very few boilers and furnaces are equipped with oxygen analysers, and few have adequate temperature measurement instrumentation. Most plants visited did not have the necessary flue gas sampling points installed. It is, of course, possible to set the combustion conditions reasonably well without such instruments, although changes in air temperature, fuel characteristics or furnace load will immediately require the plant operator's attention to readjust the firing conditions. Portable instruments may be used to check firing conditions, but it is now common practice in industrial plants in many countries to install permanent measuring instruments. Larger plants may even include automatic re-setting of air rates to burners according to the oxygen content that is measured. A 1% increase in oxygen content, if left uncorrected, would lead to a decrease in combustion efficiency of about 1% for a typical plant.

A pilot project could therefore be undertaken to demonstrate equipment available commercially to control combustion efficiency. The project should be designed to demonstrate the applicability of instruments to a range of furnace and boiler sizes, and to a cross-section of Dominican industry. In this way, broad replication of the pilot project will be encouraged.

One example of a furnace for which instrumentation could be supplied was seen at the bakery of Panadería Pepín, in Santo Domingo. This plant has three large gasoil-fired bread ovens, in addition to several smaller electric ovens for special product lines. A small gasoil-fired boiler is also installed. Adjustment and maintenance of the gasoil burners is carried out approximately once per week. The cost of gasoil to the bakery in 1980 was almost RD$70,000. Due to lack of sample points, it was not possible to determine the actual operating efficiency of the ovens during the visit. However, the provision of a small oxygen analyser for use on each of the gasoil-firing ovens and boiler could be expected to lead to an improvement in the average combustion efficiency of at least 3%, based on experience in similar plants overseas. The savings in fuel consumption would thus amount to at least RD$2,000 per year, and much greater savings may be obtainable. One analyser would cost under $5,000 to install, including sample lines to allow regular performance checks to be made on each operating oven and the boiler. At worst, a payback of about 2 years could therefore be expected for the bakery.

Since there are over 200 bakeries in the Dominican Republic, the potential for replication in the bakery industry alone is significant, and the demonstration results would be equally applicable in a very large number of other industrial plants. Nevertheless, it is recommended that a combustion control pilot project be designed to include at least ten fully-instrumented demonstrations on different types of furnace in selected industries. The total cost for this project would therefore be $80,000 to $100,000.

3. Mini Hydro Development Program

a. Site Selection Methodology

The site selection methodology intended for use under this Program was developed by a team of USAID consultants during intensive review. It will be revised and improved as necessary during project implementation with the help of the Program's Technical Advisor. The methodology is designed for professionals in the field with a two-fold purpose. Its application will yield a set of objective criteria for establishing priorities among potential mini-hydro sites and, in addition, will result in an analysis of each site that touches on all the topics and considerations covered in a full feasibility study. The following is a summary of the methodology, which appears in full as Annex G.4.

1. Basic Site Selection Criteria

The basic criteria involved in site selection include:

-Technical Viability

-Economic and Financial Feasibility

-Social Desirability

-Institutional Compatibility

-Environmental Impact

2. Compilation of Existing Information

A first step in conducting a site selection study is the compilation of pertinent existing technical, social, institutional and environmental data. With this information at hand, subsequent field visits to the proposed small hydro site will be dedicated exclusively to fill identified data gaps. Data collection is broken down into 4 general categories:

-Technical information - Topographic maps, pertinent hydrographic data, as well as geologic and geographic material will be assembled from various sources specified in the text.

-Social information - It is necessary to characterize the community that will be served by the proposed hydro project in terms of community response, energy demand and economic resources. Agencies to contact and surveys to consult are specified.

-Institutional information - Possible upstream competing water uses must be determined. The appropriate agencies to contact should be listed.

-Environmental information - The condition of the watersheds should be researched fully to evaluate the impact of the environment on the project and viceversa.

3. The Site Visit and Field Survey

A field questionnaire has been prepared by CNPE with additional input from the USAID consulting team. It has been designed to assist the field team in determining and quantifying physical site characteristics as well as social, institutional and environmental factors.

4. Processing of Hydrological Information

In the methodology, a discussion is presented emphasizing the importance of dependable hydrologic data and suggesting methods for the reasonable extension of available stream flow information. Conditions specific to the Dominican situation are addressed. A flow-duration curve is described and generated for use in subsequent sections.

5. Social, Institutional and Environmental Guidelines

These guidelines are useful in evaluating the "human" and "natural" context of small hydro power plant (SHPP) development. They aim at a clear evaluation of the management capabilities which are required to put in place (including the appropriate timing of local construction) and administer the SHPP.

For example, consumptive uses of water originating in the watersheds may be such that there is insufficient water available for operating the SHPP satisfactorily. Alternatively, the watershed may be in such a poor condition as to preclude the installation of an SHPP until restoration measures are in place and seen to be working.

6. Demand Calculation and Forecast

In the case of rural electrification it is essential that a potential electric demand be estimated. A method for forecasting this demand is presented in the methodology along with tables to assist in the estimate. In the absence of actual demand growth rates, a conservative growth rate of 3% per year could be assumed. This figure is the accepted population growth rate in the Dominican Republic and the assumption could be made that electricity consumption will grow at the same rate.

7. Alternative Layout Schemes

The first level of analysis that is presented in the methodology is intended to address all possible development alternatives of a potential hydro-electric site. Criteria are presented for the determination of gross static head to establish a degree of accuracy that will remain constant for varying installations.

In order to optimize the resource, it is proposed that all possibilities be sketched on a first-pass basis. The alternatives are very site-specific and a list of possible considerations are presented. Among others, these considerations include accessibility, competitive water use, availability of local labor, etc. Resulting schemes may range from run-of-river high head installations to multiple unit low-head storage installations with all encompassed possibilities examined. The layout sketches are to include gross dimensioning of appropriate features to assist in preliminary evaluation. Preliminary turbine selection is accomplished graphically, selecting the most efficient turbine for the particular layout as a function of head and design flow.

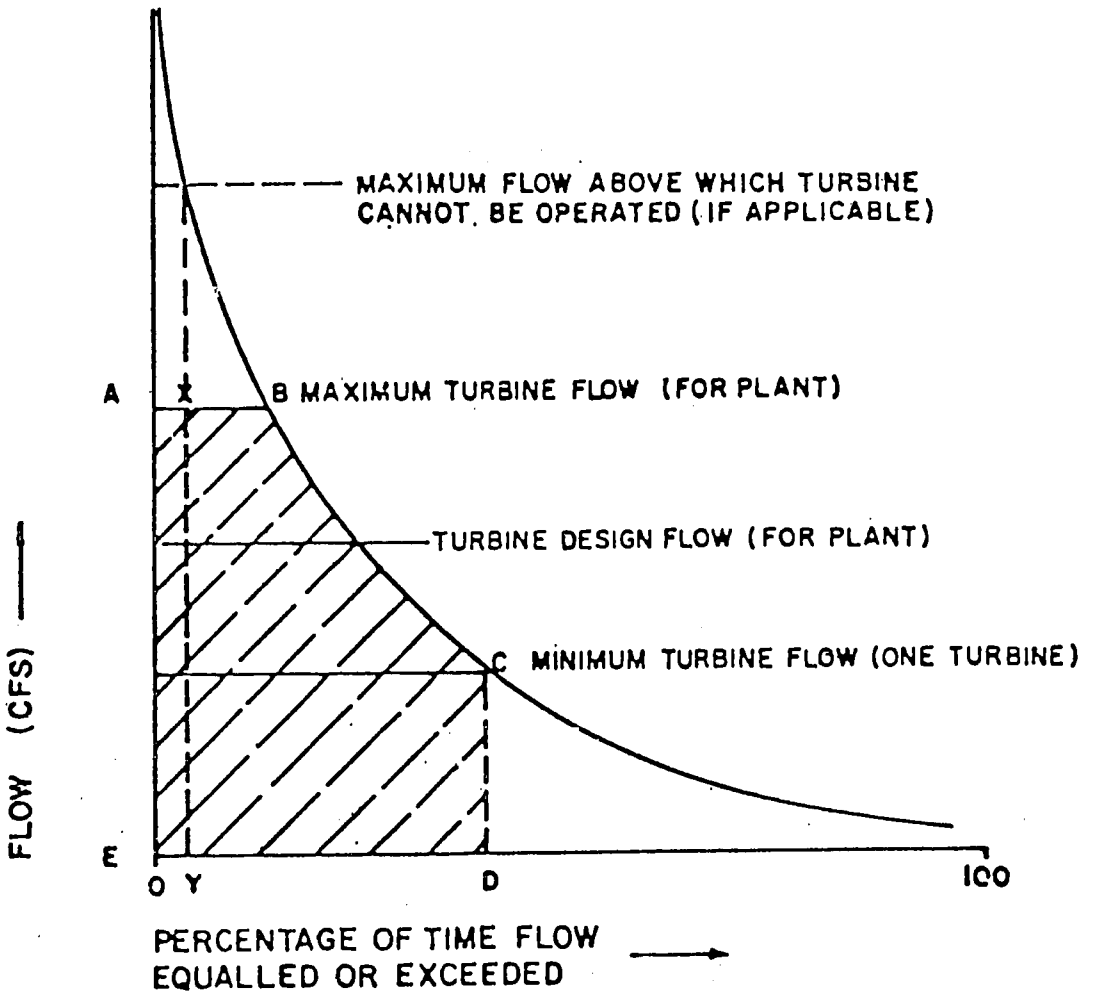
8. Estimation of Power and Energy

The installed capacity of the turbine must be selected with two major factors in mind: a) optimization of the resources; and b) projected demand of the community to be served.

The flow duration curve derived in the hydrology section is employed to determine the design flow of the turbine. Preliminary turbine selection takes into account the practical limits of flow in calculation of average annual energy. (See Figure IV.2). A 15% exceedance level is suggested for determination of maximum turbine flow from which the design flow and minimum flow can be calculated. The area contained within the turbine flow limits is the average annual energy the plant is capable of producing (when this area is converted to the proper units). The 15% exceedance level is a starting point for this calculation and may be changed to another exceedance level depending on the shape of the curve and/or the required loading factor. The installed capacity will be dependent in part upon the storage capacity (if any), but usually in rural or isolated installations it will be sized according to effective head and 85% of maximum turbine flow.

The layout task in the methodology is revisited following the selection of the preferred scheme (refer to flow diagram, Figure IV.3). Refinements are made in the arrangement of the headworks, optimal powerhouse location, penstock configuration, etc. A more detailed analysis of head loss and turbine type is carried out. At this point the methodology calls for a re-evaluation of the preferred design considering the utilization of the project output, capacity and energy. For instance, in an isolated setting with limited demand requirements, present and future, the design may be modified to include two turbines with only one being installed at the time of construction. This would allow the project to operate at optimal efficiency

FIGURE IV.2



Procedure for Use of Flow-Duration Curve

FIGURE IV.3

FLOW CHART OF THE SITE SELECTION METHODOLOGY

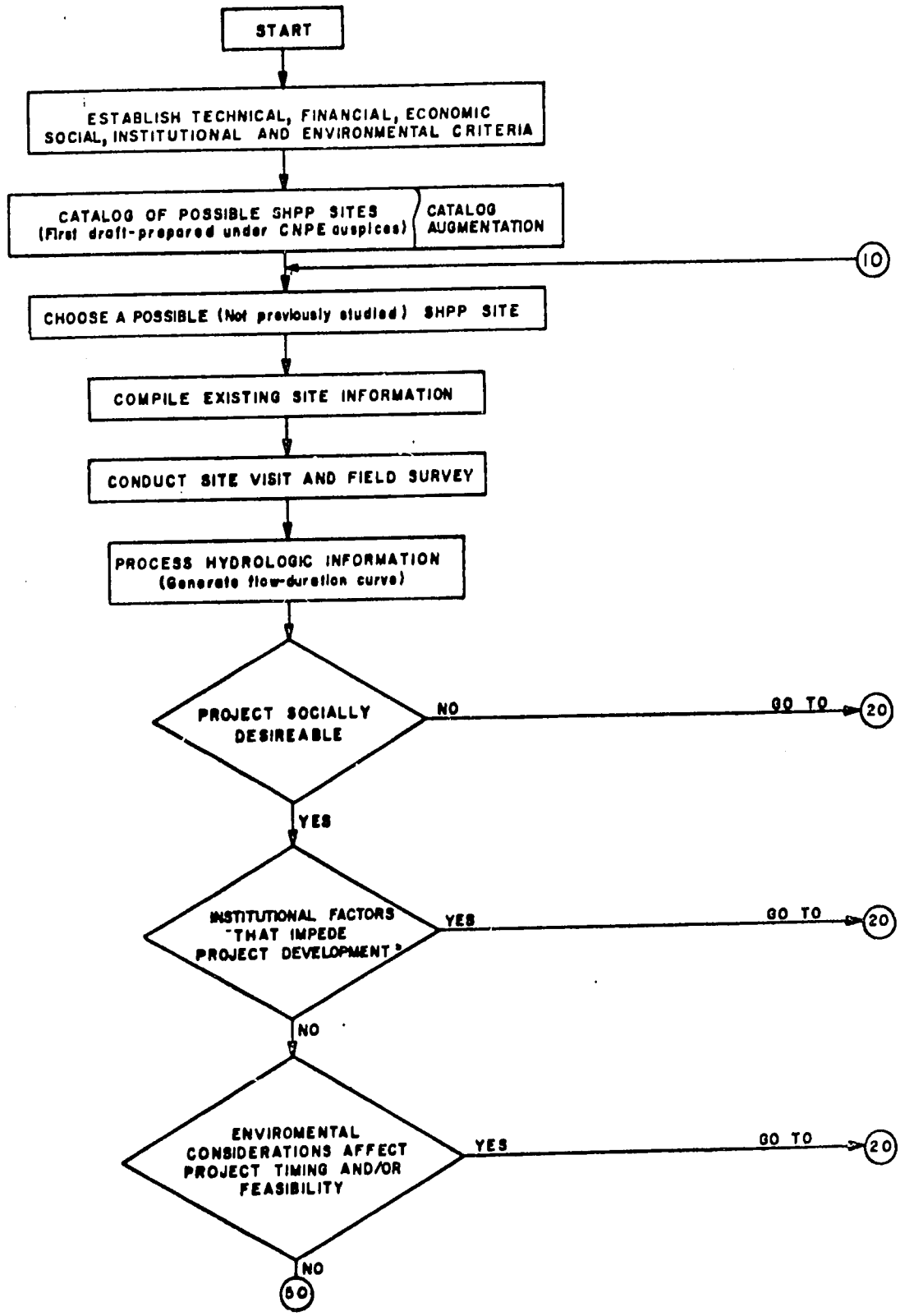
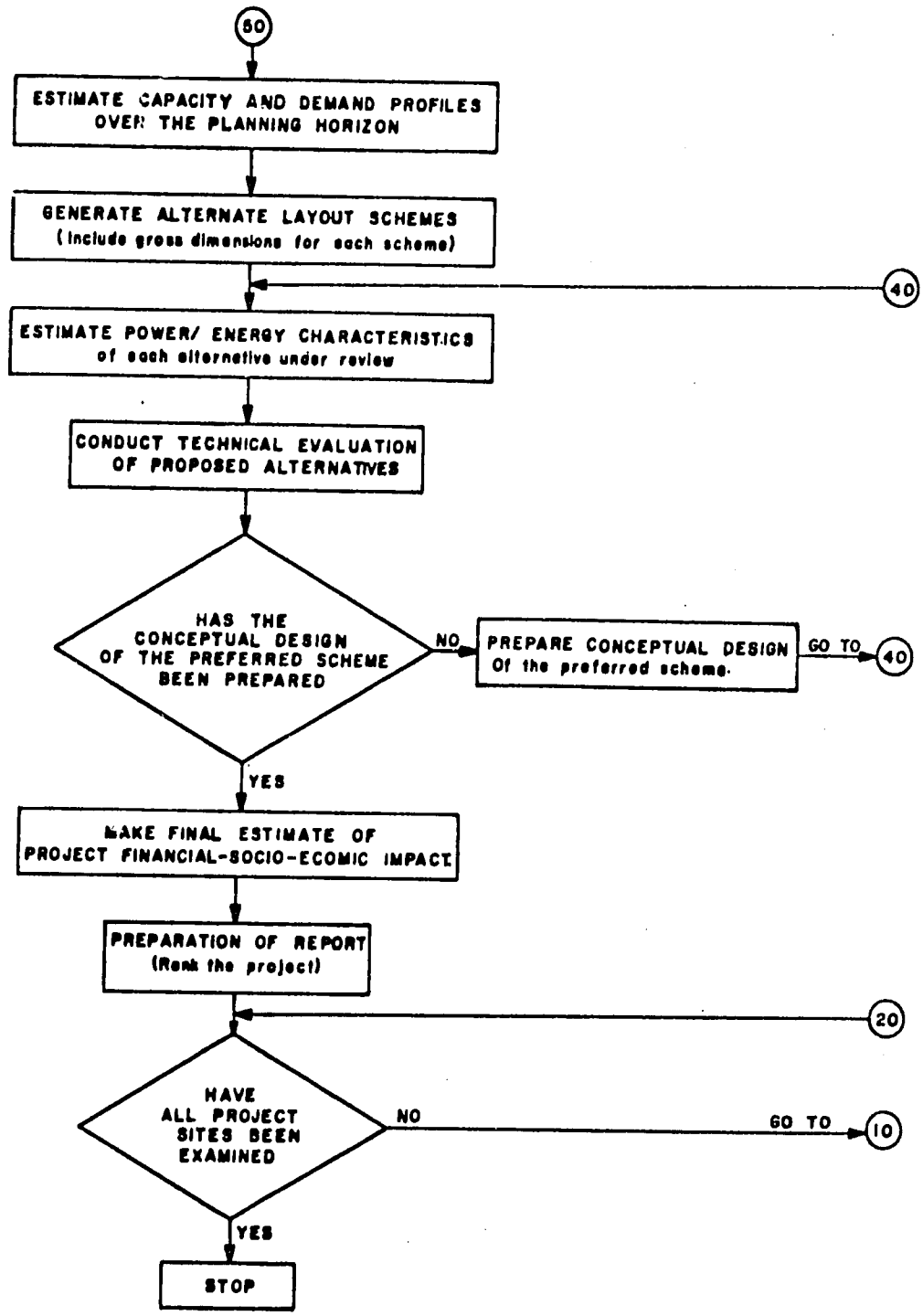


FIGURE IV.3 (CONT'D)



while the load requirements are low yet permit full exploitation of the resource in the event that a grid connection becomes possible. Other considerations and possible modifications are suggested.

9. Technical Evaluation of Alternative Schemes

The possible alternatives generated in the layout task are evaluated using sound engineering judgment. Calculations of cost, availability of local labor and observed environmental conditions will play a large role in the evaluation process. This task results in the selection of the preferred development scheme.

10. Conceptual Design of Preferred Scheme

The final layout will be prepared at this stage that will specify the following:

-Turbine type

-Estimated dimensions of civil works based on experience and available curves

-Generator (induction or synchronous)

-Transmission Requirements (length, voltage)

-Highlighting of any extraordinary feature or equipment that may be necessary for development.

11. Project Cost Estimation

An important aspect of determining the preliminary feasibility of a potential hydroelectric development is an estimate of the costs involved in the construction, and an analysis of annual operating expenses. Cost curves compiled for low-head hydroelectric projects in the U.S. are presented in an appendix to the methodology. It is noted that some of these curves are not particularly appropriate to small hydroelectric development in the Dominican Republic for various reasons. Rather, they serve illustrative purposes and give general cost relationships. It is strongly recommended that similar cost curves, locally valid, be prepared for use in the application of the methodology. The advantage of a graphical approach to costing is that quantities in civil works and per unit costs do not have to be derived for each project, thus accelerating the pre-feasibility process and standardizing costing procedures. The project costs thus derived are deemed to be accurate within ± 25%. An index is developed to relate costs in a base year to costs in subsequent years.

12. Economic and Financial Analyses

(See Economic Analysis.)

13. Report Writing

Once the technical, social, economic, institutional and environmental analyses have been conducted, the evaluating team will write the final report on the site with recommendations for or against the selection of the site for SHPP development. An outline format for the report is suggested in the methodology.

b. Illustrative Examples

The site selection methodology developed during intensive review was field tested by teams comprised of members from the following organizations: Corporación Dominicana de Electricidad (CDE), Instituto Nacional de Recursos Hidráulicos (INDRHI), Comisión Nacional de Política Energética (CNPE). The cooperation of these organizations during the course of the studies has proven to be an encouraging note for the continuing free exchange of information between them. The sites studied were selected from a field of 40 contained in the Inventario Nacional de Recursos Hidráulicos prepared by the CNPE. Initially, four potential sites were selected for visitation. This group was narrowed to the two study sites following field investigation. The following potential sites were selected for application of the methodology: Río Constanza in Constanza, la Vega Province; and Río Banilejo near El Pinar, Peravia Provice. The following is a technical review of the two studies conducted.

i) Technical Review No. 1 (Constanza)

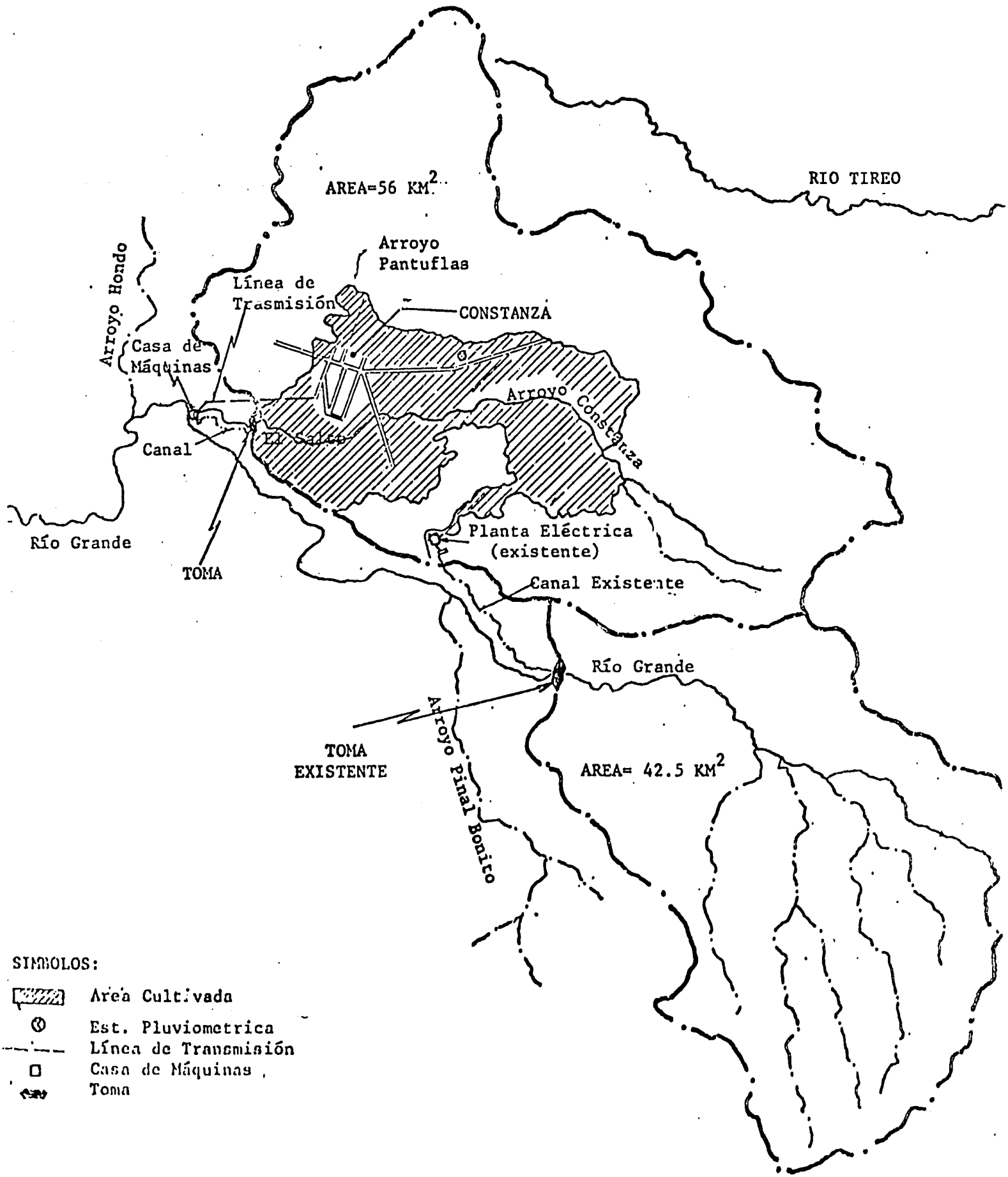
Constanza, a small city in the country's central mountain chain, lies in a rich agricultural valley isolated from the nation's electric grid system. The population of some 8,184 persons is mainly employed in commercial agriculture including the cultivation of flowers. Although there is an extensive irrigation system through aqueducts and canals, a large portion of irrigation is accomplished through the use of electric pumps.

The electric supply of Constanza consists of two diesel generating units and one small hydro unit. The economic dispatch of these units theoretically supplies the energy requirements of the city and satisfies their present peak demand of 1000 Kw. The reality of the situation falls somewhat short of theory. The large diesel, rated at 1150 Kw, is only capable of supplying a maximum of 700 Kw due to disrepair of the diesel engine. The hydro unit, rated at 250 Kw, is now out of service due to blockage of the power canal, and has been operated erratically since 1975. The small diesel rated at 150 Kw is said to have a maximum output of only 30 Kw. As a result of this situation the population of Constanza suffers frequent blackouts and voltage and frequency fluctuations.

The canal intake for the proposed hydro-electric installation would be located at the end of the Constanza Valley at the confluence of the Río Constanza and the Río Pantuflas (see Figure IV.4). The project would take advantage of the natural waterfall site called "El Salto", to produce an estimated 500 Kw of power.

FIGURE IV.4 PROYECTO: "EL SALTO" EN CONSTANZA

ESQUEMA GENERAL



Hydrology

There are no existing flow data for the drainage areas of the Río Constanza nor the Río Pantuflas. The study team collected existing rainfall information in three areas nearest the site all of which had at least 7 years of comprehensive data. Further, a flow duration curve was generated on the basis of daily flows available in drainage areas of similar size and characteristics. These inputs, combined with measurements at the time of the site visit, enabled the study team to make a preliminary estimate of the median flow available at the intake of the power canal.

This preliminary estimate of flow was then corroborated through the use of mass balance calculations based on runoff characteristics of the adjacent drainage area, hydraulic experience with the existing small hydro installation and irrigation data. The calculations appear in their entirety in Appendix II to the methodology. The median flow arrived at through calculations was .84 m^3/s while the observed flow correlated with rainfall records was .7 m^3/s. The latter flow was considered a conservative estimate and adopted as the available median flow.

Alternative Project Layouts

During the identification process of possible sites for hydroelectric development, three alternative schemes were proposed. The subsequent site visit eliminated two of the alternatives due to geologic and topographic discontinuities and it was agreed that only the following development would be studied further.

The proposed development would consist of a small dam 5 meters in height with a storage volume of some 8000 m^3 located at the confluence of the Ríos Constanza and Pantuflas. The geologic and topographic conditions at this point appear to be well suited to the construction of a concrete overflow dam. The impoundment would extend upstream some 500 meters. The conduction canal would be constructed from the left abutment of the dam and the flow regulated with a vertical slide gate. The canal is approximately 1.0 Km in length with a gradient of .5% and a capacity of .98 m^3/s. The canal ends at the headworks where a slide gate would regulate flow to the penstock 22" in diameter and 100 m in length. The gross head developed in this scheme is 70 meters as measured with an altimeter accurate to ± 3 meters.

Social, Institutional and Environmental Considerations

The existing electrical demand of Constanza is estimated at 1000 KW. The distribution system extends throughout the valley but does not reach the community of Tireo, about 7 Km southeast of Constanza. The estimated demand in this area is 200 Kw representing an increase of 20% of the present electric load. The inclusion of this community is not incorporated in the study, but it is noted that future expansion plans should address the electrification of Tireo.

Constanza has a history of community involvement and the population has participated in various public projects on a voluntary basis. The civil works construction involved in the project would draw on the labor force of the community.

Capacity and Energy Estimates

The firm capacity of the hydro unit is based on the storage capacity of the impoundment and the regulation possible during a critical day, i.e. during a low flow period. Using the present demand curve of the system, it is found that energy from the hydro source must be available 11 hours daily (See Figure IV.5). This energy duration requirement combined with the storage capacity available yields a calculated firm capacity of 170 Kw. The flow required to produce this capacity is .3 m^3/sec., resulting in a power volume drawdown per day of 6500 m^3. The 95% duration flow is .14 m^3/sec, thus allowing a daily cycling of the system (i.e., in flow - .14 m^3/sec. x (24-11) hours x 3600 sec/hour = 6552 m^3).

The average annual energy available from the hydro installation during a median year is 2.41 Gwh. This is calculated using the average annual flow of .55 m^3/sec. that occurs during the median water year.

The use of the generation of the project is shown graphically in Figure IV.5. The block diagram depicts the electrical demand and energy usage of Constanza during a critical day and a median day. In both cases the total hydro output would be fully utilized displacing expensive diesel energy.

Estimate of Project Cost

The civil works costs for the project were estimated using unit cost data compiled by CDE and INDRHI. These costs vary significantly from U.S. costs due to the decreased cost of labor. The equipment costs are mainly U.S. costs based on curves compiled by Tudor Engineering Co. for low head sites. Where head or flow parameters fell outside the range of these curves previous experience with similar equipment was called upon.

The costs presented below include the following assumptions:

1. The equipment costs are considered valid for delivery to the port in Santo Domingo. A separate item of 4.5% of direct costs is applied by CDE to account for transportation of equipment and materials to the site.

2. The cost of labor in construction and installation is assigned a value that is a weighted average of local labor costs and semi-skilled labor costs.

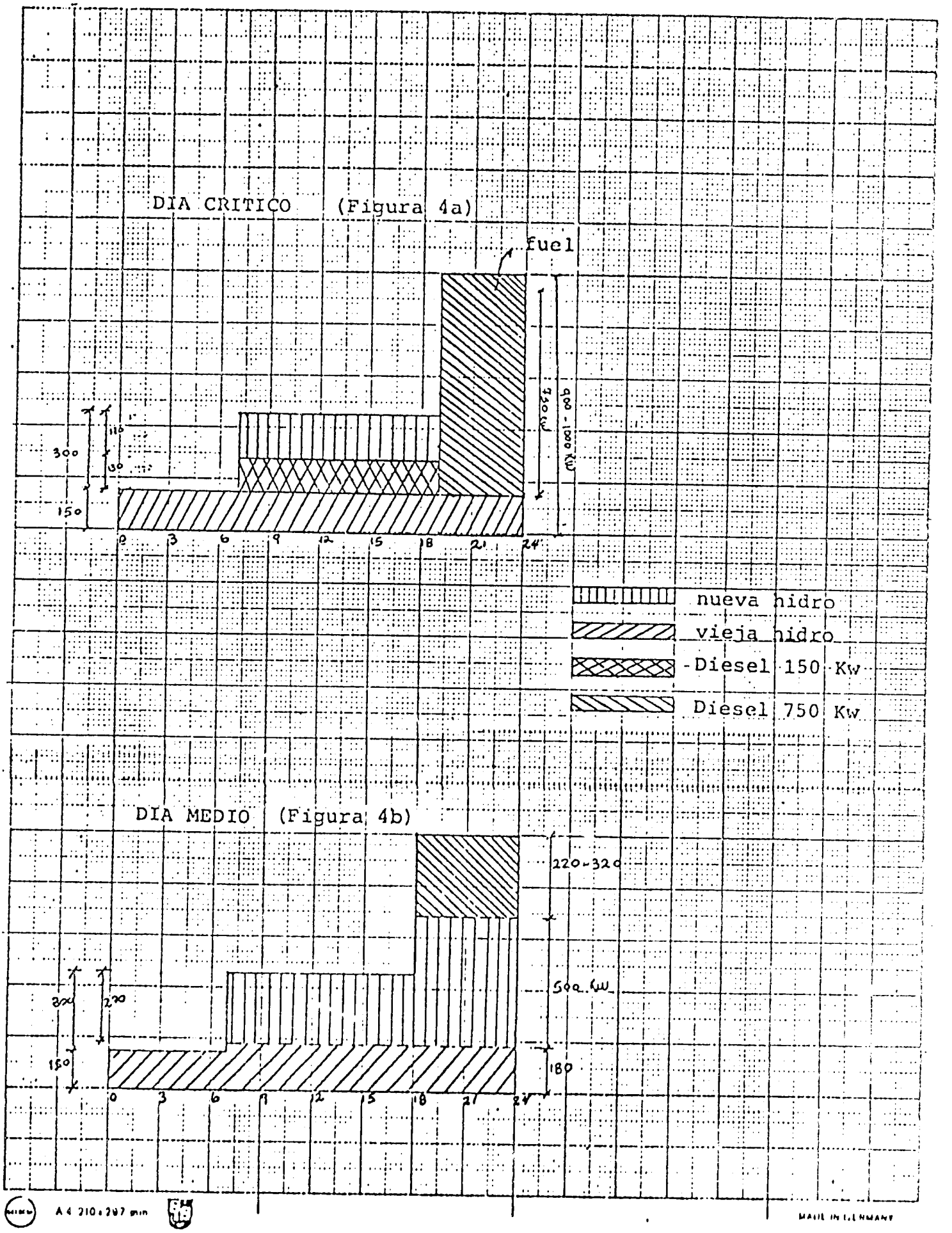
3. All costs are expressed in terms of 1981 RD$.

4. Engineering design and construction supervision costs are not included.

The following is a summary of the construction and equipment installation costs:

FIGURE IV.5

Use of Generated Energy on an Average Day and a Critical Day in Constanza



ITEM		COST (RD$)
1. New Dam and Spillway		54,700
2. Power Canal		125,200
3. Intake		7,000
4. Penstock		39,800
5. Power Plant and Electrical Equipt.		372,000
6. Transmission line and Protection Equipment		52,000
7. Land clearing and Access		10,000
	Subtotal	660,700
Admin. and General Exp.	10%	66,100
Contingencies	15%	99,100
Equipment Transport	4.5%	29,700
	Total	855,600

ii) Technical Review No. 2 (Río Banilejo)

A potential site for the installation of an SHPP on the Río Banilejo lies about 3 kilometers from a possible service village, El Pinar, which in turn is about six kilometers distant from the municipality of San José de Ocoa. The principal economic activity of El Pinar is directly related to agricultural production and marketing. The village consists of about 125 houses with an estimated 600 people. The village has no existing source of electricity. There are several other villages in the area, Los Corosos being one of them, that have similar characteristics and economic activity.

Hydrology

The headwaters of the proposed installation lie approximately 3.4 Km upstream from the confluence of the Río Banilejo and the Río Ocoa. A gaging station, installed and maintained by INDRHI, is located on the Río Ocoa just above the confluence with the Río Limón. Five years of streamflow data are available. The drainage area associated with the gage is 410 Km^2 while that associated with the intake to the proposed power canal is 200 Km^2. An analysis of rainfall records reveals a relatively even distribution of precipitation throughout the total drainage area of the gage, thus permitting an extrapolation of gaged flow records to the canal intake.

The available data has been computerized by INDRHI and a flow duration curve generated with the use of their software package. (See Figure IV.6). As per the methodology, the flow/duration curve is entered at the 15% exceedance level and the maximum turbine flow, Q max, of 1.75 m^3/sec. is obtained. From this design flow Qd (Q max/1.15) and the minimum flow Q min (Qd x .30) are calculated. In order to maximize the energy available from the resource, INDRHI performed an optimization analysis plotting design flow versus energy. The flow which yielded the maximum energy production was found to be 1.5 m^3/sec using the maximum and minimum turbine flow limits suggested.

Alternative Project Layouts

Two alternative layout schemes were identified for project development. The topography of the river dictated the location of the power canal intake but the powerhouse location could be varied. Scheme A places the powerhouse at point A (see Figure IV.7) requiring a canal 2.3 km in length. This configuration provided a gross head of 66 m and an installed capacity of approximately 770 KW. Scheme B required a canal length of 5.0 Km., provided a gross head of 95 m, and an installed capacity of 1130 KW. In both cases the estimation of gross head was achieved through use of an altimeter accurate to ± 3m and the location of the powerhouse identified by on-site investigation.

Each of the alternative schemes was examined for the inclusion of a single turbine and for a multiple turbine arrangement. It was determined that a single unit was the more effective alternative in both cases.

Social, Institutional and Environmental Considerations

El Pinar and its neighboring communities exhibit very modest energy consumption habits. The average family consumes approximately RD$4 per month in fuel (primarily kerosene), mostly for lighting requirements, while small stores utilize between RD$6 and RD$10 of fuel for illumination and refrigeration.

The watershed area that would directly affect the project was observed to be in moderate condition. According to conversations with town officials the area is maintained on a regular basis by the village although subsequent conversations with local citizens raise doubts. Sediment transport, if excessive, would necessitate a regular program of canal maintenance on the part of the village to prevent loss of power through decreased canal capacity and to prevent turbine damage.

El Pinar has a history of community organization to work on projects for the general good. Voluntary labor has helped construct the road to the nearest municipality, San José de Ocoa, and has installed a public aqueduct for potable water. There are various active community organizations that assist the community in areas of health and education. The desire for rural electrification in this region is great. Community participation in the construction of an SHPP and subsequent administration and maintenance seems to be indicated.

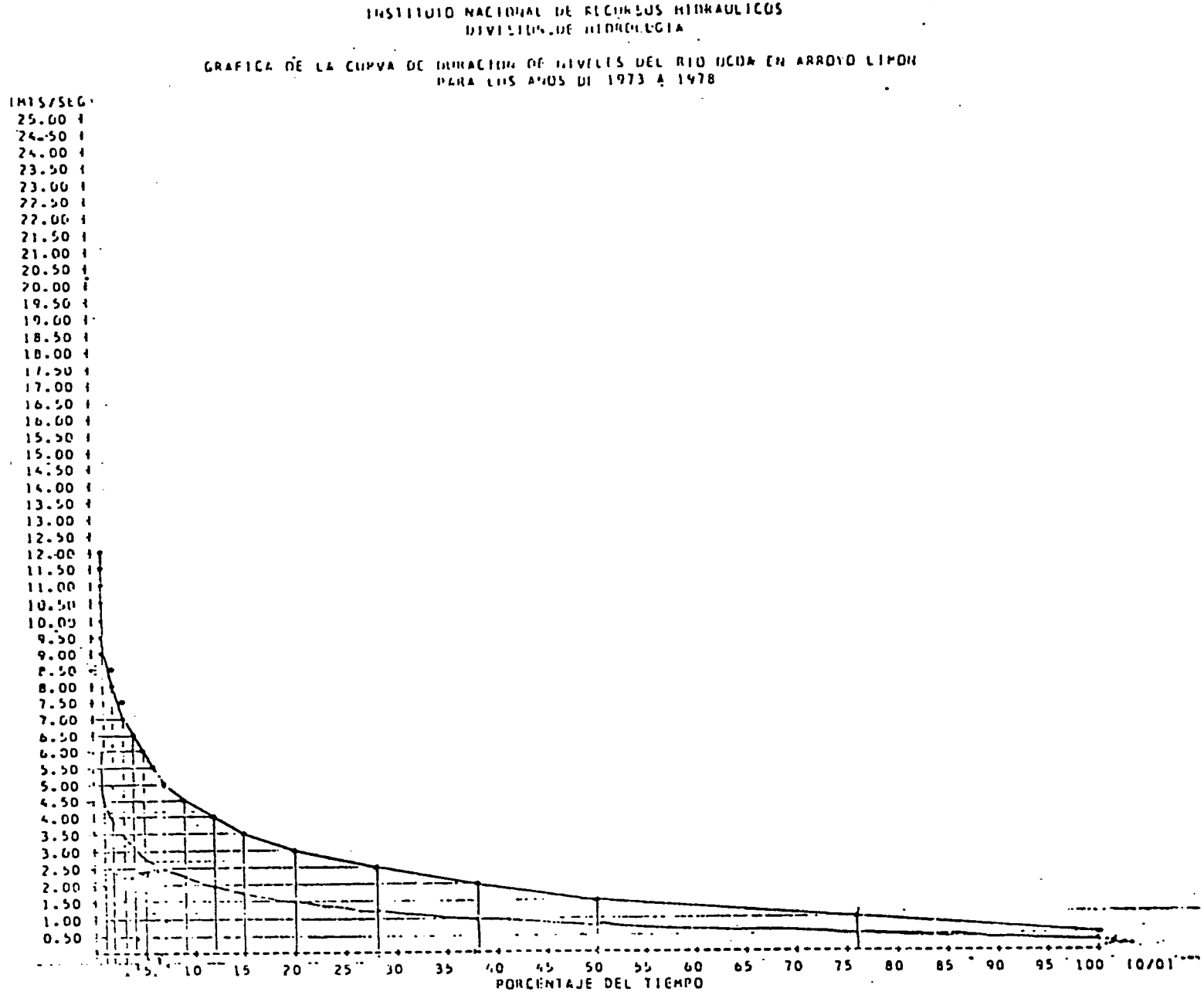
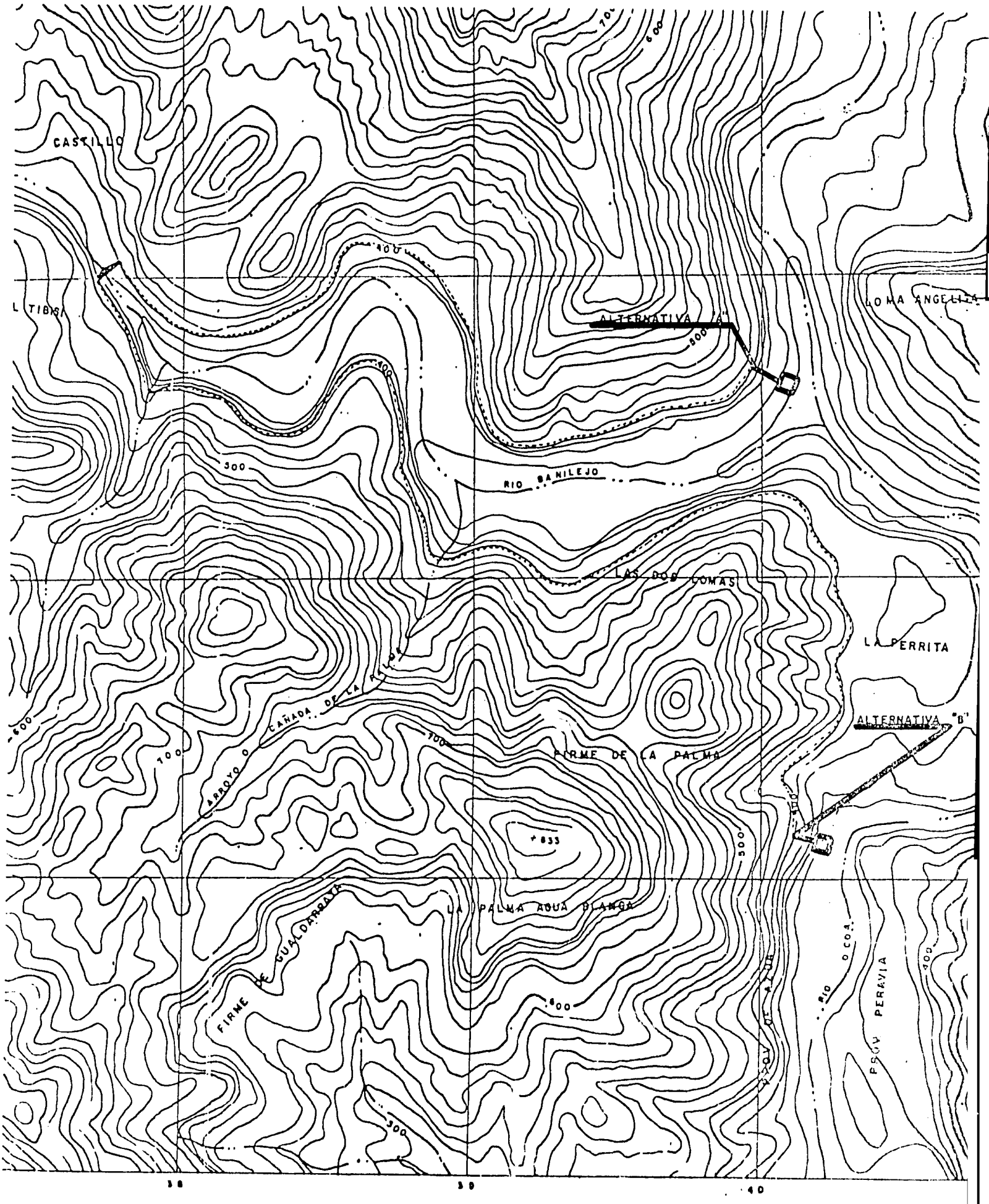


FIGURE IV.6

Flow Duration Curve for the Banilejo Study

BEST AVAILABLE DOCUMENT

FIGURE IV.7 Location of the Power Canal and Powerhouse for Banilejo



Capacity and Energy Estimates

The local estimated demand for the community of El Pinar is currently 44 Kw. If surrounding communities are included an incremental demand of 30 Kw would be realized. The estimated annual energy consumption of the region is 298 MWH which is expected to grow at an annual rate of 3%.

Initial estimates of capacity and potential generation for the SHPP proposed for Río Banilejo are 770 KW and 2.85 GWH annually. In effect, the community or region could utilize only about 10 percent of the project generation as proposed. At this point in the study, the investigating team examined connection to the grid as a possible market for excess generation as well as a source of energy during periods of low flow and maintenance down time.

A 12.5 KW distribution line passes within 1 Km. of the proposed powerhouse location and the connecting line routing would be over moderate terrain. It was decided to include this possibility of interconnection in the alternative layout schemes.

Evaluation and Selection of Preferred Scheme

The evaluation process was begun with two basic development alternatives: Scheme A, a 770 KW installation and Scheme B, a 1130 KW installation. As previously discussed, the multiple unit configuration in both cases was discarded as not being cost effective, as based on the following factors which entered into the selection process:

- Length of power canal and associated cost;
- Difficulty of canal construction (i.e. terrain, soil type);
- Length of penstock;
- Length of discharge canal or tailworks;
- Economic evaluation of incremental capacity and energy.

During this phase of the evaluation, INDRHI chose to perform rough cost estimates of the various schemes. The result of this preliminary analysis indicated the shorter conduction canal would be the most economically feasible (Scheme A). A further refinement was introduced in the type of turbine to be employed. A crossflow turbine was examined for incorporation into the scheme with its associated decrease in efficiency and increase in flow utilization. The selected scheme also incorporated interconnection with the national grid at a voltage of 12.5 KV. This is because the annual median generation far exceeds the community's energy requirements.

Estimated Project Costs

The following table presents a summary of construction and equipment installation costs for the Río Banilejo study as prepared by the INDRHI study team.

The INDRHI group has included equipment transportation in their costs of individual items and consequently that category does not appear in their estimate. This inconsistency in the costing methods emphasizes the need for standardized costing procedures.

The costs as presented have been made with the following assumptions and conditions.

1. The equipment and material costs reflect the price as delivered to the site.
2. All costs are expressed in terms of 1981 RD$.
3. The cost of labor in construction and installation is assigned a value that is a weighted average of local labor costs and semi-skilled labor cost.
4. Engineering design and construction supervision costs are not included.

ITEM	Cost (RD$)
1. New Dam & Spillway	105,000
2. Power Canal	198,700
3. Power Intake	24,000
4. Penstock	56,000
5. Power Plant and Electrical Equipment	450,800
6. Transmission line, Transformer and Protection Equipment	102,000
7. Land Clearing & Access	14,000
	950,500
Admin. & General Expenses (10%)	95,100
Contingencies (15%)	142,600
Total	1,188,200

TABLE IV.11 GENERAL CHARACTERISTICS FOR CONSTANZA SITE AND RIO BANILEJO

	Constanza	Río Banilejo
New dam and spillway		
Type:	concrete overflow	diversion
Length:	26 Mts.	36 meters
Height:	5 Mts.	3 meters
Upstream slope:	vertical	vertical
Downstream slope:	1:.9	1:.3
Construction:	rock and concrete	rock and concrete
Conduction Canal		
Section:	trapezoidal	trapezoidal
Length:	1 Km.	2.3 Km
Lining:	rock & mortar	rock and mortar
Gradiant:	.005	.001
Flow capacity:	.98 m^3/sec.	1.7 m^3/sec.
Median velocity:	1.28 m/sec.	1.2 m/sec.
Intake:	slide gate, manual	slide gate
Penstock		
Type:	steel	steel
Intake:	slide gate	slide gate
Capacity:	1.0 m^3/sec.	1.5 m^3/sec.
Diameter:	22"	36"
Length:	100 m	100 m
Thickness:	8 mm	8 mm
Turbine		
Design head:	63 m	61.75 m
Design flow:	1.0 m^3/sec.	1.5 m^3
Type:	horizontal francis	cross flow
Rated output:	675 hp	980 hp
Generator		
Type:	synchronous	synchronous
Rated output:	500 KW	726 KW
Voltage:	4160 volts at 60 hz	4160 volts at 60 hz
Speed:	1200 rpm	1200 rpm
Transmission		
Voltage:	4.160 KV	12.5 KV
Length:	2 Km	7 Km

4. Wood Fuel Development Program

a. Potential wood fuel production in the D. R.

The wood fuel research program proposed in this PP is intended to lay the basis for wide scale production of wood as an energy source in the future. The Energy Farm Study completed in 1980 estimated that the Dominican Republic has about 8.4 million tareas (1.3 million acres) of arid and semi-arid lands available for biomass farming. This land translates into a total potential of between 200 and 1400 MW of installed electrical capacity, based on the biomass yield estimate used for these unirrigated dry forests. If lands that are presently used or potentially earmarked for agriculture or utilization of forest lands in the mountain areas are considered, the estimate of potential could be much higher.

The map on the following page illustrates the availability of land for energy farming in the D. R.

b. Site Selection

Site selection for the tree research program was made with the objective of conducting experiments on soil types and in climatic regions characteristic of the dry forest zones of the Dominican Republic. Earlier work by the AID/USDA/Michigan State University Comprehensive Resource Inventory and Evaluation System (CRIES) Project divided the country into discreet Resource Planning Units (RPUS) which have characteristic soil, rainfall, vegetation and elevation parameters.

The experimental sites at Mao (RPU 36) and Azua (RPU25) are representative of 8 percent of the total land area of the Dominican Republic and 70 percent of the potential land available for energy farming activities. Further, these sites are compatible with the soil, rainfall and elevation requirements for adequate growth of the tree species selected for testing in the Dominican Republic.

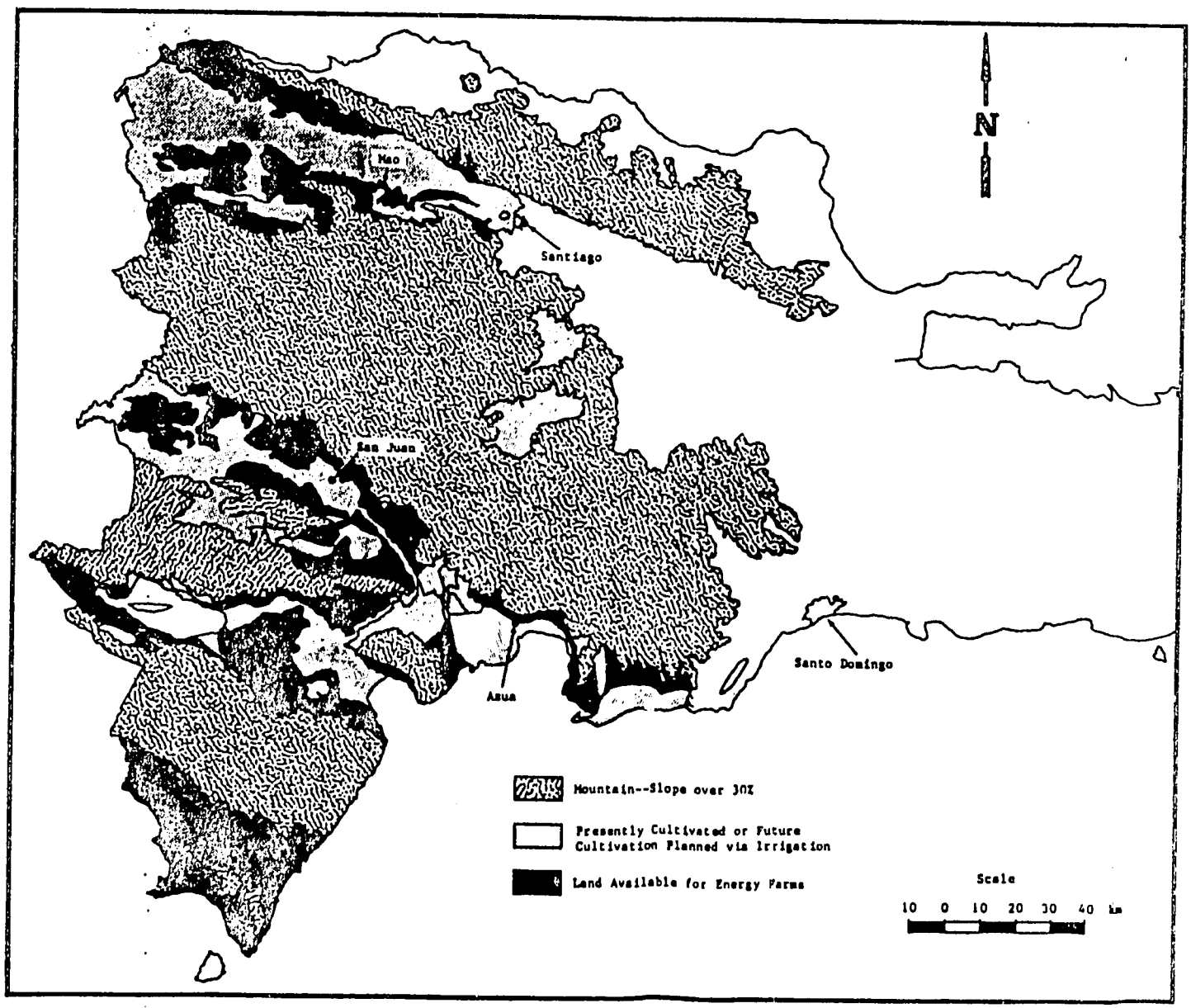
c. Proposed tree species

The following tree species are proposed for inclusion in the tree research program:

i) Leucaena leucocephala

Main Attributes. Of all tropical legumes, leucaena probably offers the widest assortment of uses. Through its many varieties, leucaena can produce nutritious forage, firewood, timber, and rich organic fertilizer. Its diverse uses include revegetating tropical hillslopes and providing windbreaks, firebreaks, shade, and ornamentation. Individual leucaena trees have yielded extraordinary amounts of wood - indeed, among the highest annual total yields ever recorded.

LAND AVAILABLE FOR ENERGY FARMING IN THE DOMINICAN REPUBLIC



Source: Potential for Energy Farming in the Dominican Republic, Mitre Corp., May, 1980

Use as Firewood. Leucaena wood makes excellet firewood and charcoal. It has long been used for these purposes in the Philippines. New varieties are so productive that they are already being planted to provide fuel for electric generators, factories, and agricultural-processing facilities. The wood has uncommonly high density and calorific value for a fast-growing tree, and because the stumps readily coppice, the plant could become a renewable fuel resource in areas suited to its agronomic requirements. The calorific value is 4,200-4,600 Kcal per Kg.

Yield. In the Philippines, dense leucaena plantations have yielded higher annual quantities of wood than any species yet measured. Annual leucaena increments have been measured from 24 to over 100 m^3 per ha.

Environmental Requirements.

-Temperature. Leucaena is restricted to the tropics and subtropics; frost kills it.

-Altitude. This is a species for lowland areas mainly below 500 m. The plant continues growing at high elevations, but without its lowland vigor.

-Rainfall. The species grows best where annual rainfall is 600-1,700 mm. However, it is the dominant vegetation covering Honolulu's Diamond Head, where annual rainfall amounts to only 250 mm.

-Soil. Leucanea's root system allows it to tolerate a wide array of soil conditions. It is found in soils varying from rock to heavy clay to coral. Unaided leucaena grows well only in neutral or alkaline (especially limestone) soils. It grows poorly in acidic soils.

Establishment. Seed viability is high and the seeds can be succesfully planted by hand or machine. Seedlings are slow starters.

ii) Eucalyptus camaldulensis

Main Attributes. As firewood, the timber from Eucalyptus camaldulensis has few equals. It is also a good charcoal wood, and the steel industry in Argentina, for example, relies on its charcoal for steelmaking. The tree will grow in many climates from tropical to subtropical; it has the ability to thrive on relatively poor soils and in areas where dry seasons are prolonged.

Use as Firewood. When fully dry, the wood is an outstanding fuel, highly valued in Australia. It is moderately dense (specific gravity, 0.6), with a fuel value of 4,800 Kcal per Kg. The species is being planted in fuelwood projects in Upper Volta and Senegal. Some of its provenances coppice well for six or more rotations.

Yield. With the right provenance on a favorable site, Eucalyptus camaldulensis grows very fast. Mean annual growth increaments of 2 m in

height and 2 cm in diameter can be maintained for the first 10 years. Annual wood yields of 20-25 m^3 per ha have been reported from Argentina, 30 m^3 per ha from Israel, 17-20 m^3 per ha from Turkey for the first rotation (from seedlings) and 25-30 m^3 per ha in subsequent coppice rotations. On good sites, plantations are managed on coppice rotations of 7-10 years. But on poor dry sites, annual yields drop off to between 2 and 11 m^3 per ha and rotations of 14 or 15 years may be needed.

Environmental Requirements. Because the species occurs over such an extensive natural range, seed collected from different localities may produce trees with very different appearance, growth rate, health, environmental tolerance, and wood quality. It is critically important to get seed from a climatic zone similar to that of the planting area.

-Temperature. The trees withstand high summer temperatures and are hardy down to 3°C, though some provenances can withstand -5°C and as many as 20 frosts a year.

-Altitude. Although mainly a tree of river plains, some provenances can be grown in highland areas (above 1,200 m in Zimbabwe, for example).

-Rainfall. In its native habitat the species is found both in areas of low and high rainfall (200-1,250 mm). A lower limit for commercial plantations is 400 mm annual rainfall, although the trees will grow well in drier areas if there is seasonal flooding or a high water table.

-Soil. The tree adapts well to a wide variety of soils, although, as noted, the provenance choice is very important. Salt tolerance also varies with seed origin. Most provenances, however, will tolerate periodic waterlogging.

Establishment. Eucalyptus camaldulensis produces good seed crops every year or two. Seed germination is high and seeds are long-lived when sealed and in dry, cold storage. Seedlings are usually started by nursery planting in containers. When transplanted to the field, spacings as close as 2 m x 2 m are used for fuelwood.

iii) Azadirachta indica (Neem)

Main Attributes. Neem is potentially one of the most valuable of all arid-zone trees. It can grow in arid and nutrient-deficient soil and is a fast-growing source of fuelwood. Moreover, it has many commercially expolitable by-products and environmentally beneficial attributes. Although in Asia neem leaves are often used as fodder, the ecotype in West Africa is ignored by cattle, sheep, and even goats, which makes it easy to establish.

Use as Firewood. Neem has long been used for fuel in India and Africa. It has become the most important plantation species in northern Nigeria and is planted for fuelwood and poles around the large towns.

The calorific value of its wood is reputed to be only slightly less than that of Enugu coal in Nigeria. The wood is relatively heavy with specific gravity varying from 0.56 to 0.85 (average, 0.68). The tree coppices freely and early growth from coppice is faster than growth from seedlings.

Yield. The rate of development of young neem plants after the first season is fairly rapid. As a rule, the trees put on an average annual girth increment of 2.3-3.0 cm, though more rapid growth is easily attained. In 4 different test plots, tree height varied from 4 to 7 m after the first 3 years and from 5 to 11 m in 8-year-old stands.

Enrironmental Requirements.

-Temperature. Neem survives great heat-even shade temperatures up to 44°C. Trees in Dade County, Florida, have occasionally withstood temperatures near 0°C or lower.

-Altitude. It will grow at altitudes from 50 to 1,500 m.

-Soil. The tree is undemanding and grows well on most soils, including dry, stony clay, and shallow soils. It will not grow on seasonally waterlogged soils or in deep dry sands where the dry-season water table lies below 18 m. The roots seem to have an unusual ability to extract nutrients and moisture from even highly leached, sandy soils.

Establishment. Although neem can be easily raised in a nursery and transplanted (as pot plants, or seedlings) early in the rains of the second season, direct sowings of fresh seed in the shelter of existing vegetation have also proved successful, though the initial growth is usually slower. In the field, the plants establish an extensive root system before aerial growth becomes rapid.

iv) Casuarina equisetifolia

Main Attributes. Almost all of the approximately 35 Casuarina species produce top-quality firewood. There are rapid-growing, carefree species for sites and climates as varied as coastal sand dunes, high mountain slopes, the hot humid tropics, and semiarid regions. They tend to be salt tolerant, wind resistant, and adaptable to moderately poor soils. Although they are not legumes, they do have the ability to form root nodules and fix atmospheric nitrogen. Casuarina equisetifolia is, perhaps, the most widely used so far, but other Casuarina species deserve more attention and testing. Casuarina equisetifolia can attain heights of up to 50 m, with diameters of up to 18 cm. However, it is generally only 15-25 m tall.

Use as Firewood. The wood of Casuarina equisetifolia burns with great heat and has been called the best firewood in the world. It is used for both domestic and industrial fuel. In India, it fuels some railroad locomotives and in the State of Karnataka it is the major species planted for firewood. It burns readily, even when green, and the ashes retain heat for a long time. It makes exceptionally fine charcoal. It has a specific gravity of 0.8-1.2 and calorific value of about 4,950 Kcal per Kg.

Yield. On good sites in Malaysia and the Philippines the tree commonly grows 2-3 m a year. In general, the yield per ha. varies from 75-200 t, on a rotation of 7-10 years, with a spacing between plants of about 2m. In the Philippines, even higher yields have been noted.

Environmental Requirements.

-Temperature. This is a species for warm to hot subtropical and tropical climates. The monthly mean maximum temperature in its native areas is 10°- 33°C, but it is adapted to a wide range of temperatures. It is not frost hardy, although some other Casuarina species are.

-Altitude. This is a lowland tree that can be planted from sea level up to 1,500 m.

-Rainfall. In its natural habitat, annual rainfall is from 700 to 2,000 mm, often with a dry season of 6-8 months. However, it has been planted succesfully in areas with annual rainfall as little as 200-300 mm or as much as 5,000 mm.

-Soil. Casuarina equisetifolia trees have root nodules containing nitrogen-fixing actinomycete microorganisms. They are therefore not dependent on soil nitrogen for good growth. The species tolerates calcerous and slightly saline soils, but it grows poorly on heavy soils such as clays. It can withstand partial waterlogging for a time.

Establishment. The trees produce seed plentifully. Normally, seedlings are raised in a nursery for transplanting to the field. Transplanting is carried out at the onset of the rainy season, 4-18 months after sowing. In dry sites, irrigation may be needed immediately after transplanting and as long as the first 3 years.

v) Calliandra calothyrsus

Main Attributes. This small tree is unusually promising as a firewood source because of its excellent coppicing ability and very quick growth. In Indonesia it has been cut for fuel after only a year's growth and harvested annually for the next 15-20 years. Even when harvested on such short rotations, it produces a sizable yield of branch wood that makes good household fuel.

Use as Firewood. In many parts of Java, Calliandra calothyrsus has become a favorite fuelwood. (In one instance, an experimental plantation of 0.5 ha. was established in 1963; by 1975, over 250 ha. of firewood plantations had been independently established on a nearby privately owned farms and home lots.) The wood has a specific gravity of 0.51-0.78, its calorific value is 4,500-4,750 Kcal per Kg, and its ash content is 1.8 percent. It is used for cooking as well as in small industries; for example, those making lime, tiles, or bricks.

Yield. Trial plots in Indonesia showed initial growth of 2.5-3.5 m in only 6-9 months. After 1 year's growth, calliandra can be cut at about 50 cm above the ground, reportedly yielding about 5-20 m^3 per ha. Afterwards, yearly cuttings are possible, producing between 35 and 65 m^3 of small-sized fuelwood per ha.

Enrironmental Requirements.

-Temperature. Unknown.

-Altitude. On Java, the tree grows at altitudes between 150 and 1,500 m.

-Rainfall. The plant grows where rainfall is over 1,000 mm per year, though it can withstand drought periods lasting several months.

-Soil. It can grow on many different soils, including infertile ones, and even grows on heavily compacted clay-type soils with poor aeration.

Establishment. Plantations are easily established by direct seeding or by seedlings. Seeds or seedlings are usually planted at the beginning of the wet season. Seedlings are transplanted from the nurseries at about 4-6 months at spacings of 2 m x 2 m or 1 m x 1 m.

vi) Prosopis juliflora

Main Attributes. Prosopis juliflora is a highly esteemed fuelwood source in several tropical countries and it is also valued for the shade, timber, and forage it can provide. It is planted where other, more valuable forest species cannot be successfully grown.

Use as Firewood. Prosopis juliflora wood is hard and heavy (specific gravity, 0.70 or higher). It is excellent for firewood and makes superior charcoal. Because of its high heat value, the wood has been termed "wooden anthracite." It burns slowly and evenly and holds heat well.

Yield. Prosopis juliflora grows fast. On a 15-year rotation, the expected yield is 75-100 t per ha; on a 10-year rotation, it may be 50-60 t per ha. The trees coppice readily.

Environmental Requirements.

-Temperature. Prosopis juliflora grows in very warm, dry climates. Some varieties are not frost hardy.

-Altitude. The tree is found growing from sea level to 1,500 m.

-Rainfall. It grows in areas with an annual rainfall of 150-750 mm. The plant's roots penetrate to great depths in search of soil moisture.

-Soil. The tree grows on a variety of soils. It does well on sandy soils and will grow on rocky terrain provided that root growth is not impeded.

Establishment. Prosopis juliflora reproduces easily by root suckers and seeds.

d. Charcoal Production

The following tables present basic technical data on charcoal production.

TABLE IV.12

GENERAL PROPERTIES OF CHARCOAL

YIELD BY WEIGHT	25 to 40 percent of dry weight of wood
YIELD BY VOLUME	50 to 65 percent of the volume of wood
SPECIFIC GRAVITY	Varies with Carbonization Temperature
AVERAGE BULK DENSITY	250 Kg/Cubic Meter
HARDNESS	Varies with the Density of the Wood used and Inversely with the Increase in Carbonization Temperature
MOISTURE CONTENT	1 to 5 percent
VOLATILE MATTER CONTENT	7 to 30%. Varies Inversely with Carbonization Temperature. The lower the volatile matter, the less smoke in cooking stoves.
FIXED CARBON CONTENT	80 to 90 percent. Varies with carbonization.
CALORIFIC VALUES	5,600 to 7,222 Kcal/Kg

TABLE IV.13

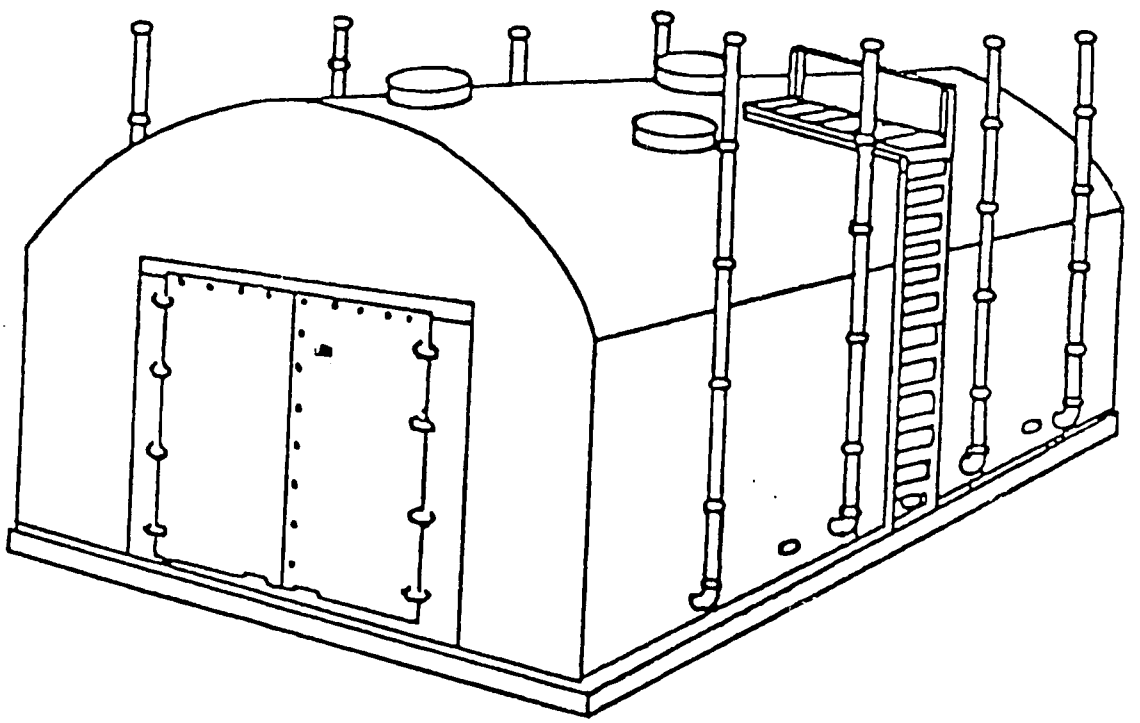
AMOUNT AND COMPOSITION OF CHARCOAL PRODUCED AT DIFFERENT MAXIMUM TEMPERATURES

Distillation Temperature, (°C)	Composition of charcoal (%) Carbon	Hydrogen	Oxygen	Yield a/ (%)
200	52.3	6.3	41.4	91.8
250	70.6	5.2	24.2	65.2
300	73.2	4.9	21.9	51.4
400	77.7	4.5	18.1	40.6
500	89.2	3.1	6.7	31.0
600	92.2	2.6	5.2	29.1
700	92.8	2.4	4.8	27.8
800	95.7	1.0	3.3	26.7
900	96.1	0.7	3.2	26.6
1000	96.6	0.5	2.9	26.8
1100	96.4	0.4	3.2	26.1

a/ expressed as a percentage of the dry weight of wood

The following figure illustrates the Missouri charcoal kiln to be included in the program. Illustrations of the beekive and metal kilns to be included in the program were not reproducible with sufficient clarity to present here.

FIGURE IV.8 Missouri Charcoal Kiln



"Missouri-type" charcoal kiln

e. Electricity Production

During intensive review, a USAID consultant team examined the cost of converting wood to electricity using two different established technologies. The results are summarized below.

i) Wood-steam generated electricity

Steam Condition: 250 Psig and Dry Saturated (Inlet to Turbine Condition) 15 Psig and Wet (Outlet Condition from Turbine) Non-Condensing steam cycle.

Estimated Costs - 150 KW: ($000)

1. Site Preparation.....$15
2. Fuel Preparation and Storage.....$20
3. Building and Foundation for Equipment Systems.....$50
4. Boiler System.....$250
5. Boiler System Installation.....$60
6. Deaerator and Water Treatment.....$25
7. Single Stage Turbine-Generator Unit-Installed Cost.....$60
8. Air Cooled Condenser.....$25
9. Elec. Switch Gear.....$ 5
10. Dump Truck.....$20
11. Piping Systems Installed.....$10
12. Feasibility Study (Steam only).....$50
13. Technical Assistance (1 Man-Year).....$100

Total $690

ii) Wood Gasification

Estimated Cost - 150 KW: ($000)

1. Site Preparation.....$15
2. Fuel Preparation & Storage.....$20
3. Building and Foundation.....$15
4. Gasifier, Feed System, and Engine-Generator Set.....$180
5. Elec. Switch Gear.....$5
6. Dump Truck.....$20
7. Technical Assistance (1 man-year).....$100

Total $355

Because of the relatively high cost of these options, it was decided to limit this aspect of the program to testing and demonstration of lower cost, experimental wood to electricity conversion technologies. One such technology, proposed for inclusion in the program, involves a mobile wood gasification system rated at 50 KW, which would be available in the D. R. for only $35,000. The following figures illustrate this technology.

FIGURE IV.9 - 50 KW Mobile Wood Gasification Electricity Production Unit

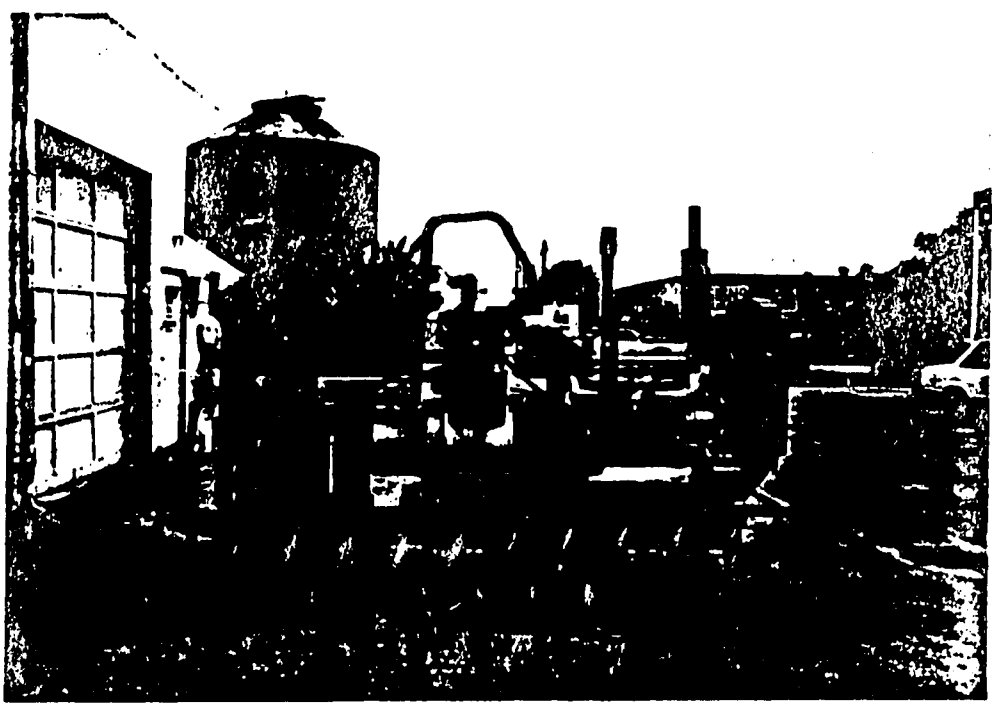
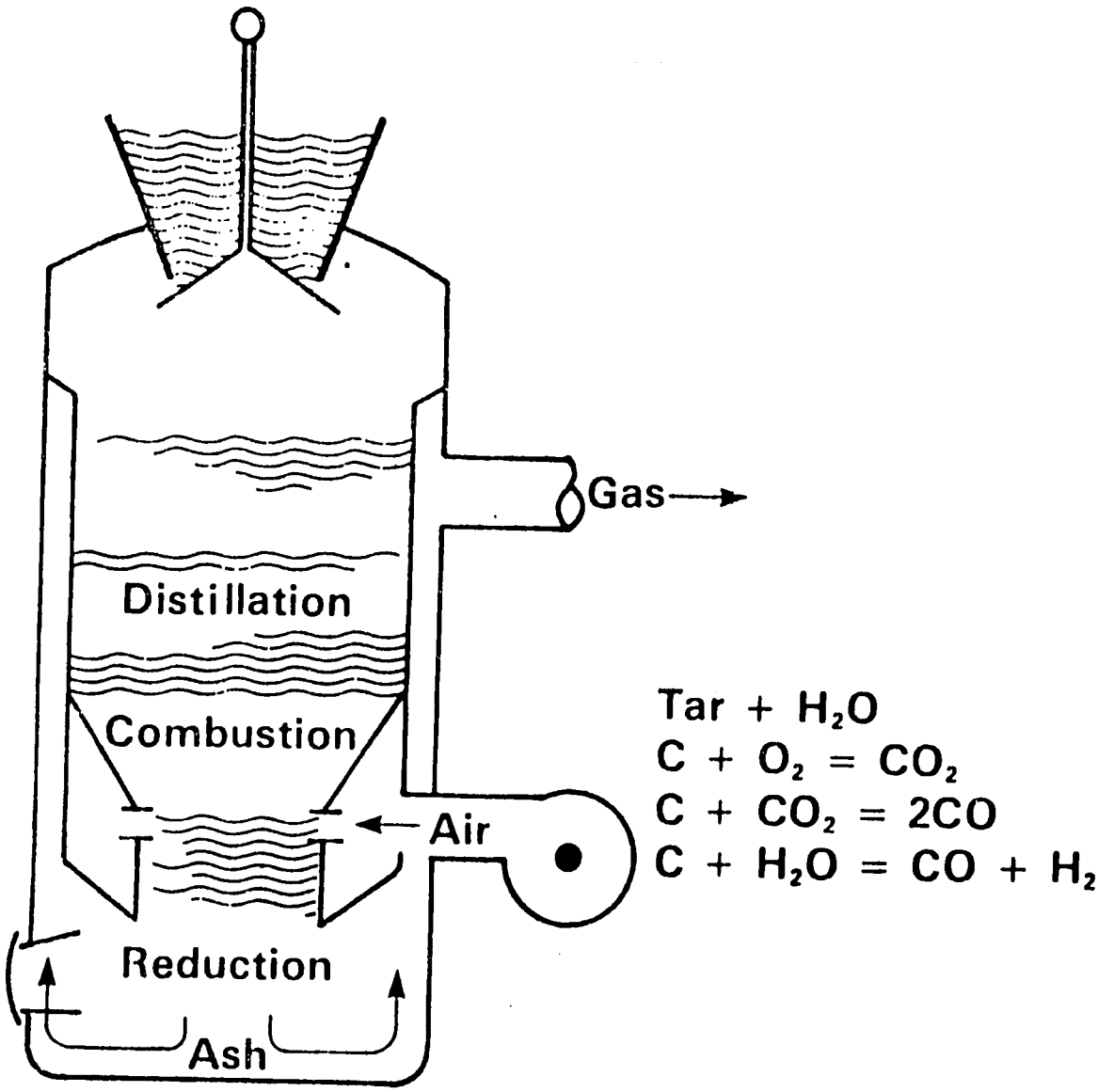
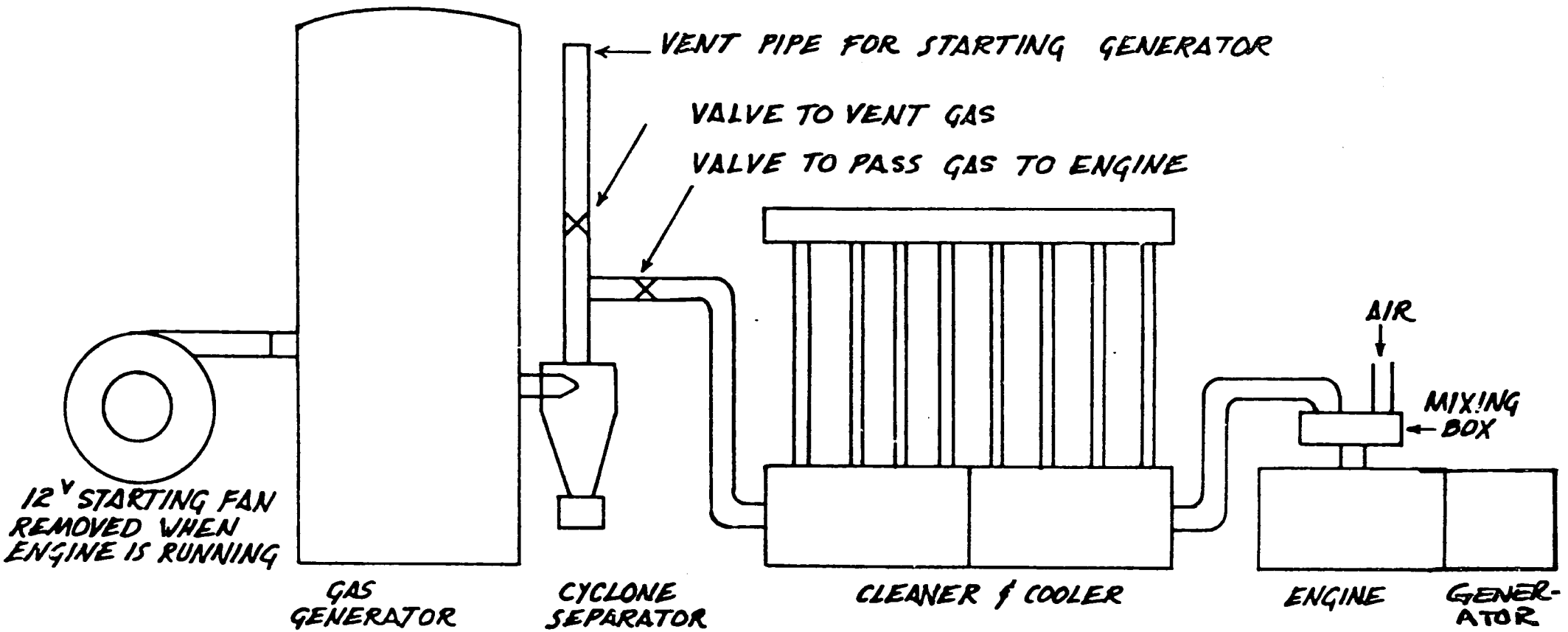


FIGURE IV.10



Schematic Diagram of Downdraft Gasifier

FIGURE IV. 11



TYPICAL COMPONENTS OF GAS GENERATOR SYSTEM

The economics of the 50 KW unit are claimed by the manufacturer to be as follows:

CAPITAL COST INSTALLED	$35,000.00
ANNUAL COST OF 24 HOUR/DAY OPERATION	(8,000 hours)
Depreciation - 10%	$ 3,500.00
Maintenance - 6%	$ 2,100.00
Labor (developing countries $1.00/hour)	$ 8,000.00
Fuel $10/ton & 110 lbs/hour	$ 4,400.00
TOTAL	$18,000.00

ELECTRICITY PRODUCED - 400,000 KW hrs. (8,000 hrs. x 50 KW)

COST.....$ .045/KWh

Under the program, it is proposed to procure, operate and monitor closely such a unit in order to determine its appropriateness for wide scale application in the D. R.

5. CDE Technical Assistance Program

The following table summarizes the power generating system of CDE.

TABLE IV.14

CDE POWER GENERATING SYSTEM

	Installed Capacity (MW)	Firm Capacity (MW)	Fuel Type
STEAM			
Haina 1, 2, 3, 4,	277.8	220	Bunker 6
Puerto Plata I	27.6	20	"
Santo Domingo	64.5	40	"
Falconbridge	90.0	90	"
Sub-Total	459.9	370	
GAS TURBINES			
Los Minas	70.0	60	Gas-oil
Timbeque	42.2	30	"
San Pedro de Macorís	28.3	25	"
Barahona	28.3	20	"
Sub-Total	168.8	135	
DIESEL			
Various - 17 Units	22	21	Diesel/oil
HYDRO			
Las Damas	7.5	5.0	
Tavera	40.0	20.0	
Valdesia	54.0	36.0	
Rincón	10.0	6.0	
Sabana Yegua	13.0	5.6	
Sub-Total	124.5	72.6	
Totals	775.2	598.6	

C. INSTITUTIONAL ANALYSIS

Considerable information is provided in the Project Description on the roles of the different institutions involved in project implementation and how those institutions will be strengthened or assisted under the project. The purpose here is to provide supporting information on the institutional structure and organization of the institutions involved.

1. National Energy Policy Commission

The National Energy Policy Commission will be the overall project coordinator and will be directly involved in implementation of the National Energy Planning component, the Industrial Conservation, Mini-Hydro and Wood Fuel programs and Long Term Training.

The National Energy Policy Commission was established by Presidential Decree No. 584, January 19, 1979. The Commission is chaired by the Technical Secretary of the Presidency and includes as members:

Secretary of Industry and Commerce;
Administrator General of CDE;
President of the Petroleum Refinery;
Executive Director of INDRHI;
Executive Director of INDOTEC;
President of CODIA;
Representative of the Universities;
Representative of the Private Industrial Sector;
Representative of the Private Transportation Sector;
Executive Secretary of the Commission.

The Commission at this highest level meets approximately once every 45 days. Most of the day-to-day activities of the Commission are carried out by the staff of the Executive Secretariat under the direction of the Executive Secretary of the Commission. The Commission receives an annual operating budget of $1.3 million and has a staff of 60 employees.

As stated in its regulatory statutes, the principal objective of the Commission is the elaboration of national energy policies and programs to achieve a reduction in dependence of foreign energy sources. The specific functions of the Commission are to coordinate the energy-related activities of different public and private sector agencies, analyze the national energy situation and develop national energy plans, identify appropriate areas for public and private investment, and recommend to the President specific energy policies and programs. The Commission's authority includes the preparation of specific legislative or regulatory measures for submission to the executive power. This also includes "suggestions" regarding gasoline prices, electricity rates, and other energy price structures. The Commission is furthermore designated as the coordinating and recipient body for all external financial and technical assistance in the area of energy.

The establishment of the National Energy Commission is viewed as a very positive step in addressing the energy problem in the Dominican Republic. In the past, government actions to reduce dependence on imported petroleum have tended to be carried out by individual agencies somewhat in isolation. The need for a coordinating institution capable of developing energy policy in light of the overall energy situation has been very evident. By supporting the Commission through this and other projects, USAID hopes to strengthen the Commission's ability to fulfill this much needed role.

Although its specific powers vis-a-vis other agencies are still being defined, the Commission does appear to have the potential to influence the energy situation in a significant way, not only by recommending specific policy and investment measures to the President, but also by educating and motivating public and private leaders, and working with other institutions in the development and implementation of energy programs. Recent examples of this kind of influence include coordinating the participation of CDE, Falconbridge Dominicana and the cement industries in the Bechtel study of coal conversion, collaboration with the State Sugar Council in the Solar Bagasse Drying Project, and assiting the mini-hydro site studies carried out by CDE and INDRHI for development of this project.

Within its annual budget, the Commission also carries out technical research activities and individual pilot projects and programs, in addition to its overall policy analysis and planning activities. In its workplan for 1981, the Commission is proposing to carry about 20 different projects in energy conservation and local energy resource development, about a third of which are to be financed from its own budget.

The Secretariat of the Commission, which has full responsibility for the day-to-day activities of the Commission, is headed by an Executive Secretary and divided into Departments of Energy Conservation, Energy Research and Development, and Economic Affairs.

The Energy Conservation Department is divided into sections for industry and commerce, housing and buildings, education and extension, and special programs in the transportation and electrical sectors, for example. The functions of the Conservation Department include programs to increase public awareness of the energy problem and conservation possibilities, and individual conservation programs focused on the industrial, commercial and transportation sectors.

The Department of Energy Research and Development is divided into sections for conventional and non-conventional resources. Its functions include examination of domestic and international energy supply trends, research into the development of indigenous conventional and non-conventional energy resources, and specific programs to develop and promote the utilization of local energy resources.

The Economic Affairs Division is divided into sections for Energy Information and Energy and Economic Analysis. Its functions include

establishing and operating an infrastructure for the collection, management and analysis of energy information, the development of national energy balances and projections and research and analysis of the relationship between economic and energy factors.

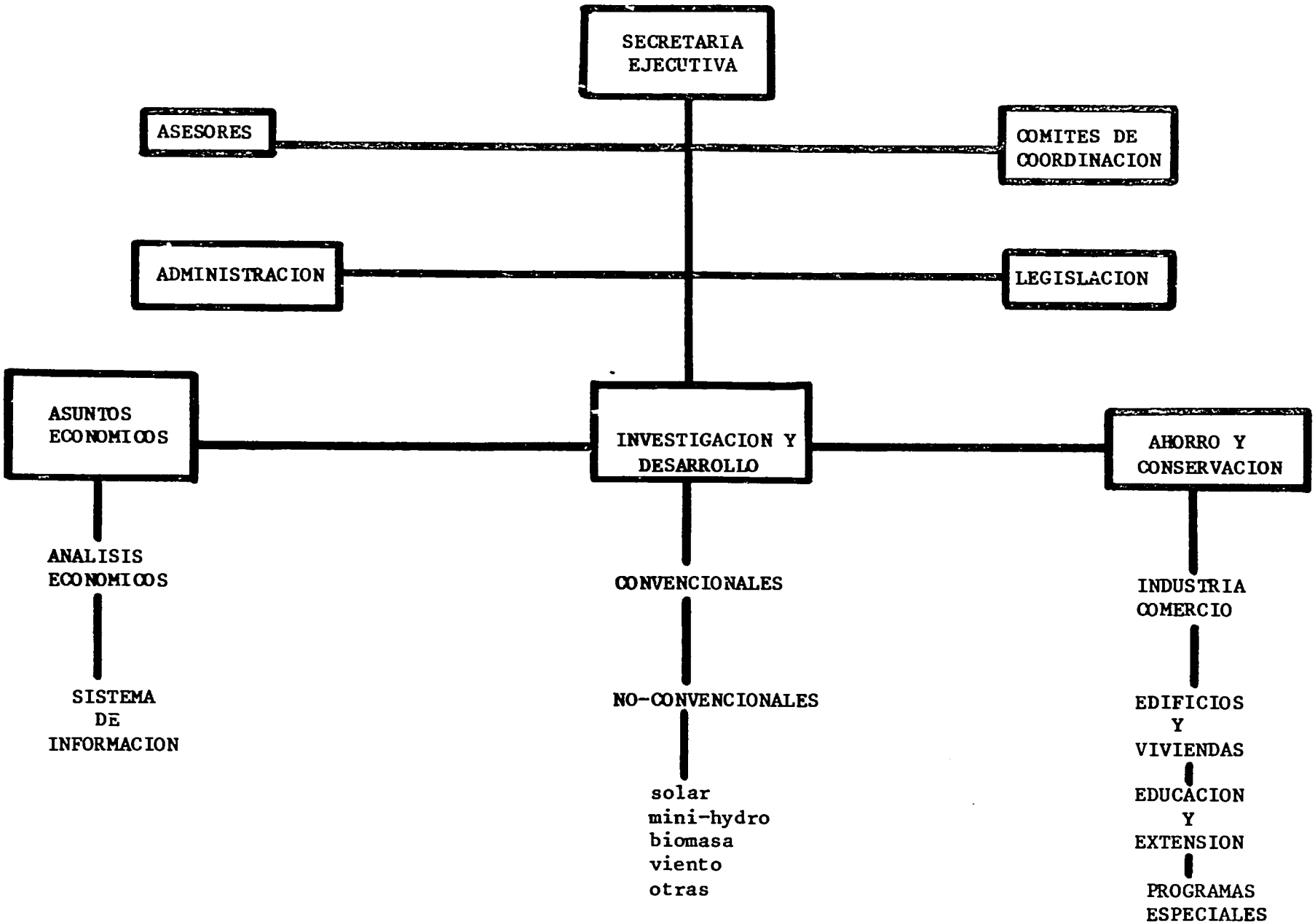
The majority of the professional staff employed by the Commission have technical backgrounds in engineering, architecture, economics, etc. The following is a list of educational qualifications of the staff hired to date:

Electromechanical Engineers	12
Civil Engineers	6
Biochemical Engineers	4
Chemical Engineers	4
Industrial Engineers	3
Consultant Engineers (part time)	2
Economists	8
Computer Programmers/Operators	2
Social Scientists	2
Architects	2
Accountants	3
Librarians	2
Receptionist/Secretaries	6
Chauffers	3
Messenger	1

The following diagram illustrates in more detail the institutional structure of the National Energy Commission:

FIGURE IV.12

COMISION NACIONAL
DE POLITICA ENERGETICA



2. Dominican Electricity Corporation (CDE)

CDE will be involved in implementation of the Mini-Hydro Development Program and, of course, the CDE Technical Assistance Program.

CDE is a state owned corporation which is responsible for all production, transmission and distribution of electricity. It establishes its own operating and expansion programs and approves changes in its tariff with the President's agreement. CDE is governed by a Board of Directors, whose president and six other members are appointed by the President of the GODR. The General Administrator is also appointed by the President for an indefinite period of time and therefore may be removed from office at any time during performance of his functions.

CDE's total annual budget for 1981 is approximately $483 million, of which $175 million is estimated to be spent for fuel, $51 million for personnel and operations, $82 million for debt financing and repayment and $175 for construction and expansion projects. CDE finances these expenses through sales of electricity ($220 million), external and internal financing including loan funds from Venezuela and Mexico, and subsidies from the central government. CDE currently has about 4,000 salaried employees.

CDE consists of eight Departments which report directly to the General Administrator. The primary responsibilities of each Department are listed below.

Engineering	-	Scheduling, design and construction of thermal plants, transmission and distribution networks and associated substations.
Production	-	Operation and maintenance of generating plants, including fuel procurement.
Operations	-	Operation and maintenance of transmission and distribution networks and substations; operation of load dispatch; and control of the communications system of the Corporation.
Hydroelectric Development	-	Programming, design, and construction of hydroelectric plants.
Non-Conventional Energy	-	Study, programming and construction of non-conventional energy sources, such as wind and biomass.
Commercial	-	Invoicing and collection of payments for electric services provided by CDE and installation, administration, supervision and control of electric meters.

Planning - Load and energy forecasting; development of short, medium, and long range transmission, distribution and generation expansion plans.

Administration - Financial management and accounting; direction and coordination of general company support services; transportation, purchasing, supply; personnel administration.

The organizational structure of CDE has undergone several changes since it was formed in 1955. The most recent change was made in 1980 with the creation of two additional Departments, those for Planning and Non-Conventional Energy.

An organizational chart for CDE appears on the following page.

3. National Institute of Water Resources (INDRHI)

INDRHI will be involved in implementing the Mini-Hydro Development Program.

INDRHI was created as an autonomous institution in September 1965 with broad responsibilities as the supreme authority for the integral development of the nation's water resources, in accordance with national development plans. In the energy area, INDRHI's responsibilities include the development of the nation's hydroelectric resources through the stages of planning, design and construction, either on its own or in conjuction with other competent institutions in the public and private sectors. INDHRI sees its role as ensuring that the maximum economic benefits result from every water development project, even in those cases where it does not take the lead agency role.

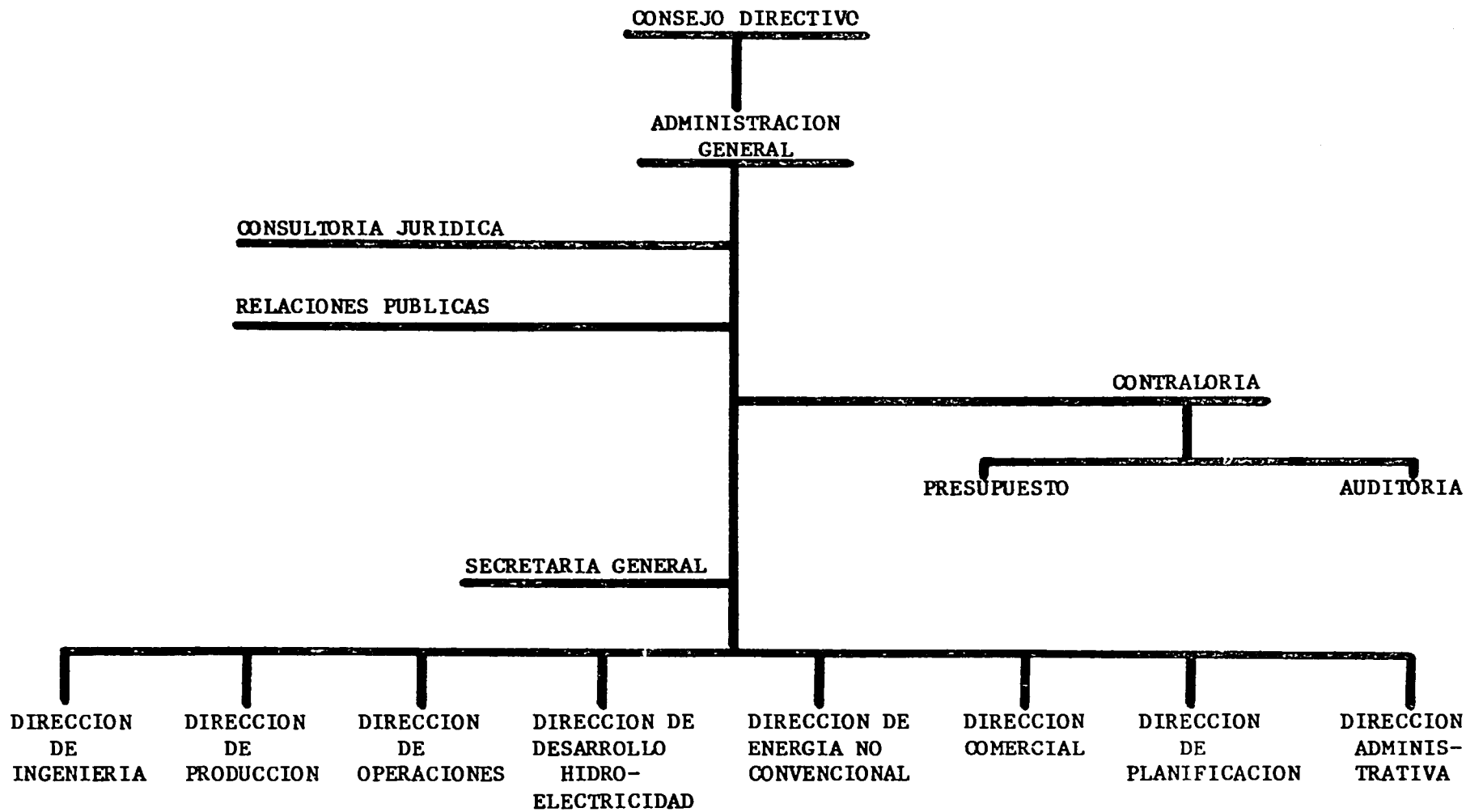
INDRHI currently has 1,050 salaried employees and an annual operating budget of $14 million.

At the present time, the Dams and Hydroelectric Project Sections of INDRHI are responsible for the development of small scale hydro electric projects. The staffing of these Sections is as follows:

SPECIALTY	NUMBER OF PROFESSIONALS
Civil Engineering	6
Civil Engineering-Hydraulics	2
Electro-Mechanical	2
Electrical	2
Support	2

FIGURE IV.13

CORPORACION DOMINICANA DE ELECTRICIDAD



When considered necessary, the Sections can call upon professional support from other entities of INDRHI such as the Hydrology Division and the Geology Section.

INDRHI has participated in the design of all major hydroelectric facilities in operation and has under construction the only modern mini-hydro installation in the country.

4. Dominican Institute of Industrial Technology (INDOTEC)

INDOTEC is an agency supported by the Central Bank, intended to assist in the development of Dominican industry. The staff of INDOTEC consists of approximately 150 technical professionals with a broad range of qualifications, and facilities include laboratories for physical, chemical and microbiological work, pilot plants for investigation of industrial processes, and a comprehensive library and information center. INDOTEC receives a budget of $2 million annually from the Central Bank. The work of INDOTEC is performed by several departments, such as Technical Service, concerned with project feasibility studies and process analyses and investigations; Analytical Services, providing a service to INDOTEC itself as well as to industry; and Research and Development, responsible for the development of new and improved techniques and technologies for industry.

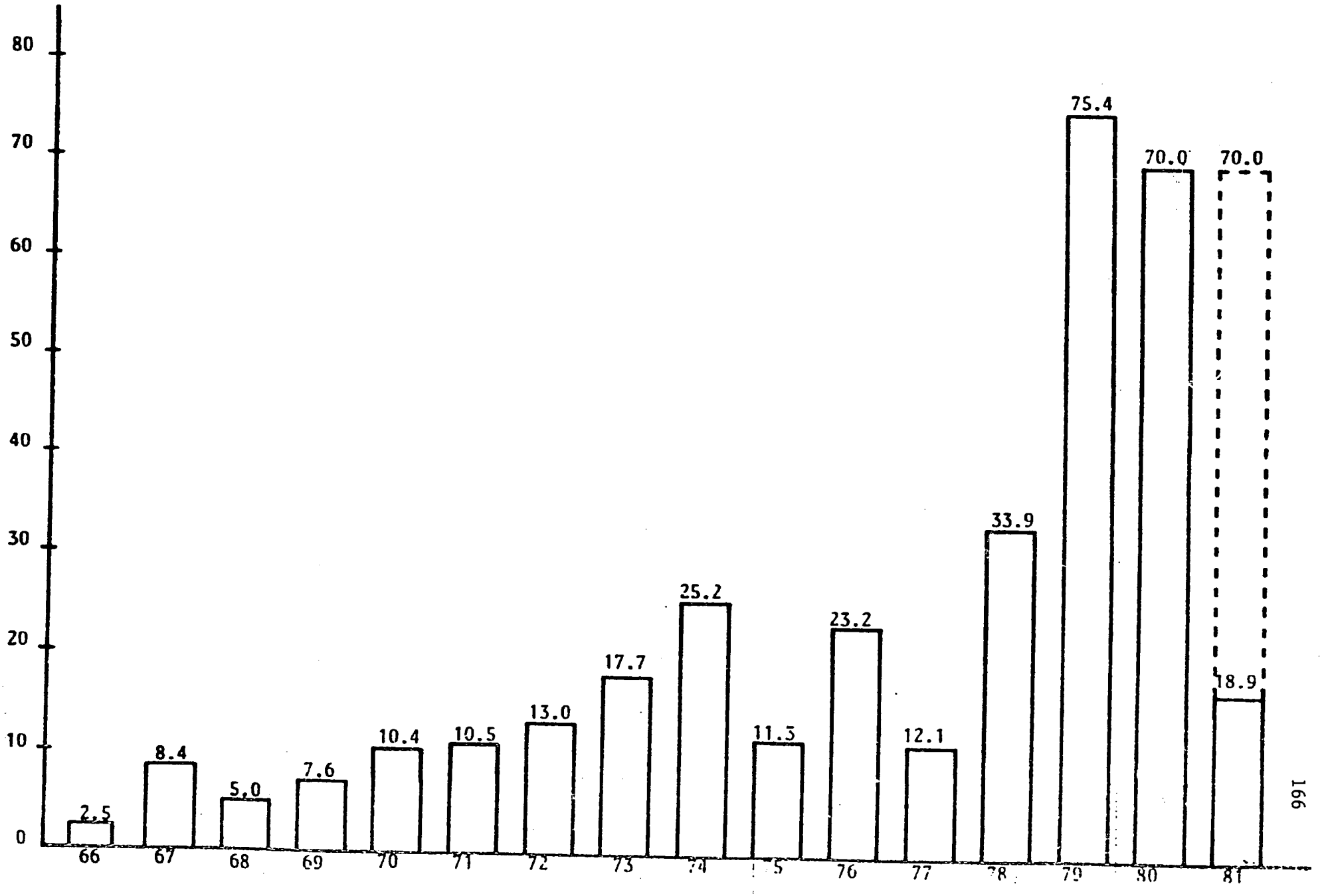
Together, these services of INDOTEC provide companies and industries with information and advice on the national resources of the country and their potential for industrial exploitation, including the quality of raw materials and products of Dominican industry. INDOTEC will also assist enterprises in short, medium and long term planning, production programming, controlling product quality, selecting manufacturing processes and equipment, and training of plant technical personnel.

The contacts between INDOTEC and Dominican industry, and the experience of INDOTEC personnel in industrial processing, represent a resource which will be utilized by the Commission in conducting the proposed Industrial Conservation Program. The specialized knowledge of several INDOTEC staff members of the food processing industry, for example, could be used in both short and extended audits, and in the task for assisting industry to develop conservation programs. It is therefore proposed that inclusion of appropriate INDOTEC personnel from such groups as the Technical Services Department be arranged by the Energy Commission at the outset of the program.

5. Fund for Investment in Economic Development (FIDE)

FIDE was established within the Central Bank in 1966 for the purpose of channeling resources, through intermediary lending institutions, to the agricultural, livestock and industrial sectors. FIDE funds are provided both from GODR (Central Bank) resources and from foreign private and public financial institutions. Since 1966, FIDE has made loans totalling over $396 million. Its annual lending level has now reached about $70 million (see chart on next page). These funds are apportioned about equally among agricultural production, livestock production and industrial activity.

FIGURE IV.14 FONDO DE INVERSIONES PARA EL DESARROLLO ECONOMICO (FIDE)
PRESTAMOS APROBADOS
1966-1981
(En millones RD$)



FIDE has a total of 42 employees who have demonstrated a high level of competence in project analysis and loan recuperation. FIDE's cumulative default rate is less than 4 percent. There is no question as to FIDE's capability to manage the lending program contemplated under this project.

6. Superior Agricultural Institute (ISA)

ISA will have primary responsibility for implementation of the Wood Fuel Development Program.

ISA, located in Santiago, was founded in 1962 with funding from the GODR and A.I.D. Although the Institute receives some subsidies from the GODR, it is primarily a private institute, managed by a Board of Directors comprised of some of the most prominent businessmen in the country. The institute currently offers agricultural degrees in specific technical areas, at both the high school and university levels. Since its inception, 574 high school and 209 university degrees have been awarded in areas of Agricultural Engineering (high school), Farm Management, Agricultural Education, Agricultural Mechanization, Agricultural Economics, Horticulture, and Crop Technology. Currently, there are some 260 university students and 110 high school students enrolled, and by 1985, ISA expects these numbers to increase to 500 and 200 respectively, with a faculty of 45 professors. To help meet the growing need for rural development management training, ISA now plans to establish a Center for Administration of Rural Development. There is also a healthy interchange of staff and students with the nearby Catholic University (UCMM).

In addition to the extensive research it undertakes, ISA has also helped organize and sponsor national and international conferences, such as the Caribbean Conference on Energy and Agriculture in 1978. ISA staff have expanded their research activities considerably in the energy area and now are involved in work in biogas digestors, solar heaters, micro-hydro turbines, and of course wood fuel production and conversion.

ISA has extensive land holdings both at its main campus (4,742 tareas) and at Mao (16,000 tareas).

The ISA staff has demonstrated considerable competence in agro-forestry and appropriate technology research. With the technical assistance and training provided under the project, ISA should be fully capable of implementing the Wood Fuel Development Program.

D. SOCIAL SOUNDNESS ANALYSIS

The Energy Conservation and Resource Development Project is directed primarily at developing institutional capacity and initiating priority programs in the energy sector. Its impact on large numbers of individual Dominicans will flow from future activities of the institutions involved and the expansion of the programs which will be initiated under the project. For this reason, beneficiary oriented Social Soundness Analysis in its usual form is not applicable. Therefore, each component of the Project will be discussed with emphasis upon the means by which basic principles of Social Soundness Analysis will be introduced into the project activities, rather than the impact upon the immediate beneficiaries of the project itself.

1. National Energy Planning

The energy investment planning activity has as its primary objective establishing priorities for energy investments on the basis of economic, social and technical criteria. In contrast to energy investment planning procedures in the past, which have focused for the most part on technical and economic considerations, in this activity, the benefit incidence dimension of energy project planning will be formally introduced and made a permanent feature of Dominican investment decision making in the energy sector. This approach will help to assure that the needs of many Dominicans who now do not benefit from access to energy at reasonable cost will be taken into account. It will also assure that the negative impact of major energy projects on some people, for example persons displaced from their homes and farms by reservoirs, will be taken into account. Another dimension of investment analysis which will be incorporated in energy planning is consideration of the behavorial changes which must take place in order to assure that investments do in fact produce the economic benefits which are predicted for them. The siltation of major dam projects caused by inapropriate agricultural practices in the watershed have led to enormous economic losses in the Dominican Republic. Investment decisions must be taken with full consideration of the aggregate system costs involved. Thus, in some cases, the system cost may include major conservation investments as well as project infrastructure. In this connection, energy investment planning will introduce a new approach and set of techniques in decision making. Awareness of this kind of problem, and commitment of the Government to act in light of a broader understanding of the social implications of major investments, is believed to exist in the Dominican Republic at this time. (See Natural Resources Management Project Paper.)

Thus, this component is viewed as being compatible with the socio-cultural objectives of both USAID and the GODR, and likely to have a favorable impact on the distribution of benefits and burdens of energy investments in the future.

2. Industrial Energy Conservation Program

The Industrial Energy Conservation Program addresses itself primarily to the private industrial community. It develops institutional capacity to heighten awareness of the potential for energy conservation, to provide technical assistance in adopting energy saving techniques and devices, and to offer credit facilities to assist financing of conservation measures.

The industrial community of the Dominican Republic, while not fully modernized in all areas, generally shares the values, orientation and basic techniques of modern industrial management. There appears to be no reason to believe that Dominican managers would resist energy saving, and therefore money saving and profit increasing investments, provided that they know what the possibilities are, that adequate technical assistance to realize improvements is available and that credit facilities can be accessed where necessary. To the contrary, rising energy costs and problems of the reliability of the energy supply, particularly from CDE, are a matter of great concern in the industrial community. Thus the program does not appear to raise any issues of socio-cultural feasibility.

Because the project creates an institutional capacity to encourage energy conservation, it carries with it the potential for spread effect far beyond the immediate beneficiaries of the program to the rest of the industrial sector and subsequently to other sectors including agriculture, transportation and services.

The problem of benefit incidence of the industrial conservation component has given the Mission some pause. The more alert and progressive firms are likely to be the first claimants for assistance under this program. It is not out of the question that some firms may be so significantly benefitted by improved energy practices that they may be able to lower prices, seize larger market shares and otherwise improve their position relative to less progressive firms. The incidence of benefits and burdens from such developments is impossible to predict. This project does constitute an intervention in a number of markets. The aggregate effect will benefit the economy of the country as a whole but it may well be harmful in the short run to weaker competitors and their employees. The project will attempt to minimize this problem by assuring broad publicity and, to the extent possible, of access of all firms in a given market to energy conservation assistance as quickly as possible.

3. Mini-Hydro Development

The Mini-Hydro Development Program addressess itself to building the institutional capacity to carry out a wide scale mini-hydro development program.

The project will include the construction of 3-4 mini-hydro installations in rural areas. The social soundness of each project will be examined both in the site selection process and, of course, in the final

project feasibility and design activity. Further, the project contemplates community participation in management and operations of the facilities built. Training and technical assistance will be provided to community members in operation and maintenance, administration, promotion of efficient uses of electricity, watershed conservation and other aspects of project operations to make community participation a reality.

Social soundness analysis will generally follow the methodology developed by the mini-hydro consultant team and applied in the two illustrative cases examined in the development of this project. This basic methodology, which will be amplified and refined by experience and further technical assistance, incorporates a formal survey and in-depth examination of key community issues, including:

a) the present and future demand for electricity, and

b) the nature of participation of community members in the decision-making and implementation process.

In depth interviews will examine issues such as how participation in the project might be strengthened and the magnitude and distribution of benefits and burdens under the project.

The social analysis will look for possible adverse effects of the installation and operation of the mini-hydro facility such as the aggravation of a skewed income distribution pattern in the community (for example, if cheaper energy prompts mechanization to the detriment of rural employment opportunities), and the impact of rural electrification on migration.

The potential for community participation, including local labor opportunities, possibilities for training local people for operations, maintenance and administration of the project, potential for local contribution to investments in extending distribution lines, and other business and technical dimensions of the project will be examined.

The analytical process appears to provide adequate consideration of the social aspects of the project. If the institutionalization contemplated by the project is succesful, spread effects will be assured. The ultimate benefit incidence of this component, as in the case of the industrial conservation component, cannot be predicted now with precision. No doubt, relatively better off people within a community will be in a better position to take advantage of access to electricity than others. Whether people may actually be harmed significantly by introduction of electricity service and how such problems might be dealt with must be left to the more in-depth analysis of the specific site. There is no question that rural communities selected under the project will be benefited as a whole.

4. Wood Fuel Development

The Wood Fuel Development Program addresses itself to the development of fast growing tree varieties and technologies for conversion of wood to charcoal and electricity. Wood and charcoal are the predominant energy sources for the poor in the Dominican Republic. Cutting wood and producing charcoal provides employment for a large number of rural people. Charcoal is used as a cooking fuel by very large numbers of both the urban and rural poor. Indeed, wood is the source of 23 percent of energy utilized in the Dominican Republic. Prices of wood and charcoal have been steadily rising. An increased supply of wood and charcoal at lower prices would clearly be beneficial to the poorer segments of the population.

Significant increases in the effective supply of wood through the utilization of fast growing tree varieties and improvements in the rather wasteful techniques now used to convert wood into charcoal appear to be feasible. However, very little research and applied engineering has been done in the Dominican Republic on this problem. (See the Dominican Republic Environmental Profile and the Natural Resources Management Project Paper.) Appropriate technologies, both biological and mechanical, need to be identified, tested and adapted to Dominican conditions before major efforts at the wide scale diffusion of improved techniques can be undertaken. Until such time as the optimal conditions and techniques for growing fast growing trees varieties are determined, detailed examination of the social implications of various silvaculture techniques would be premature. This project will generate extensive information on these varieties and techniques. It is believed that there will be no problems of socio-cultural feasibility associated with wide-scale utilization of fast growing tree varieties or improved wood conversion technologies contemplated following this program. Other problems, including legal disabilities, are being addressed in the context of the Natural Resources Management project.

Spread effects of the project appear to be favorable. Indeed the more economically viable a particular tree growing method or conversion technology is, the more likely it will be found acceptable and utilized by the rural population. The longer term benefit incidence implications of investment in wood growing and conversion research, therefore, appear to be wholly positive.

5. CDE Technical Assistance

The CDE Technical Assistance Program deals with management, technical and administrative problems of the national electric utility. A significant improvement in CDE performance is considered feasible and the benefits of such an improvement would directly and indirectly benefit all Dominicans, including those who do not now consume electricity, in the sense that the central government is now forced to use national resources to subsidize CDE. Any social burdens of improved CDE performance, for example on those individuals now permitted to use electricity without paying for it, are not worthy of defense, although unfortunately not trivial in scope.

V. PROJECT IMPLEMENTATION

A. Financial Analysis and Plan

The total cost of the project is $22,222,000. A.I.D. will provide $15,932,000 of which $10,818,000 will be loan funds and $5,114,000 grant funds. Grant funds will be used to cover the costs of technical assistance, grants for industrial audits, and project administration and evaluation. The GODR counterpart contribution will be $6,290,000, which represents 28 percent of the total project cost.

A.I.D. funds will cover foreign exchange costs estimated at US$10,465,000 and local currency costs estimated at RD$5,467,000. Project costs are incremental and do not include central, regional or local salaries already being incurred in carrying out existing programs.

The following tables illustrate the financial disbursement plans for the project as a whole as well as for individual project components.

TABLE V.1 SUMMARY FINANCIAL PLAN
($000)

		A.I.D.		GODR	TOTAL
		L	G		
1.	National Energy Planning	-	250	50	300
2.	Industrial Conservation Program	6,544	2,040	4,852	13,436
3.	Mini-Hydro Development Program	3,260	540	868	4,668
4.	Wood Fuel Development Program	924	674	470	2,068
5.	CDE Technical Assistance Program	90	610	50	750
6.	Project Administration and Evaluation	-	1,000	-	1,000
	TOTALS	10,818	5,114	6,290	22,222

Funds will be reprogrammable among different project components up to 15 percent.

TABLE V.2 NATIONAL ENERGY PLANNING
($000)

	YEAR 1		YEAR 2		TOTAL	
	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR
1. Technical Assistance	200	-	50	-	250	-
2. Dominican Personnel and Local Materials	-	40	-	10	-	50
TOTAL	200	40	50	10	250	50

TABLE V.3 INDUSTRIAL CONSERVATION PROGRAM
($000)

	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		TOTAL	
	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR
1. Dominican Personnel												
10 Energy Audit Engineers	-	90	-	120	-	120	-	120	-	-	-	450
2 Data Monitoring and Technical Information Specialists	-	12	-	18	-	24	-	24	-	-	-	78
2 Promotional and Training Specialists	-	-	-	12	-	12	-	12	-	-	-	36
Administration of Finance Program	-	-	-	48	-	48	-	48	-	48	-	192
Support Personnel	-	18	-	18	-	30	-	30	-	-	-	96
Subtotal	-	120	-	168	-	186	-	186	-	48	-	852
2. Technical Assistance												
Long Term Program Advisor	100	-	100	-	100	-	100	-	-	-	400	-
Short Term Audit and Process Experts	150	-	150	-	100	-	100	-	-	-	500	-
Subtotal	250	-	250	-	200	-	200	-	-	-	900	-
3. Portable Instruments	100	-	13	-	13	-	13	-	-	-	139	-

4. Vehicles 2 Vans including Operation and Maintenance	36	-	8	-	8	-	8	-	-	-	60	-
5. Publications and Materials	25	-	50	-	75	-	75	-	-	-	225	-
6. Overseas Training	120	-	20	-	-	-	-	-	-	-	140	-
7. Pilot Projects	-	-	200	-	600	-	200	-	-	-	1000	-
8. Audit Finance Program	-	-	200	-	325	-	475	-	-	-	1000	-
9. Credit Fund	-	-	250	250	750	750	1250	1250	1750	1750	4000	4000
Subtotal	525	125	993	475	1973	988	2223	1488	1750	1750	7464	4852
Inflation and Contingency (15%)	79	-	149	-	296	-	333	-	263	-	1120	-
TOTAL	604	125	1142	475	2269	988	2556	1488	2013	1750	8584	4852

a. Salaries for Dominican personnel = average RD$1,000/month, except support personnel = RD$500/month. Any necessary per diem for local personnel will be paid by the GODR as a non project cost.

b. Cost of vehicles = $14,000/vehicle
Annual operating and maintenance costs = $4,000/vehicle

TABLE V.4 MINI-HYDRO PROGRAM
($000)

	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		TOTAL	
	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR
1. Dominican Personnel												
Program Coordinator	-	12	-	12	-	12	-	12	-	12	-	60
2 Program Managers	-	14	-	16	-	16	-	12	-	12	-	70
2 Electro-Mechanical Engineers	-	16	-	16	-	6	-	4	-	2	-	44
2 Design Engineers	-	12	-	18	-	2	-	-	-	-	-	32
Cost Engineers	-	6	-	10	-	-	-	-	-	-	-	16
Geologist	-	8	-	6	-	-	-	-	-	-	-	14
Sociologist	-	4	-	4	-	2	-	2	-	2	-	14
Survey Brigade	-	6	-	6	-	-	-	-	-	-	-	12
Environmental Scientist	-	4	-	4	-	2	-	1	-	1	-	12
Draftspersons	-	2	-	12	-	-	-	-	-	-	-	14
2 Site Inspectors	-	-	-	6	-	24	-	12	-	-	-	42
Transmission/ Distribution Engineers/Supervisors	-	-	-	6	-	24	-	12	-	-	-	42
Community Advisor/Trainers	-	-	-	4	-	12	-	12	-	2	-	30
Accountants	-	2	-	4	-	16	-	4	-	2	-	28
Support Personnel	-	6	-	12	-	12	-	6	-	2	-	38
Subtotal	-	92	-	136	-	128	-	77	-	35	-	468

2. Vehicles 6 4-wheel drive vehicles including operation and maintenance	62	-	14	-	45	-	22	-	22	-	165	-
3. Technical Assistance												
Long Term Advisor	120	-	120	-	30	-	30	-	-	-	300	-
Short Term Experts	80	-	80	-	40	-	20	-	20	-	240	-
Subtotal	262	-	214	-	115	-	72	-	42	-	705	-
4. Pilot Projects	-	-	200	25	800	150	1000	175	600	50	2600	400
Subtotal	262	92	414	161	915	278	1072	252	642	85	3305	868
Inflation and Contingency (15%)	39	-	62	-	137	-	161	-	96	-	495	-
TOTAL	301	92	476	161	1052	278	1233	252	738	85	3800	868

a. Salaries for all Dominican personnel = average RD$1,000/month, except draftsperson, accountants = RD$600/month, and support personnel = RD$500/month. Any necessary per diem for local personnel will be paid by the GODR as a non project cost.

b. Cost of vehicles = $12,000/vehicle
Annual operating and maintenance costs = $3,600/vehicle

TABLE V.5 WOOD FUEL DEVELOPMENT PROGRAM
($000)

	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		TOTAL	
	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR
I. Tree Research Program												
1. Dominican Personnel	-	34	-	34	-	34	-	34	-	34	-	170
2. Local Materials/ Support	-	5	-	5	-	5	-	5	-	5	-	25
3. Contracted Labor	25	-	28	-	35	-	39	-	41	-	168	-
4. Equipment and Supplies	75	-	5	-	5	-	3	-	2	-	90	-
5. Vehicles (2)	31	-	8	-	7	-	7	-	7	-	60	-
6. Technical Assistance	140	-	80	-	40	-	20	-	20	-	300	-
7. Training	30	-	28	-	22	-	13	-	1	-	94	-
Subtotal	301	39	149	39	109	39	82	39	71	39	712	195
Inflation and Contingency (15%)	46	-	22	-	16	-	12	-	11	-	107	-
Subtotal I	347	39	171	39	125	39	94	39	82	39	819	195
II. Wood Conversion Program												
1. Dominican Personnel	-	50	-	50	-	50	-	50	-	50	-	250
2. Local Materials/ Support	-	5	-	5	-	5	-	5	-	5	-	25
3. Contracted Labor	16	-	12	-	10	-	8	-	6	-	52	-

4. Charcoal Program												
Site Preparation	35	-	-	-	-	-	-	-	-	-	35	-
Kilns	10	-	24	-	3	-	-	-	-	-	37	-
Instrumentation	10	-	-	-	-	-	-	-	-	-	10	-
Tools and Equipment	8	-	-	-	-	-	-	-	-	-	8	-
Analysis	10	-	5	-	5	-	-	-	-	-	20	-
Training	20	-	10	-	10	-	-	-	-	-	40	-
4. Electricity Program	75	-	75	-	25	-	-	-	-	-	175	-
5. Vehicles (2)	31	-	8	-	7	-	7	-	7	-	60	-
6. Technical Assistance	120	-	60	-	30	-	30	-	-	-	240	-
Subtotal	335	55	194	55	90	55	45	55	13	55	677	275
Inflation and Contingency	51	-	29	-	13	-	7	-	2	-	102	-
Subtotal II	386	55	223	55	103	55	52	55	15	55	779	275
TOTAL	733	94	394	94	228	94	146	94	97	94	1598	470

a. Salaries for all Dominican personnel = average RD$1,000/month. Any necessary per diem for local personnel will be paid by the GODR as a non project cost.

b. Cost of vehicles = $12,000/vehicle
Annual operating and maintenance costs = $3,600/vehicle

TABLE V.6 CDE TECHNICAL ASSISTANCE PROGRAM

	YEAR 1		YEAR 2		TOTAL	
	A.I.D.	GODR	A.I.D.	GODR	A.I.D.	GODR
1. Coal Procurement	100	-	60	-	160	-
2. Coal Strategy and Materials Handling	100	-	25	-	125	-
3. Transmission and Distribution Engineering Design	50	-	-	-	50	-
4. System Planning	100	-	50	-	150	-
5. System Protection	30	-	-	-	30	-
6. Hot Line Maintenance	25	-	-	-	25	-
7. Safety	40	-	-	-	40	-
8. Financial Reporting	30	-	-	-	30	-
Local Personnel and Materials	-	35	-	15	-	45
Subtotal	475	35	135	15	610	50
Inflation and Contingency (15%)	70	-	20	-	90	-
TOTAL	545	35	155	15	700	50

TABLE V.7
FOREIGN EXCHANGE AND LOCAL CURRENCY COSTS - A.I.D.
($000)

	Project	Foreign Exchange	Local Currency	Total A.I.D.
1.	National Energy Planning	200	50	250
2.	Industrial Conservation	6,377	2,207	8,584
3.	Mini-Hydro Development	2,137	1,663	3,800
4.	Wood Fuel Development	906	692	1,598
5.	CDE Technical Assistance	395	305	700
6.	Project Administration and Evaluation	450	550	1,000
	TOTAL	10,465	5,467	15,932

Cash Flow Analysis - Industrial Conservation Credit Fund

The following table presents projections of cash flow and financial balances for the Industrial Conservation Credit Fund. The analysis has been prepared jointly by USAID and Central Bank personnel on the basis of FIDE interest and repayment terms which will be applied under the program (10 percent to intermediary institutions, 2 year grace period, 6 year repayment period).

Two cases are presented. The first case demonstrates that even in the absence of additional resources following the project, the credit fund remains viable. The second case assumes an additional capitalization of the fund from other donor resources beginning in the first year after the project, which permits an increase in both lending activity and net financial position.

TABLE V.8

INDUSTRIAL CONSERVATION CREDIT FUND

Cash Flow Projections

($000)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Case 1											
A. Beginning Cash Balance	-	-	-	50.0	250.0	761.1	305.7	306.1	384.5	346.5	242.0
B. Cash Receipts											
GODR Resources	-	250.0	750.0	1250.0	1750.0	-	-	-	-	-	-
A.I.D. Resources	-	250.0	750.0	1250.0	1750.0	-	-	-	-	-	-
Loan Repayments (Interest and Principal)	-	-	50.0	200.0	511.1	1044.6	1500.4	2078.5	2462.0	2895.5	3351.3
Total availability	-	500.0	1550.0	2750.0	4261.1	1805.7	1806.1	2384.6	2846.5	3242.0	3593.3
C. Disbursements											
Loan Disbursements	-	500.0	1500.0	2500.0	3500.0	1500.0	1500.0	2000.0	2500.0	3000.0	3000.0
End of Year Balance	-	-	50.0	250.0	761.1	305.7	306.1	384.5	346.5	242.0	593.3
Case 2											
A. Beginning Cash Balance	-	-	-	50.0	250.0	761.1	305.7	306.1	384.5	346.5	242.0
B. Cash Receipts											
GODR Resources	-	250.0	750.0	1250.0	1750.0	-	-	-	-	-	-
A.I.D. Resources	-	250.0	750.0	1250.0	1750.0	-	-	-	-	-	-
Resources of Other Donors and Financial Institutions	-	-	-	-	-	1000.0	2000.0	2500.0	2500.0	-	-
Loan Repayments	-	-	50.0	200.0	511.1	1044.6	1600.4	2388.5	3210.7	4239.2	5163.3
Total Availability	-	500.0	1550.0	2750.0	4261.1	2805.7	3906.1	5194.6	6095.2	4585.7	5405.3
C. Disbursements											
Loan Disbursements	-	500.0	1500.0	2500.0	3500.0	2500.0	3600.0	4810.1	5748.7	4343.7	4812.0
End of Year Balance	-	-	50.0	250.0	761.1	305.7	306.1	384.5	346.5	242.0	593.3

B. Disbursement Procedures and Reporting Requirements

A.I.D. funded U.S. Dollar costs under this project will be primarily for technical assistance, training, and the procurement of equipment. U.S. Dollar disbursements under the loan and grant for eligible goods and services will be made through the use of Direct Reimbursement Authority (DRA) or by issuing Letters of Commitment (L/COMM) and making payments directly or by Letters of Credit.

A.I.D. funded Peso costs will help finance the local costs of construction, local contracted personnel and local materials. Disbursements in Pesos will be made monthly based upon the estimated requirements of the project for a period of 90 days. The borrower/grantee will submit to USAID reports presenting the status of the funds previously disbursed and specifying the needs for the ensuing 90 day period. The above described procedure will provide USAID with the information necessary to determine program requirements and make disbursements accordingly. Advance checks will be forwarded directly to the GODR National Treasury for immediate release to the implementing agency.

C. Procurement

In general, all grant funded technical assistance will have its source and origin in either the United States (Geographic Code 000) or the Dominican Republic. All loan funded commodities and equipment will have their source and origin in selected free world countries (Geographic Code 941) or in the Dominican Republic, with the exception of vehicles, which will have their source and origin in the United States.

1. National Energy Planning

Technical services under this component will be procured through a formal request for proposals. A single contract is contemplated.

2. Industrial Conservation Program

All technical assistance, including training, will be procured from a single source through a formal request for proposals. The resident Program Advisor will serve as technical assistance team leader.

Commodities and equipment for the program will be procured through formal IFB procedures if over $100,000, and through informal competitive procedures if less than $100,000.

Procurement under sub-loans from the Credit Fund will follow ICI procurement procedures set forth in A.I.D. Handbook 1 B.

3. Mini-Hydro Development Program

All technical assistance, including training, will be procured from a single source through a formal request for proposals. The resident Program Advisor will serve as technical assistance team leader.

Commodities and equipment will be procured by CDE through formal IFB procedures if over $100,000, and through informal competitive procedures if less than $100,000.

4. Wood Fuel Development Program

The Mission has determined that procurement of technical assistance for the Wood Fuel Development Program will be undertaken by A.I.D. directly with a US university. This determination is based on the conclusion that the US university system can best provide the technical expertise and institutional backstopping necessary for successful implmentation of this component. A university contract will also encourage long term inter-institutional cooperation between US and Dominican education/research institutions.

The university contract will be for 36 person-months of long term technical assistance and 18 person-months of short term technical assistance. An RFP will be prepared by USAID with assistance from the Regional Contracting Officer and distributed to qualified universities.

Short visits and training outside the Dominican Republic will be arranged by the same entity that is awarded the technical assistance contract.

No single procurement of commodities or equipment is expected to exceed $100,000. Therefore, informal competitive procurement procedures will be followed.

5. CDE Technical Assistance Program

All technical assistance will be procured from a single source through a formal request for proposals.

D. Conditions, Covenants and Negotiating Status

1. Conditions Precedent to Initial Disbursement

(1) Evidence that a full time coordinator has been appointed by the National Energy Policy Commission for the project.

(2) Evidence that adequate administrative arrangements have been made within the National Energy Policy Commission to provide the necessary supporting staff, equipment and other resources to administer the Project.

2. Condition Precedent to Disbursement for Industrial Conservation Audits, Commodities and Equipment (not including Vehicles)

(1) A detailed implementation plan for the entire Industrial Conservation Program covering the full life of the Project.

3. Condition Precedent to Disbursement for Industrial Conservation Pilot Projects

(1) Evidence of the legal arrangements between the National Energy Policy Commission and individual industries where pilot projects are to be carried out, regarding ownership, liability, access to facilities, and implementation responsibilities.

4. Condition Precedent to Disbursement for the Industrial Conservation Credit Fund

(1) Evidence of the establishment of the Credit Fund and sub-loan procedures, terms and criteria to be used by FIDE.

5. Conditions Precedent to Disbursement for Mini-Hydro Commodities and Equipment (not including Vehicles)

(1) A detailed implementation plan for the entire Mini-Hydro Development Program covering the full life of the Project.

(2) Evidence of an interagency agreement among the National Energy Policy Commission, CDE and INDRHI regarding institutional responsibilities for implementation of the program.

(3) Evidence of the legal arrangements between CDE and individual communities where mini-hydro facilities are to be installed, regarding ownership of equipment, maintenance and procurement of spare parts, and entitlement to revenues generated.

6. Conditions Precedent to Disbursement for Commodities and Equipment for the Wood Fuel Development Program (not including Vehicles)

(1) A detailed implementation plan for the entire Wood Fuel Development Program covering the full life of the Project, including the institutional responsibilities of the National Energy Policy Commission, ISA, the Secretariat of Agriculture, FORESTA and INDOTEC.

(2) Evidence of ISA's title or right to use the land at Mao for the Wood Fuel Program.

(3) Evidence of a legal dispensation issued by the GODR allowing trees grown under the program to be cut for research and experimental purposes.

Negotiating Status

Detailed negotiations regarding the objectives, specifics and costs of project activities have been on-going with all involved Dominican institutions since project development began almost a year ago. Drafts of the

Project Paper have been discussed in detail with each participating Dominican institution and recent negotiations have included the Technical Secretary of the Presidency and President of the Energy Commission. No difficulties are expected in signing of the Project Agreement.

E. Project Administration and Evaluation

1. GODR Project Administration

The project will be managed and administered by existing Dominican institutions. As indicated earlier in the PP, the National Energy Policy Commission will be the overall project coordinator and will be directly involved in implementation of the National Energy Planning component, and the Industrial Conservation, Mini-Hydro and Wood Fuel Development Programs.

The Dominican Electricity Corporation (CDE) will be responsible for implementation of the CDE Technical Assistance Program and will be involved in implementation of the Mini-Hydro Development Program together with the National Institute of Water Resources (INDRHI).

Other Dominican institutions participating in this project are: The Dominican Institute of Industrial Technology (INDOTEC), which will participate with the Energy Commission in conducting the Industrial Conservation Program; the Central Bank Fund for Investment in Economic Development (FIDE), which will manage the Industrial Conservation Credit Fund, and the Superior Agricultural Institute (ISA), which will have primary responsibility for implementation of the Wood Fuel Development Program.

Counterpart costs for administration of the project are included among the costs for the individual project components and appear in the budgets for those components. A breakout of estimated administrative costs to be borne by the GODR appears below.

Component	Amount (RD$000)
National Energy Planning	20
Industrial Conservation	115
Mini-Hydro	100
Wood Fuel	75
CDE Technical Assistance	25
TOTAL	345

2. Mission Management

Careful consideration has been given to to the management of the additional workload which this project will place upon the Mission. The

following arrangements are considered adequate to provide for effective Mission management.

The project will be managed within the Capital Resources Development Office of the Mission under the general supervision of the Deputy Capital Resources Development Officer, who also currently serves as the Mission Energy Officer. Two additional support persons will be contracted with project grant funds to assist the Mission in overall project administration. One person will be contracted to handle preparation of documentation and liason functions under the supervision of the Deputy CRDO for the entire project implementation. An engineer with experience in hydro-electric design and operation will also be contracted for 28 months beginning in the second year of the project. This person will work under the supervision of the General Engineering Officer of the Mission and will assist in review of feasibility and bid documentation and inspection of mini-hydro construction and installation. Both persons will be officed and supported in the U.S. Mission. The total cost of these two contractors is estimated at $650,000.

Operations under the energy project will be monitored through a computerized project management system which will be developed in conjunction with a mini-computer evaluation effort now being undertaken by USAID/DR, SER/FM and SER/DM.

3. Project Accounting

In order to reinforce project accounting, one or two professional accountants will also be contracted with project grant funds to assist the Energy Commission to set up and maintain ledgers in accordance with accepted accounting practices and carry out related financial reporting functions. These accountants will be mutually selected by USAID and the Energy Commission. Although they will work under the immediate supervision of the Commission, they will report to the USAID/Controller. Logistical support such as office space and furniture, office material, secretarial service and transportation will be provided by the Energy Commission. The estimated cost of these accountants is $150,000 over the 5 year life of the project.

4. Evaluation

The evaluation plan for this project contemplates separate evaluation activities under each component during project implementation and one final overall project impact evaluation.

Interim evaluations will be scheduled for the components as follows:

COMPONENT	DATES	PURPOSE
1) Investment Plan	Completion of Work	-Overall quality -Methods and techniques of general A.I.D. interest -Use in ongoing Dominican investment planning
2) Industrial Conservation	July, 1983	-Institutional Structure
	December, 1986	-Impact on beneficiaries
3) Mini-Hydro	July, 1983	-Institutionalization
	July, 1985	-Construction -Community Organization
	December, 1986	-Impact on Beneficiaries
4) Wood Fuel	December, 1983	-Research in progress
	July, 1985	-Dissemination of research findings
	December, 1986	-Impact
5) CDE	January, 1984	-Effect of A.I.D. T.A. on CDE operations

The ultimate impact of the project will be difficult to measure for a number of years after project completion, it at all. The Energy Information System now being implemented under the Energy Policy Development Project will be a useful tool for identifying progress in energy conservation and non petroleum resource development. The Mission will determine in the process of developing the scope of work for the final evaluation of the project as a whole whether quantifiable results can be determined with the assistance of the Energy Information System.

Whether or not broader goal achievement can be measured precisely, the final evaluation will examine questions such as the effectiveness of the project in the institutionalization of energy investment decision making, inudstrial conservation and mini-hydro development. The wood fuel development program will be evaluated largely on the basis of the specific outputs of the research and whether those results can be broadly utilized. The CDE technical

assistance program will be evaluated on the basis of improved performance of the public utility.

Consultants will be hired to assist the Mission in both interim and final evaluations at an estimated cost of $70,000.

SUMMARY BUDGET
PROJECT ADMINISTRATION AND EVALUATION

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1. Project Administration Contractor	100	100	100	100	100	500
2. Mini-Hydro Engineer Contractor	-	65	65	20	-	150
3. Project Accounting Contractors (2)	30	30	30	30	30	150
4. Evaluation Consultants	-	15	20	15	20	70
Subtotal	130	210	215	165	150	870
Inflation and Contingency (15%)	20	31	32	25	22	130
TOTAL	150	241	247	190	172	1000

ANNEX A

DRAFT
PROJECT AUTHORIZATION

Name of Country	:	Dominican Republic
Name of Project	:	Energy Conservation and Resource Development
Number of Project	:	517-0144
Number of Loan	:	517-T-036

1. Pursuant to Section 103 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Energy Conservation and Resource Development Project for the Dominican Republic (the "Cooperating Country") involving planned obligations of not to exceed Ten Million Eight Hundred Eighteen Thousand United States Dollars ($10,818,000) in loan funds ("Loan") and Five Million One Hundred Fourteen Thousand United States Dollars ($5,114,000) in grant funds ("Grant") over a five year period from the date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB allotment process, to help in financing foreign exchange and local currency costs for the project.

2. The project ("Project") consists of: assisting in a program to be implemented by the National Energy Policy Commission, in collaboration with other Dominican agencies, to develop the institutional capability within the Government of the Dominican Republic to promote energy conservation and development of non-petroleum energy resources on a wide scale.

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

(a) Interest Rate and Terms of Payment

The cooperating country shall repay the Loan to A.I.D. in U.S. Dollars within twenty-five (25) years from the date of first disbursement of the Loan, including a grace period of not to exceed ten (10) years. The Borrower shall pay to A.I.D. in U.S. Dollars interest from the date of first disbursement of the Loan at the rate of (i) two percent (2%) per annum during the first ten years (10) years; and (ii) three percent (3%) per annum thereafter, on the outstanding disbursed balance of the Loan and on any due and unpaid interest accrued thereon.

(b) Source and Origin of Goods and Services (Loan)

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

(c) Source and Origin of Goods and Services (Grant)

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

(d) Conditions Precedent to Initial Disbursement (Loan and Grant)

Prior to any disbursement, or the issuance of any commitment documents under the Project Agreement, the Cooperating Country shall, except as A.I.D. may otherwise agree in writing, furnish in form and substance satisfactory to AID:

(1) Evidence that a full time coordinator has been appointed for the Project.

(2) Evidence that adequate administrative arrangements have been made within the National Energy Policy Commission to provide the necessary supporting staff, equipment and other resources to administer the Project.

(e) Condition Precedent to Disbursement for Industrial Conservation Audits, Commodities and Equipment - not including Vehicles (Loan)

Prior to any disbursement, or the issuance of any commitment documents under the Project Agreement for industrial conservation audits, commodities and equipment, the Cooperating Country shall, except as A.I.D. may otherwise agree in writing, furnish in form and substance satisfactory to AID:

(1) A detailed implementation plan for the entire Industrial Conservation Program covering the full life of the Project.

(f) Condition Precedent to Disbursement for Industrial Conservation Pilot Projects (Loan)

Prior to any disbursement, or the issuance of any commitment documents under the Project Agreement for industrial conservation pilot

projects, the Cooperating Country shall, except as A.I.D. may otherwise agree in writing, furnish in form and substance satisfactory to AID:

(1) Evidence of the legal arrangements between the National Energy Policy Commission and individual industries where pilot projects are to be carried out, regarding ownership, liability, access to facilities and implementation responsibilities.

(g) Condition Precedent to Disbursement for the Industrial Conservation Credit Fund (Loan)

Prior to any disbursement, or the issuance of any commitment documents under the Project Agreement for industrial conservation credit fund, the Cooperating Country shall, except as A.I.D. may otherwise agree in writing, furnish in form and substance satisfactory to AID:

(1) Evidence of the establishment of the Credit Fund and sub-loan procedures, terms and criteria to be used by FIDE.

(h) Conditions Precedent to Disbursement for Mini-Hydro Commodities and Equipment - not including Vehicles (Loan)

Prior to any disbursement, or the issuance of any commitment documents under the Project Agreement for mini-hydro commodities and equipment, the Cooperating Country shall, except as A.I.D. may otherwise agree in writing, furnish in form and substance satisfactory to AID:

(1) A detailed implementation plan for the entire Mini-Hydro Development Program covering the full life of the Project.

(2) Evidence of an interagency agreement among the National Energy Policy Commission, CDE and INDRHI regarding institutional responsibilities for implementation of the program.

(3) Evidence of the legal arrangements between CDE and individual communities where mini-hydro facilities are to be installed, regarding ownership of equipment, maintenance and procurement of spare parts, and entitlement to revenues generated.

(i) Conditions Precedent to Disbursement for Commodities and Equipment for the Wood Fuel Development Program - not including Vehicles (Loan)

Prior to any disbursement, or the issuance of any commitment documents under the Project Agreement for commodities and equipment for the Wood Fuel Development Program, the Cooperating Country shall, except as A.I.D. may otherwise agree in writing, furnish in form and substance satisfactory to AID:

(1) A detailed implementation plan for the entire Wood Fuel Development Program covering the full life of the Project, including the institutional responsibilities of the National Energy Policy Commission, ISA, the Secretariat of Agriculture, FORESTA and INDOTEC.

(2) Evidence of ISA's title or right to use the land at Mao for the Wood Fuel Program.

(3) Evidence of a legal dispensation issued by the GODR allowing trees grown under the program to be cut for research and experimental purposes.

_____
Administrator

_____
Date

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

LAC/DR-IEE-81-20

ENVIRONMENTAL THRESHOLD DECISION

Project Location	:	Dominican Republic
Project Title and Number	:	Energy Conservation and Resource Development 517-0144
Funding	:	FY 1980, Grant $5,450,000 Loan $6,100,000
Life of Project	:	Five years: FY 1981 - FY 1985
IEE Prepared by	:	Charles Blankstein, CRDO
Recommended Threshold Decision	:	Negative Determination
Bureau Threshold Decision	:	Concurrence with Mission Recommendation
Action	:	1) Copy to Philip R. Schwab Director USAID/Dominican Republic
	:	2) Charles Blankstein
	:	3) IEE file

Robert O. Otto Date 6 May 81

Robert O. Otto
Chief Environmental Officer
Bureau for Latin America
and the Caribbean

INITIAL ENVIRONMENTAL EXAMINATION

PROJECT LOCATION	:	Dominican Republic
PROJECT TITLE	:	Energy Conservation and Resource Development
PROJECT NUMBER	:	517-0144
FUNDING	:	FY-1980, Grant $5,450,000; Loan $6,100,000
LIFE OF PROJECT	:	Five years FY-1981/FY-1985
IEE PREPARED BY	:	Charles Blankstein, CRDO

Signature Date April 27, 1981

ENVIRONMENTAL ACTION RECOMMENDED: Negative Determination

CONCURRENCE: Philip R. Schwab, Director USAID/DR

Signature Date April 27, 1981

I. PROJECT DESCRIPTION

The goal of the Project is to help reduce the dependence of the Dominican Republic on imported petroleum and to increase the availability of affordable energy to low income groups in the country. The subgoal of the Project is to develop the institutional and policy base necessary for achieving energy conservation and non-petroleum resource utilization on a wide scale.

The purposes of the project are to 1) develop comprehensive national energy investment and pricing plans, 2) initiate a continuing program of industrial energy conservation, 3) develop the institutional capacity to exploit small scale hydro and wood fuels as alternative sources of energy, and 4) upgrade the management and planning capabilities of the Dominican Electricity Corporation.

The outputs of the project are: 1) a National Energy Investment and Pricing Plan and improved capability in the GODR to develop, revise and update national energy plans;

2) a national plan for energy conservation in the transportation sector;

3) an Industrial Efficiency Plan including specific recommendations for near term conservation measures in principal Dominican industries;

4) establishment of an Industrial Conservation Center to carry out energy audits of industries of all sizes, recommend appropriate energy conservation measures, and assist industries in the implementation of those recommendations, including the preparation of feasibility and financial analysis as necessary;

5) five pilot projects in industrial conservation to demonstrate the feasibility of energy saving measures which could be replicated on a large scale;

6) a credit mechanism established for assisting industries of all sizes in financing energy conservation measures;

7) a mini-hydro development study and plan.

8) establishment of a mini-hydro institutional capability to identify and analyze potential mini-hydro sites, supervise the construction/installation of mini-hydro equipment in appropriate sites,

and assist benefited communities in the operation and maintenance of installed mini-hydro and electric grid system - in effect, to promote mini-hydro development on a broad scale.

9) a small number of mini hydro projects of different sizes to test and demonstrate the economic, social and technical feasibility of mini-hydro utilization in a rural Dominican setting and help develop the institutional capability described above;

10) a wood fuel research program to determine the most appropriate tree species for energy purposes in the Dominican Republic and the most efficient technologies for converting wood to different energy end uses;

11) a comprehensive analysis of management and planning deficiencies in the Dominican Electricity Corporation (CDE) and initiation of a program of technical assistance to upgrade CDE management and planning capabilities; and

12) approximately 100 person years of long term training provided in energy planning, management and technical areas.

II. IMPACT IDENTIFICATION AND EVALUATION

Most of the elements of the project have no direct environmental implications whatsoever. These elements include 1) the National Energy Investment and pricing plan; 2) the energy conservation plan for the transportation sector; 3) the industrial efficiency plan; 4) the industrial conservation center; 5) the industrial conservation credit mechanism; 6) the mini-hydro development plan; 7) the establishment of mini-hydro institutional capability; 8) the management and planning analysis and technical assistance for the Dominican Electricity Corporation (CDE); and 9) the training component as the result of the research activity is extended beyond the small research plot which will be directly affected by this project.

With respect to the remaining activities, it is impossible to determine at this time the scope and nature of environmental implications although the Mission believes that it is unlikely that significant negative environmental implications will arise from any of the activities currently contemplated.

The five pilot projects in industrial conservation are unlikely to have any environmental implications at all.

The wood fuel research program will directly affect about 1,000 tareas in a carefully controlled research activity. Consideration will be given in project design to environmental considerations, but the very nature of the work implies very careful control. Indirectly, the wood fuel research program is expected to have very positive environmental effects in the long run as the results of the research activity is extended beyond the small research plot which will be directly affected by this project.

The only activity under the project which might have a significant environmental effect is the construction of two mini-hydro installations. As the sites will not be selected in the project development process but rather will be selected by the mini-hydro institution, the development of which is the primary objective of this component, consideration of environmental effects will be deferred until it is feasible to address them; that is, at the time that the installation plans the subprojects. The project will provide technical assistance in a number of areas to the institution including environmental analysis of mini-hydro projects.

III. ENVIRONMENTAL ACTION RECOMMENDATION

As the only area of concern arises in connection with construction of two mini-hydro installations, sites for which will not be selected in PP development, and in light of the intention of the Mission to provide environmental technical assistance to the institution which will carry out the projects, a negative determination is recommended.

5C(1) - COUNTRY CHECKLIST

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

A. GENERAL CRITERIA FOR COUNTRY ELIGIBILITY

1. FAA Sec. 116. Has the Department of State determined that this government has engaged in a consistent pattern of gross violations of internationally recognized human rights? If so, can it be demonstrated that contemplated assistance will directly benefit the needy?

   No. Assistance will directly benefit the needy.

2. FAA Sec. 113. Has particular attention been given those programs, projects, and activities which tend to integrate women into the national economies of developing countries, thus improving their status and assisting the total development effort?

   Yes

3. FAA Sec. 481. Has it been determined that the government of the recipient country has failed to take adequate steps to prevent narcotic drugs and other controlled substances (as defined by the Comprehensive Drug Abuse Prevention and Control Act of 1970) produced or processed, in whole or in part, in such country, or transported through such country, from being sold illegally within the jurisdiction of such country to U.S. Government personnel or their dependents, or from entering the U.S. unlawfully?

   The Dominican Government has instituted adequate measures for the control of narcotics and other controlled substances

4. FAA Sec. 620(b). If assistance is to a government, has the Secretary of State determined that it is not dominated or controlled by the international Communist movement?

   The Secretary of State has determined that the Dominican Republic is not controlled by the international communist movement.

D2

A. 5.	FAA Sec. 620(c). If assistance is to a government, is the government liable as debtor or unconditional guarantor on any debt to a U.S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) the debt is not denied or contested by such government?	According to information available, the Dominican Republic is not known to be so indebted.
6.	FAA Sec. 620(e)(1). If assistance is to a government, has it (including government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities?	No
7.	FAA Sec. 620(a), 620(f), 620D; Continuing Resolution Sec. 511, 512 and 513; ISDCA of 1980 Secs. 717 and 721. Is recipient country a Communist country? Will assistance be provided to Angola, Cambodia, Cuba, Laos or Vietnam? (Food and humanitarian assistance distributed directly to the people of Cambodia are excepted). Will assistance be provided to Afghanistan or Mozambique without a waiver? Are funds for El Salvador to be used for planning for compensation, or for the purpose of compensation, for the confiscation nationalization, acquisition or expropriation of any agricultural or banking enterprise, or property or stock thereof?	No
8.	FAA Sec. 620(i). Is recipient country in any way involved in (a) subversion of, or military aggression against, the United States or any country receiving U.S. assistance, or (b) the planning of such subversion or aggression?	No

9.	FAA Sec. 620(j). Has the country permitted, or failed to take adequate measures to prevent, the damage or destruction, by mob action, of U.S. property?	No
10.	FAA Sec. 620(k). Does the program furnish assistance in excess of $100,000,000 for the construction of a productive enterprise, except for productive enterprises in Egypt that were described in the Congressional Presentation materials for FY 1977, FY 1980 or FY 1981?	No
11.	FAA Sec. 620(l). If the country has failed to institute the investment guaranty program for the specific risks of expropriation, inconvertibility or confiscation, has the AID Administrator within the past year considered denying assistance to such government for this reason?	The Dominican Government has signed and instituted such an agreement.
12.	FAA Sec. 620(m). Is the country an economically developed nation capable of sustaining its own defense burden and economic growth and, if so, does it meet any of the exceptions to FAA Section 620(m)?	No
13.	FAA Sec. 620(o); Fishermen's Protective Act of 1967, as amended, Sec. 5. If country has seized, or imposed any penalty or sanction against, any U.S. fishing activities in international waters,	Not applicable
	a. has any deduction required by the Fishermen's Protective Act been made?	Not applicable
	b. has complete denial of assistance been considered by AID Administrator?	

A.	14. FAA Sec. 620(q); Continuing Resolution Sec. 518. (a) Is the government of the recipient country in default for more than six months on interest or principal of any AID loan to the country? (b) Is the country in default exceeding one year on interest or principal on any U.S. loan under a program for which the Continuing Resolution appropriates funds?	No
	15. FAA Sec. 620(s). If contemplated assistance is development loan or from Economic Support Fund, has the Administrator taken into account the percentage of the country's budget which is for military expenditures, the amount of foreign exchange spent on military equipment and the amount spent for the purchase of sophisticated weapons systems? (An affirmative answer may refer to the record of the annual "Taking into Consideration" memo: "Yes, taken into account by the Administrator at time of approval of Agency OYB." This approval by the Administrator of the Operational Year Budget can be the basis for an affirmative answer during the fiscal year unless significant changes in circumstances occur.)	Yes. During the last three years, total defense expenditures have averaged approximately 10 percent of the total budget. Almost 60 percent of those expenditures represent salaries for enlisted members of the armed forces. Purchase of military equipment consists mainly of excess U.S. property supply. Amount of foreign exchange spent on military equipment is very small, none of which is for sophisticated equipment.
	16. FAA Sec. 620(t). Has the country severed diplomatic relations with the United States? If so, have they been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption?	No. Diplomatic relations have not been severed.
	17. FAA Sec. 620(u). What is the payment status of the country's U.N. obligations? If the country is in arrears, were such arrearages taken into account by the AID Administrator in determining the current AID Operational Year Budget?	GODR is current on U.N. obligations

A. 18. FAA Sec. 620A; Continuing Resolution Sec. 521. Has the country aided or abetted, by granting sanctuary from prosecution to, any individual or group which has committed an act of international terrorism? Has the country aided or abetted, by granting sanctuary from prosecution to, any individual or group which has committed a war crime?

No

19. FAA Sec. 666. Does the country object, on the basis of race, religion, national origin or sex, to the presence of any officer or employee of the U.S. who is present in such country to carry out economic development programs under the FAA?

No

20. FAA Sec. 669, 670. Has the country, after August 3, 1977, delivered or received nuclear enrichment or reprocessing equipment, materials, or technology, without specified arrangements or safeguards? Has it detonated a nuclear device after August 3, 1977, although not a "nuclear-weapon State" under the nonproliferation treaty?

No

B. FUNDING SOURCE CRITERIA FOR COUNTRY ELIGIBILITY

1. Development Assistance Country Criteria.

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

Yes. The Dominican Republic has established necessary criteria in its Regional planning documents and in the three year investment plan.

B.1.	b. FAA Sec. 104(d)(1) If appropriate, is this development (including Sahel) activity designed to build motivation for smaller families through modification of economic and social conditions supportive of the desire for large families in programs such as education in and out of school, nutrition, disease control, maternal and child health services, agricultural production, rural development, assistance to urban poor and through community-based development programs which give recognition to people motivated to limit the size of their families?	Not applicable
2.	Economic Support Fund Country Criteria.	
	a. FAA Sec. 502B. Has the country (a) engaged in a consistent pattern of gross violations of internationally recognized human rights or (b) made such significant improvements in its human rights record that furnishing such assistance is in the national interest?	Not applicable. This is not supporting assistance.
	b. FAA Sec. 532(f). Will ESF assistance be provided to Syria?	Not applicable
	c. FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made?	Not applicable
	d. FAA Sec. 620B. Will ESF be furnished to Argentina?	Not applicable

5C(2) PROJECT CHECKLIST

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

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

A. GENERAL CRITERIA FOR PROJECT

1. Continuing Resolution Unnumbered; FAA Sec. 634A; Sec. 653(b).

(a) Describe how authorizing and appropriations Committees 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 amount)?

a) The project was included in the FY82 Congressional Presentation as a FY82 project. A Congressional notification is required. b) An advice of program change will be submitted for the increased funding required.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

a) Yes

b) 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 legislative action is needed other than regular Congressional approval of GODR obligation. All A.I.D. projects have received approval routinely in the past and no difficulty is anticipated in obtaining approval in this case.

A. 4.	FAA Sec. 611(b); Continuing Resolution Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the Principles and Standards for Planning Water and Related Land Resources, dated October 25, 1973?	To extent applicable, yes.
5.	FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?	Yes
6.	FAA Sec. 209. Is project susceptible of execution as part of regional or multilateral project? If so why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.	Project not susceptible of execution as regional or multilaterial 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; and (c) encourage development and use of cooperatives, and 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.	a) international trade encouraged through purchases of goods and reduction of oil related demands on foreign exchange; b) private activity encouraged through improved energy efficiency; c) encourages community action for local energy development; d) discourages monopolistic practices by improving technical efficiency in energy generation and use; e) improves technical efficiency in energy sector; f) no effect on labor unions.
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.	A large portion of the technical assistance and equipment for the project will be procured from U.S. private sector sources.

A.8. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).

9. FAA Sec. 612(b), 636(h); Continuing Resolution Sec. 508. 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 in lieu of dollars.

The loan agreement requires counterpart contribution.

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. Continuing Resolution Sec. 522. 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?

This project will not directly produce any commodity in surplus on world markets or which will compete with U.S. producers.

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-

The project will involve the poor by lowering energy costs, increasing employment, creating economic opportunities, developing appropriate technology, investing in rural areas, and improving access to energy.

B.1.a. 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?

b) The project will improve the lives of the poor through better access to energy and local organization ownership and control of energy sources.

c) The project supports self help efforts of the country.

d) Women's participation is promoted through promoting energy access and employment.

e) Regional cooperation may be promoted by setting an example of energy development activity in the area.

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 (a) extent to which activity is specifically designed to increase productivity and income of rural poor; 103A if for agricultural research, full account shall be taken of the needs of small farmers, and extensive use of field testing to adapt basic research to local conditions shall be made; (b) extent to which assistance is used in coordination with programs carried out under Sec. 104 to help improve nutrition of the people of developing countries

a) Project in part increases productivity and income of rural poor through improved energy access and employment. Research on trees and wood conversion address methods to be used by small farmers and landless poor.

b) not applicable

c) not directly applicable

B.1.b.(1) through encouragement of increased production of crops with greater nutritional value, improvement of planning, research, and education with respect to nutrition, particularly with reference to improvement and expanded use of indigenously produced foodstuffs; and the undertaking of pilot or demonstration of programs explicitly addressing the problem of malnutrition of poor and vulnerable people; and (c) extent to which activity increases national food security by improving food policies and management and by strengthening national food reserves, with particular concern for the needs of the poor, through measures encouraging domestic production, building national food reserves, expanding available storage facilities, reducing post harvest food losses, and improving food distribution.

(2) [104] for population planning under sec. 104(b) or health under sec. 104(c); if so, (i) 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.

(4) [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;

B.1.b.(4)	and (ii) extent to which assistance provides advanced education and training of people in developing countries in such disciplines as are required for planning and implementation of public and private development activities.	
	(5) [106; ISDCA of 1980, Sec. 304] for energy, private voluntary organizations, and selected development activities; if so, extent to which activity is: (i) (a) concerned with data collection and analysis, the training of skilled personnel, research on and development of suitable energy sources, and pilot projects to test new methods of energy production; (b) facilitative of geological and geophysical survey work to locate potential oil, natural gas, and coal reserves and to encourage exploration for potential oil, natural gas, and coal reserves; and (c) a cooperative program in energy production and conservation through research and development and use of small scale, decentralized, renewable energy sources for rural areas;	a) The project involves energy investment analysis, training, research and development and pilot activities b) Not applicable c) The project includes energy production and conservation R+D and use of small scale, decentralized renewable energy sources for rural areas.
	(ii) technical cooperation and development, especially with U.S. private and voluntary or regional and international development, organizations;	Technical cooperation with U.S. private organizations is contemplated.
	(iii) research into, and evaluation of, economic development process and techniques;	Energy investment planning and other components involve research and evaluation of economic development process and techniques
	(iv) reconstruction after natural or manmade disaster;	Not applicable
	(v) for special development problems, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance;	Not applicable
	(vi) for programs of urban development, especially small laborintensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.	Not directly applicable

8.1.	c. [107] is appropriate effort placed on use of appropriate technology? (relatively smaller, cost-saving, labor using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor.)	
	d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least developed" country)?	Yes
	e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to 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 processes essential to self-government.	The program addresses a key need of all Dominicans: access to energy at reasonable cost; it is heavily oriented to institutional development
	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	

B.2.a. repay the loan, at a reasonable rate of interest.	Country capable of repaying loan. See Economic Analysis
b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, 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?	Not applicable
3. Project Criteria Solely for Economic Support Fund	
a. FAA Sec. 531(a). Will this assistance promote economic or political stability? To the extent possible, does it reflect the policy directions of FAA Section 102?	Not applicable
b. FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities?	No

5C(3) - STANDARD ITEM CHECKLIST

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

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

A. Procurement

1.	FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of commodities and services financed?	Yes
2.	FAA Sec. 604(a). Will all procurement 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 commodities be insured in the United States against marine risk with a company or companies authorized to do a marine insurance business in the U.S.?	Not applicable
4.	FAA Sec. 604(e); ISDCA of 1980 Sec. 705(a). 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? (Exception where commodity financed could not reasonably procured in U.S.)	Not applicable
5.	FAA Sec. 603. Is the shipping excluded from 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	No

A.5. (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?	
6. FAA Sec. 621. If technical assistance is financed, to the fullest extent practicable will such assistance, goods and professional and other services be furnished from private enterprise on a contract basis? 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
7. 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. carriers will be utilized to the extent such service is available?	Yes
8. Continuing Resolution Sec. 505. If the U.S. Government is a party to a contract for procurement, does the contract contain a provision authorizing termination of such contract for the convenience of the United States?	Will be included if applicable
B. Construction	
1. FAA Sec. 601(d). If 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 interests?	Yes

B.	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?	Yes
C.	Other Restrictions	
	1. FAA Sec. 122(b). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter?	Yes
	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?	Not applicable
	3. FAA Sec. 620(h). Do arrangements exist to insure that United States foreign aid is not used in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the Communist-bloc countries?	Not applicable
	4. Continuing Resolution Sec. 514 If participants will be trained in the United States with funds obligated in FY 1981, has it been determined either (a) that such participants will be selected otherwise than by their home governments, or (b) that at least 20% of the FY 1981 fiscal year's funds appropriated for participant training will be for participants selected otherwise than by their home governments?	Not applicable

C. 5. Will arrangements preclude use of financing:

a. FAA Sec. 104(f). To pay for performance of abortions as a method of family planning or to motivate or coerce persons to practice abortions; to pay for performance of involuntary sterilization as a method of family planning, or to coerce or provide financial incentive to any person to undergo sterilization?	Not applicable
b. FAA Sec. 620(g). To compensate owners for expropriated nationalized property?	Not applicable
c. FAA Sec. 660. To provide training or advice or provide any financial support for police, prisons, or other law enforcement forces, except for narcotics programs?	Not applicable
d. FAA Sec. 662. For CIA activities?	Not applicable
e. FAA Sec. 636(i). For purchase, sale, long-term lease, exchange or guaranty of the sale of motor vehicles manufactured outside U.S., unless a waiver is obtained.	Yes
f. Continuing Resolution Sec. 504. To pay pensions, annuities retirement pay, or adjusted service compensation for military personnel?	Not applicable
g. Continuing Resolution Sec. 506. To pay U.N. assessments, arrearages or dues.	Not applicable
h. Continuing Resolution Sec. 507. To carry out provisions of FAA section 209(d) (Transfer of FAA funds to multilateral organizations for lending.)	Not applicable
i. Continuing Resolution Sec. 509. To finance the export of nuclear equipment fuel, or technology or to train foreign nationals in nuclear fields?	Not applicable

C.5.	j. Continuing Resolution Sec. 510. Will assistance be provided for the purpose of aiding the efforts of the government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights?	Not applicable
	k. Continuing Resolution Sec. 516. To be used for publicity or propaganda purposes within U.S. not authorized by Congress?	Not applicable

CERTIFICATION PURSUANT TO

Section 611 (e) of the

FOREIGN ASSISTANCE ACT

As Amended

I, Philip R. Schwab, the principal officer of the Agency for International Development in the Dominican Republic, do herewith certify that in my judgment, the Dominican Republic has both the financial capability and human resources to maintain and utilize effectively goods and services procured under the capital assistance project entitled Energy Conservation and Resource Development.

This judgment is based upon the record of implementation of A.I.D.-finaced projects in the Dominican Republic and the results of the consultations undertaken during intensive review of this new project.

Philip R. Schwab

Director, USAID Dominican Republic

December 4, 1981

Date

PROGRAM: DOMINICAN REPUBLIC

ACTIVITY DATA SHEET

CP 81-08 (8-79)

TITLE	FUNDS	PROPOSED OBLIGATION (In thousands of dollars)	
Energy Conservation and Resource Development	Agriculture, Rural Development and Nutrition	FY 82 G-2,000; L-10,818	LIFE OF PROJECT G-5,114; L-10,818

NUMBER		PRIOR REFERENCE	INITIAL OBLIGATION	ESTIMATED FINAL OBLIGATION	ESTIMATED COMPLETION DATE OF PROJECT
517-0144 GRANT ☒ LOAN ☒	NEW ☒ CONTINUING ☐	None	FY - 1982	FY - 1984	FY - 1987

Purpose: To: (1) develop a national energy investment planning capability; (2) initiate a continuing program of industrial energy conservation; (3) develop the institutional capacity to exploit small scale hydro and wood fuels as alternative sources of energy; and (4) upgrade the management and planning capabilities of the Dominican Electricity Corporation (CDE).

Background: The center of the energy problem in the Dominican Republic continues to be the country's heavy dependence on imported petroleum. The rapidly rising-costs of imported oil and other petroleum products, along with a growing demand for energy, are placing a serious strain on the balance of payments and development of the economy as a whole. Overall, imported petroleum represents nearly 60 percent of all energy consumed. The amount spent annually on imported petroleum has increased from $42 million in 1973 to around $450 million in 1980, and will continue to rise through the decade of the 1980's. The biggest consumers of petroleum are industry, transportation, and the public utility for electricity generation. The Government of the Dominican Republic (GODR) established in 1979 a permanent National Energy Policy Commission with the mandate to develop a comprehensive national approach for dealing with the energy problem. This Commission is the primary GODR entity with which AID will be working in carrying out this energy project.

Project Description: AID's objective is to help the GODR reduce the nation's dependence on imported petroleum and increase the availability of affordable energy to all Dominicans. This project will assist the GODR to: (1) develop investment priorities, evaluate alternative investments, and determine required changes in fuel pricing and rate structure policies; (2) conduct energy audits and provide direct assistance to industries through pilot projects; (3) clarify and strengthen institutional capabilities and carry out several demonstration projects to expand mini-hydro development; (4) conduct research and demonstration of wood fuels as alternative sources of energy; and (5) provide technical assistance to the CDE. A basic goal of the project is the development of an institutional capability within the GODR to carry on energy activities when AID funding terminates.

Relation of Project to AID Country Strategy: This project is directly related to AID's strategy in the Dominican Republic of helping the nation become more energy efficient through energy conservation and by developing effective alternative energy resources.

Beneficiaries: Given this project's wide-ranging purposes, it is impossible to determine specific levels of beneficiaries. Certainly, many industries will benefit as will a great number of individual Dominicans through more efficient uses of energy and availability of more affordable energy sources.

Host Country and Other Donors: The host country contribution is estimated to be $6.29 million.

Major Outputs:	All Years
National Energy Plan	X
Industrial Conservation Center	X
Industrial Audits	1,200
Mini-Hydro Program	X
Wood Fuel Research Program	X

AID Financed Inputs:	Life of Project (In $ Thousands) Grant	Loan
Technical Assistance	3,114	-
Materials/Equipment	-	4,685
Credit	1,000	4,000
Local Costs	-	220
Project Administration	1,000	-
Inflation/Contingency	-	1,913
TOTAL	5,114	10,818

U.S. FINANCING (In thousands of dollars)

	Obligations	Expenditures	Unliquidated
Through September 30, ~~1978~~ 1980	-	-	-
Estimated Fiscal Year ~~1979~~ 1981	-	-	
Estimated through September 30, ~~1980~~ 1981	-	-	-
		Future Year Obligations	Estimated Total Cost
Proposed Fiscal Year ~~1981~~ 1982	G-2,000;L-10,818	G-3,114	G-5,114-L-10,818

PRINCIPAL CONTRACTORS OR AGENCIES

National Energy Commission (GODR).
Contractors to be determined.