

CEER - X-124 "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 at the University of Puerto Rico, Center for Energy and Environment Research.

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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 a 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 considerations, 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...

Due to the natural scarcity of oil, natural gas, and coal mines, there is good potential for the application of alternative energy sources such as solar, thermal, and electric energies, biomass, wind, and ocean thermal. This article is dedicated to the analysis of the necessary steps to be able to carry out the transfer of existing technology in alternative energy sources, especially in terms of adapting to the conditions of a particular territory. Some of the factors to consider are: the influence of local microclimates; the impact of social conditions and industrial development; the evaluation and effect of these factors on natural energy sources; and the training of local personnel for the utilization of this new technology. We expose in this article those key areas related to energy policy programs, training, communication and information, and technological development projects.

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 preclude 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 way 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 energy 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. "The goal of the project is to develop 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 LOC'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 development.

Hoping technology capability in developing countries, 88 were just recently observed first hand during 18 extensive trips through the region by the four members of the CEER evaluation team, which visited one 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, COB 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.

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With regard to optimum placement of alternative energy projects, first as a demonstration and then as a 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 the 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 delays in recruiting personnel of the desired caliber. 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

The assessment is to ensure that 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, they might not dedicate enough time to these functions. While 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 are as follows:

(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 the 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 thus may not prioritize it as highly.

The government may decline to allocate sufficient human and financial resources for particular initiatives. This could happen even when there is a near-term monetary advantage for the government in capitalizing on regional energy programs.

(3) The "penny-wise, pound-foolish" Minister of Finance: The Finance Minister is unwilling to allocate "new" money for energy initiatives because he does not see any immediate financial

benefits for the government. The fact that the economy of the country could greatly benefit in the long run does not persuade him. For compelling reasons, he is primarily concerned about the immediate impact on the budget. Therefore, he instructs the Minister responsible for energy to reduce spending elsewhere if they wish to allocate funds for energy.

(4) Lack of coordination: This can occur even in the most efficient countries, but it is particularly detrimental to energy initiatives, which require above-average coordination. For example, field tests and demonstrations of alternative energy technologies may be distributed among different ministries. If coordination is poor, the ministry in charge of energy may lose touch with many activities and even lose control over programmatic and budgetary priorities within the energy sector.

(5) The "additional duty" problem: In many countries, it is common to assign energy functions as additional duties to one or more individuals, rather than hiring full-time energy staff. However, if the individuals 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 individual was overworked to start 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 encountered a wide variety of attitudes towards energy conservation among both maintenance personnel and management. At one extreme is almost total ignorance of the energy problem and the possibilities for saving.

Energy can be conserved by altering operating practices or equipment. However, often there is a level of awareness about energy conservation that is coupled with indifference. This is because management tends to believe that increases in energy costs can be readily passed on to customers. In other instances, maintenance personnel are aware of specific adjustments that could be made to save energy, but management is unwilling to make these changes.

Some managers and owners are reluctant to invest in energy conservation measures and equipment due to perceived political or economic risks. Conversely, there are managers who are enthusiastic "energy savers," who experiment with innovative equipment and encourage their employees to achieve greater energy efficiency. This suggests that decisions about energy are often made at different levels within an organization and that communication about energy must be addressed at all these levels for it to be effective on a national scale. These are identified as national constraints.

The Caribbean area also faces significant regional constraints, such as the inherent complexity of the energy problem and its solutions. The Project Paper identifies the smallness of participating countries, their economies, and energy systems as an important, and often decisive, constraint on national solutions to energy problems. It offers a compelling justification for a regional approach.

It should be more cost-effective to address the energy problems of a group of small, neighboring areas on a regional basis rather than individually, whether these small areas constitute separate countries or subdivisions within a larger country. However, this approach will not be simpler; it will be more complex. Unless this increased complexity is specifically recognized and accounted for, many of the "economies of scale" obtained through a regional approach will be lost. Worse yet, poor solutions may then prevail throughout the region.

After all, if the energy problem were simple, a small, poor country would have already solved it.

Could order a "solution" to its problem out of an equipment catalog.

Unfortunately, developing the 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, it's 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

The text should be fixed as follows:

The project paper includes alternative energy activities in the F programs. It identifies 19 agencies that have ongoing, completed, or proposed projects of this kind. With 19 donor agencies, two regional agencies, a dozen governments, and innumerable ministries involved, it is highly likely 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 specific technology may be more influenced 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 the persistence of coordination problems.

The wide variety of conditions in the region presents an additional challenge. There is an unusual variety of conditions among the countries in the Caribbean mentioned by the project paper. Energy consumption in million BTUs 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 9.1 million in the Dominican Republic.

Thus, the degree to which a given country can undertake energy work and the amount of regional assistance it will require is likely to vary significantly from country to country. This means that national energy organizations may vary in size 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 depth.

10. 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

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 databases 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 accidental 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

ongoing 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.

On a national level, it is vital for such countries to ensure the attainment of the project objectives. Regarding the second area, the project recognizes the importance of training, communication, and information as means of achieving its general goal. A few trained individuals in the area can contribute to the attainment of the project goals. Additionally, there are institutions capable of developing a capacity for training both energy policy makers and technical personnel.

Given the vast geographical area where the participating countries are dispersed, and the burden this poses for the installation of a successful training system, it's hoped that every program and sub-project will incorporate some specific training aspect and objective, even if it isn't a training activity per se.

In the screening of training projects, it is important to select those addressing national energy problems, prioritizing those problems common to more than one nation. National energy assessments will be useful in designing the training projects and maximizing the regional character of the activity. Workshops are crucial to the training project. They should be practical, well-organized, and have operational objectives determined in advance and communicated to the participants. This approach will ensure an objective and valid self-evaluation of the activity.

Lecturers and group leaders should be selected based on their expertise as educators. If possible, the personnel should be familiar with the national scenarios of the prospective participants so that educational material relevant to the energy problems in these countries can be chosen.

So far, the impact of the communication and information components has not been felt. Normal start-up difficulties are partly to blame for this observation. Mostly, the complex nature of the communication activity aimed at a vast geographical region containing isolated areas is responsible.

The main factor responsible for the lack of adequate impact up to this time is the little or no infrastructure on which to base information systems. The information component has made adequate progress towards accomplishing procedural and organizational inputs. However, the net use by the participating countries of the 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.

### 3 Projects Country of Benefit

- Wind and Solar Energy Resource Assessment Region (08 Solar Passive Building, Barbados
- Design-Construction-Monitoring 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-Region, Barbados National Standards Institute (BSI)
- Banana De-Fibering 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.

The text will be corrected as follows:

"Before the loan is approved, adequate technical assistance will be provided to implement the activities. The lack of field technical assistance often results in project delays, which originate in the field countries. Project officers should make field visits to assist the ongoing activities more often. 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 confront 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.