

**THE CARIBBEAN REGION –  
A CHALLENGE FOR ALTERNATIVE ENERGY  
TECHNOLOGY TRANSFER AND DEVELOPMENT**

by

**Dr. Kenneth G. Soderstrom  
Associate Director, CEER**

and

**Dr. Juan A. Bonnet, Jr.  
Director, CEER**

**for presentation to**

**FIFTH INTERNATIONAL SCIENTIFIC FORUM ON CHANGES IN ENERGY  
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**CENTER FOR ENERGY AND ENVIRONMENT RESEARCH**  
UNIVERSITY OF PUERTO RICO

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## ABSTRACT

On a macroscopic scale, countries of the Caribbean Region, although politically and culturally diverse, do share a common energy problem, an overdependence on imported petroleum. In this Region where there is scarcity of petroleum, gas and coal reserves, alternative energy sources encompassing the technologies of solar thermal and electric, biomass, wind and ocean thermal energy all have relatively excellent potential applications.

This paper looks at the steps to effect an alternative energy technology transfer in terms of adaption to local conditions, which include such parameters for evaluation as the influence of microclimates, social and industrial variations, their assessments and effects on natural energy sources, technological utilization, and training of local personnel. The key areas of energy policy programs, training, communication and information programs, and technological projects are considered.

## RESUMEN

En una escala macroscópica, los países de la región geográfica del Caribe, aunque tanto política como culturalmente son diferentes, comparten sin lugar a dudas un problema energético común: La dependencia absoluta de petróleo importado. Es en esta región en donde, debido a la escasez natural de petróleo, gas natural y minas de carbón, existe un buen potencial para la aplicación de fuentes alternas de energía tales como las energías solares, térmica y eléctrica, la biomasa, la eólica y la océano térmica.

Este artículo está dedicado al análisis de las etapas necesarias para poder efectuar la transferencia de tecnología existente en fuentes alternas de energía, sobre todo en lo que se refiere a la adaptación a las condiciones de un territorio en particular. Algunos de los factores a considerar son: La influencia de los microclimas locales; el impacto de las condiciones sociales o de desarrollo industrial; la evaluación y efecto de estos factores sobre las fuentes naturales de energía; y el entrenamiento de personal local para la utilización de esta nueva tecnología. Exponemos en este artículo aquellas áreas clave relacionadas con programas de política energética, entrenamiento, comunicación e información y proyectos de desarrollo tecnológico.

All of the Caribbean Countries except Trinidad-Tobago, are petroleum importers, and the price increases on the international market during the last decade have had serious effects on the economies of these countries. The crude petroleum and refined products share of total merchandise imports increased from less than 9 percent in 1971 to about 25 percent in 1980.

In addition to sharing this problem, the Caribbean nations share several energy characteristics:

- (1) the subcritical sizes of most national energy systems precludes a choice of solutions;
- (2) there are no markets for indigenous fuels;
- (3) the use of indigenous fuels has been replaced by the use of imported petroleum;
- (4) commercially exploitable indigenous resources are lacking;
- (5) there are few trained personnel to carry out energy assessments and develop alternative energy programs;
- (6) national governments have not yet accepted regional cooperative efforts as the best ways to approach energy problems.

Realistic options include the devising of effective programs with careful balances in supply development, demand management, the structuring of energy institutions and sectors, and pricing policies. These options, though, require bilateral or multilateral support. This has been accomplished in the Caribbean to some extent during the last two years through the good offices of several regional and international agencies.

This presentation focuses on a project concerning alternative energy solutions for the region that has received combined support from the United States Agency for International Development (USAID), Caribbean Community Secretariat (CARICOM), and the Caribbean Development Bank (CDB). In particular, this project

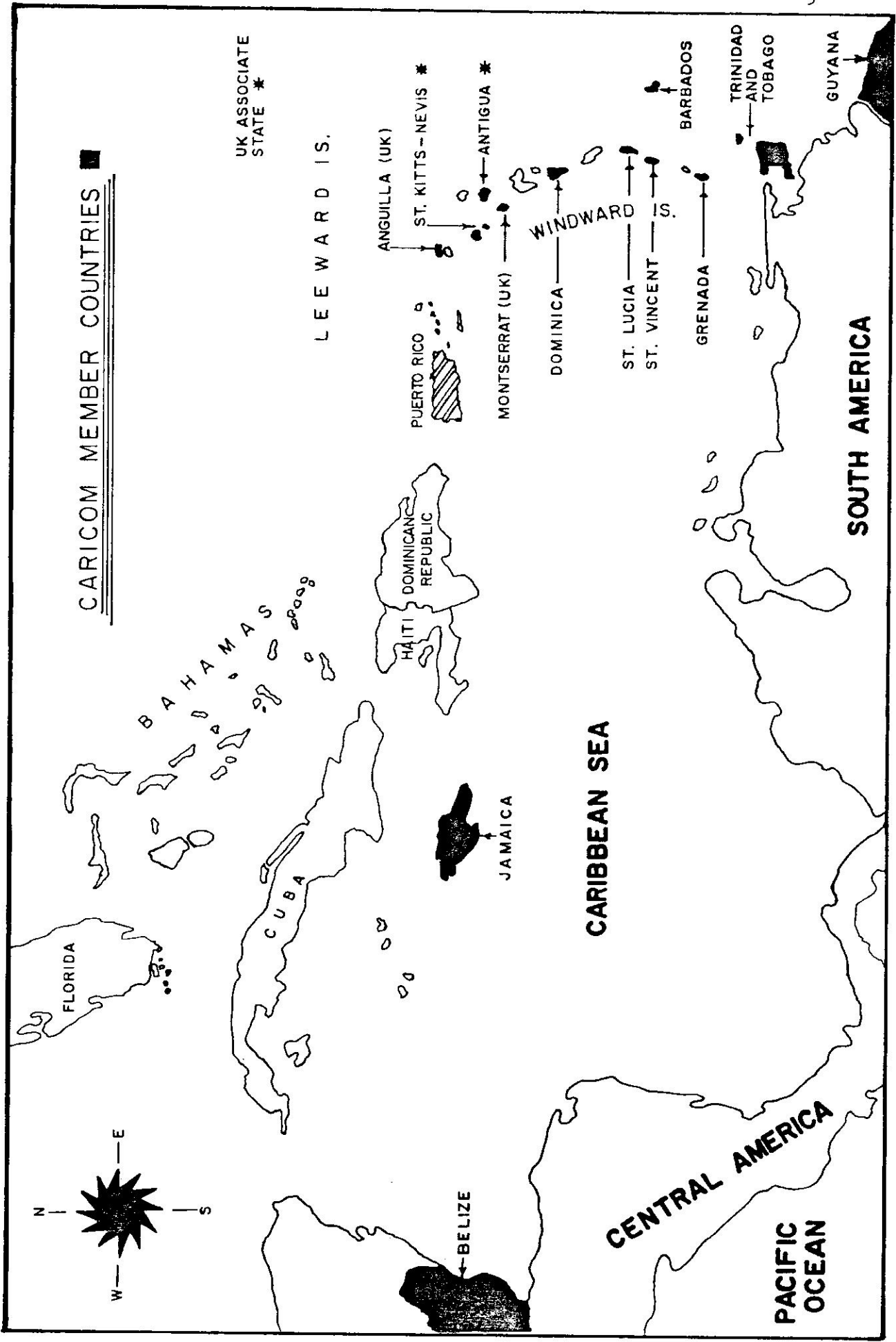
is identified in the USAID Caribbean Regional Project Paper for Alternative Energy Systems. This Project Paper states the goals and purpose as follows:

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

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

The Center for Energy and Environment Research (CEER) of the University of Puerto Rico signed a Consultancy Agreement with CARICOM and the CDB for the evaluation of this project at the end of its second year. The following is a presentation of the problems of developing technology capability in developing countries as they were just recently observed first hand during extensive trips through the region by the four members of the CEER evaluation team which visited nine of the 12 member countries of CARICOM. The following map shows the Caribbean Region and the CARICOM member countries.

To meet the objectives of the project, two regional organizations, CDB and CARICOM are sharing the tasks of the project. Ideally, in order to develop the technological capability needed for the region, one would first perform the energy assessments of each country from which one could make rational decisions



with regard to optimum placement of alternative energy projects, first as demonstration and then as follow-up for commercial application. Training of personnel at all levels and all phases would be ongoing throughout the duration. Strong communication links would also be interweaved for dissemination of information to aid technology transfer and to reinforce the training effort. This presentation reviews the actual situation as compared to the ideal.

In evaluating such a project, the first step was to examine the overall project objectives to see if they were being met and also to examine the proposed time schedule. The project was found to be behind schedule for some of the following reasons.

(1) This is a complex, pioneering, experimental type project involving a dozen developing countries, none of which had ever approached energy in an integrated, comprehensive manner before.

(2) There were difficulties in recruiting personnel of the calibre desired. How much of that was due to limitations of the resource pool and how much to locational factors has not been determined, but the evaluation team believes both factors are significant.

(3) Assessments have taken longer than planned, for a number of reasons. It was necessary to do a great deal of preliminary work to orient countries as to what an assessment is, to assure them it would not be used against them by international lending agencies, and to obtain commitments to provide the national resources and the information required.

(4) A number of local governments that were interested in cooperating with the Project had difficulty in deciding how they were going to deal with the energy problem in organizational terms. Moreover, in some cases, the organization of energy matters was delayed by reorganizations of unrelated government activities. There were also problems in identifying suitable people at the national level or in having them transferred from other activities.

(5) In some cases, energy functions were assigned as additional duties to persons in existing positions in national governments. If the person was thereby overloaded or was led to consider this as only a temporary assignment, he might not dedicate enough time to these functions.

In traveling through the various countries, one gains an increased appreciation of both national and regional constraints on the project implementation. Some national constraints and their reasons for being follow:

(1) Small size of country, economy and energy systems

This will always be something of a problem because it limits the national, human and financial resources available for energy, causes diseconomies of scale (such as inability to develop desired specialized skills), and makes the local energy organization more vulnerable to the effects of turnover, political changes, brain drain, etc. However, once effective regional programs are in place and a good energy assessment has been prepared, the importance of this constraint should be substantially reduced. In particular, an appropriate portion of the analytical work will be undertaken by regional organizations and their consultants, and of the financing by regional and international institutions.

(2) Low national priority for energy

The leaders of a country may consider that certain other problems are even worse than the energy problem and may decline to make sufficient human and financial resources available for the latter. This may occur even when there is a near term monetary advantage for the government in taking advantage of regional energy programs.

(3) The 'penny-wise and pound-foolish' minister of finance

The minister of finance is unwilling to make 'new' money available for energy because he does not see any immediate financial benefits to the



government. The fact that the economy of the country may benefit handsomely in the long run does not impress him. For powerful reasons, he is primarily concerned about the here and now of the budget. So he tells the minister responsible for energy to cut back on something if the latter wants to spend money on energy.

(4) Lack of coordination between ministries

This can happen in the most efficient countries, but it is particularly hard on energy which requires an above-average amount of coordination. For example, for good reasons field tests and demonstrations of alternate energy technologies may be parceled out to different ministries. If coordination is poor, the ministry in charge of energy may lose contact with many activities and may even lose control over programmatic and budgetary priorities within the energy field.

(5) The "additional duty" problem

In many countries, it is common to assign energy functions as additional duties to one or more persons rather than to hire full-time energy persons. However, if the persons so assigned are expected to perform their original duties as well with no increase in pay, morale is likely to be poor and some tasks will be neglected. If the person was overworked to begin with, not even a pay increase will help.

(6) Indifferent or risk-shy management in the private sector

Personnel who have worked on energy conservation studies have come across a wide variety of attitudes towards energy conservation among both maintenance personnel and management. At one extreme is an almost total ignorance of the energy problem and the possibilities for saving energy by changing operating practices and/or equipment. Alternatively, there is awareness of energy conservation coupled with indifference because management feels that energy cost

increases can be readily passed on to customers. In still other cases, maintenance personnel are aware of specific savings which could be made, but management is unwilling to make changes. Then there are managers and owners who are unwilling to invest in energy conservation measures and equipment because of perceived political or economic risks. Finally, there are managers who are enthusiastic "energy savers," who try new-fangled equipment and push their employees to obtain greater energy efficiency. The foregoing implies that decisions about energy matters are usually made at several different levels within an organization, and that communication about energy must be directed at all these levels if it is to be effective on a national scale. We have identified these as being national constraints. The Caribbean area also has serious regional constraints such as the following:

(1) The inherent complexity of the energy problem and its solutions

In a number of places, the Project Paper identifies the smallness of the participating countries, their economies and energy systems as an important, and often decisive, constraint on national solutions to energy problems, and it makes a powerful justification for a regional approach. It should be cheaper to deal with the energy problems of a group of neighboring small areas on a regional basis than on an individual basis, whether the small areas constitute separate countries or sub-divisions within one large country. But this approach will not be simpler; it will be more complex. And, unless this increased complexity is specifically recognized and taken into account, many of the "economies of scale" obtained by using a regional approach will be lost. Worse yet, poor solutions will then prevail throughout the region. After all, if the energy problem was simple, a small, poor country could order a "solution" to its problem out of an equipment catalog.

Unfortunately, developing technological capability to deal with inherent energy problems by using alternative solutions is very complex for reasons such as these:

(a) Alternative energy systems are usually based on distinct, complex or novel technologies. In the case of direct solar, wind, geothermal and OTEC, these are highly site specific; in the case of biomass, fairly so.

(b) Many of the technologies, pieces of equipment and methods may be new and untried, at least under the conditions for which they are proposed.

(c) An "expert" in one type of system is seldom an expert in another, and there may be no time-tested standards by which to judge a person's qualifications.

In brief, the bigger the area, the greater the variety of technologies, equipment and site conditions which have to be considered. Even if the human and financial resources were available, it would not be wise for the many official bodies in the Region to try to become all-knowing in energy matters. The energy problem has so many facets that almost every country in the world has something to contribute to some other country. Part of the advantage of a regional approach is that one can afford to develop the skill of knowing when to call in consultants and from where, within or without the Region.

Energy assessments, policy studies and conservation studies are of unusual importance as a basis for decision making. Considerable effort should be made to do them well and to assist countries to move from them to effective action. Regional organizations should, of course, also encourage countries to follow up sub-project reports with recommendations for action. Every program and sub-project should have some specific training objective, even if it is not a training activity per se.

(2) Lack of coordination between international assistance agencies

Many multilateral and bilateral international assistance agencies are active in the Caribbean, and many of them include alternative energy activities in their programs. The Project Paper identifies 19 agencies that have on-going projects or have completed or have proposed projects of this kind.

With 19 donor agencies, two Regional agencies, a dozen governments and innumerable ministries in the picture, it is highly probable that significant cases of overlap, duplication or simple lack of coordination exist. Problems are particularly likely in the areas of training and "hardware type" projects, especially if certain donor agencies have preferences for particular educational institutions or manufacturers. Also, the number of field tests and demonstrations of a specific technology may be influenced more by the number of funding sources and manufacturers than by research design based on an analysis of a particular problem. In brief, existing arrangements invite persistence of the coordination problem.

(3) The wide variety of conditions in the Region

There is an unusual variety of conditions among the countries in the Caribbean mentioned by the Project Paper. Energy consumption in million BTU's per capita ranges from 5.9 in Haiti to 47.5 in Guyana. GDP per capita ranges from \$230 in Haiti to \$1,800 in Barbados. Population varies from 12,700 in Montserrat to 5.1 million in the Dominican Republic. Thus the degree to which a given country can undertake energy work and the amount of regional assistance which it will require is liable to vary significantly from country to country. This means that the national energy organizations may vary from one to fifteen people and will have to be "custom designed" in each case. Also, Regional assistance will have to be "custom tailored" to the needs of each country, and Regional organizations will have to be prepared to offer a variety of services in different degrees of depths.

Among the major areas that were evaluated, the following will be discussed briefly at this point. These areas are: Energy Policy Programs; Training Communication and Information; and Technology.

In the case of the Energy Policy Program, it was originally expected that the physical manifestations of the planning process would include: country energy assessments, country policy studies and Regional policy studies. There is no question that the assessments and their associated studies have improved the data bases in the countries where they were carried out, even in countries where considerable data work had been done in previous years. In addition, because of on the job training they have left behind some institutional technological capability. Moreover, a properly done assessment includes analyses of energy demand, trends and pricing. A series of assessments may also identify energy issues which are best addressed on a regional basis. However, whether it initiates a process of energy planning, whether this process is incorporated into national planning and whether there develops an understanding of the relation between economic development and energy is quite another matter. To a very considerable degree it depends on the national constraints on Project implementation. But it also depends heavily on programs of communication, information and training. In the final analysis, if planning is to be more than an academic exercise, the results of planning must produce change in society. The acid test of any assessment is whether it is used as a basis for policy studies, policy decisions and programs of action; or whether it is filed away in a drawer and forgotten. There is a good chance that the assessments will lead to positive action in at least two or three of the four countries participating in the Program to date, given the existing attitudes, enthusiasm and organization.

Concerning the changes in technological capability that have taken place as a result of on-going activities, a very substantial one took place in the

regional organization which now can boast of an experienced and promising energy unit of its own. However, the degree and pace of change is not yet sufficient at the national level for such countries to ensure the attainment of the Project objectives.

Concerning the second area, the Project recognizes the importance of training, communication and information as a means of achieving its general goal.

There are few trained people in the area who can contribute to the attainment of the project goals, but there are institutions that can develop a capacity for training both energy policy makers and technical personnel. Considering the expanse of the geographical area where the participating countries are dispersed and the burden that this poses for the installation of a successful training system, one can appreciate the hope that every program and every sub-project should have some specific training aspect and objective, even if it is not a training activity per se.

In the screening of training projects, it is important to select those that are addressed to national energy problems as long as a priority is given to those national problems which are common to more than one nation. National energy assessments will be useful to design the training projects and to maximize the regional character of the activity.

Workshops are important to the training project. It is essential that the training workshops be practical and well organized. Operational objectives should be determined "a priori" and sent to the participants. In this way, an objective and valid selfevaluation of the activity will be assured. Also lecturers and group leaders should be selected with emphasis on their expertise as educators. If possible, the personnel should be acquainted with the national scenarios of the prospective participants so that educational material relevant to the energy problems in these countries be chosen.

Thus far, the impact of the communication and information components has not been felt. Normal start up difficulties are partly responsible for this situation. Mostly, the complex nature of the communication activity addressed to a vast geographical region containing isolated areas with little or no infrastructure on which to base information systems is the main factor responsible for the lack of adequate impact up to this time. The information component has made adequate progress towards accomplishing procedural and organizational inputs. However, the net use by the participating countries of a newly established bibliographical service has not reached the level of significant impact, although it is increasing.

Whenever the national energy assessments are available, a total review of the activities plan for the training, communication and information components should be attempted, taking into consideration the results of the energy assessment and other recommendations included in this report. It would be advantageous to use the expertise of a communication/training consultant for this purpose. In addition, the increase of technical assistance to the field institutions is of paramount importance for the success of the individual activities, for the success of the overall program, and for keeping the program within the scope of the program.

The last area that we will consider is the Technology area. For your information here are some of the key energy projects being conducted under the program.

<u>Projects</u>	<u>Country of Benefit</u>
Wind and Solar Energy Resource Assessment	Region
CDB Solar Passive Building Design-Construction-Monitoring	Barbados
Wind Power Demonstration	Antigua
Study of Commercial Viability of Non-Conventional Water Heating in the Tourism Sector	Grenada
Peat Resource Assessment	Belize
Solar Drying of Chili Peppers	Guyana
Solar Water Heater Test Facility- Barbados National Standards Institute (BNSI)	Region
Banana Defibering Pilot Plant	St. Lucia
Integrated Energy Program for an Estate	St. Vincent
Promotion of Simple Domestic Solar Food Dryers	Region
Food and Fertilizer from Protein Wastes	Barbados

These projects are all progressing well, but the following general comments should be considered.

There should be assurance that an institution requesting a loan under the program will receive adequate technical assistance to implement the activities before the loan is approved. The lack of field technical assistance often results in project delays which originate in the field countries. Field visits to assist the ongoing activities should be made more often by project officers. The liaison should be a continuous assignment performed by the communication unit to assist the technical staff members in their duties.

Some of the difficulties of the energy program and the lack of definite progress in some areas arise from the lack of institutionalized technical expertise in alternative energy sources at the regional organization and in the field institutions.



With adequate energy policy programs, well planned training programs, more effective networks of communication and readily accessible information, the newly trained experts will form the backbone of a new institution of individuals ready to affront the challenges of the energy problems that will face the Caribbean region for the remainder of this century and the beginning of the next one. However, this new team of experts will soon acknowledge that there is no alternative development strategy offering an easy escape from the constraints of higher energy costs.