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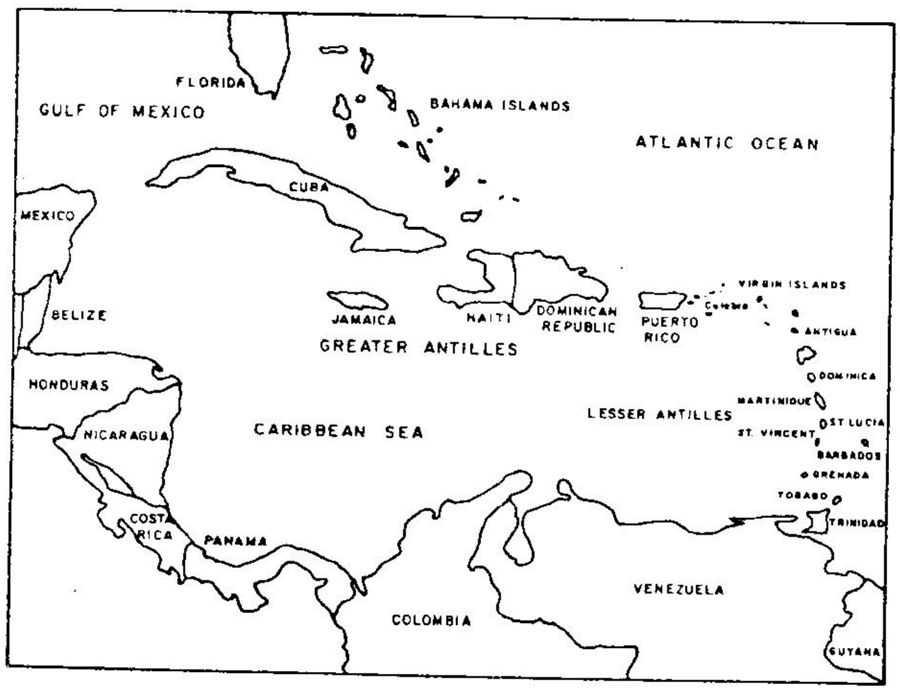
ENERGY/ENVIRONMENT MANAGEMENT: A BROAD PERSPECTIVE FOR THE ISLANDS OF THE CARIBBEAN



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CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
UNIVERSITY OF PUERTO RICO — U.S. DEPARTMENT OF ENERGY

ENERGY/ENVIRONMENT MANAGEMENT:
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ENERGY/ENVIRONMENT MANAGEMENT: A BROAD PERSPECTIVE FOR THE ISLANDS OF THE CARIBBEAN

Environment and Ecosystem

The cycle of energy production and consumption in the Caribbean produces complex impacts on the Caribbean island environment. Although petroleum supplies in the Caribbean is virtually nonexistent, with the exception of Trinidad-Tobago, its transportation within the region and the region's near total dependence upon petroleum for power guarantees that petroleum will have a profound impact on the total island environment for some time to come. Historically, close to two-thirds of all U.S. oil imports--crude as well as products--has been shipped by way of installations in the Caribbean area.

Puerto Rico has three refineries and oil transportation is a critical environmental concern. Table I details the petroleum refining capacity in the Caribbean.

Take, for example, the HOVIC or Hess oil refinery on the island of St. Croix in the Virgin Islands, the largest refinery in the World. Nearly 1,000 tankers enter or leave the Hess Port every year. The oil that passes in and out of Limetree Bay on St. Croix every year exceeds 15 billion gallons (Potter, 1978). Further, the government of St. Lucia is negotiating to construct an even larger refinery on its shores.

Table I -- Petroleum Refining Capacity in the Caribbean (Oil and Gas Journal, 1976)

Country	Exported Refinery Operated by	Capacity (000 b/d)
Venezuela	Lagoven/Exxon (ar Amuay)	600
	Maraven/Shell (at carbon)	337
Netherlands Antilles	Exxon (ar Aruba)	440
	Royal Dutch Shell (at Curacao)	409
Trinidad and Tobago	Texaco (at Point-a-Pierre)	361
	Trintoc/Shell (at Point Fortin)	100
U.S. Virgin Islands	Amerada Hess Corp. (at St. Croix)	728
Bahamas	New England Petroleum Co.	500
	Standard Oil of California	
Panama	Texaco (at Colón)	100
Puerto Rico	CORCO (at Guayanilla)	161
	Sun Oil Co. (at Yabucoa)	88
	Caribbean Gulf (at Cataño)	40
	TOTAL---------	3,864

Studies by the Marine Ecology Division of the Center for Energy and Environment Research have documented the severe perturbation which may result from petro-industrial operation on a marine enlargement such as Guayanilla Bay (López, 1980). Deleterious effects were documented in zooplankton, fish, mangroves, seagrasses, and benthic animals due to thermal pollutions. Distribution patterns of chemical contaminants demonstrated heavy accumulations downstream from effluent discharges. The occurrence of mercury in the flesh of commercially important fish was studied and documented. A productive mathematical model for a tropical bay was developed to be used for management of this ecosystem. (Chartock, 1980).

A Caribbean Oil Spill Contingency Plan coordinated by the Organization of American States (OAS) et al, is almost completed. A potential landmark decision with respect to environmental restoration after an oil spill in Bahia Sucia in Puerto Rico now awaits confirmation in Federal courts. All these are steps in the right direction.

Coal is becoming fast an economically attractive energy alternative for the Caribbean regions and this will impact the energy production, transportation and use in the region. Already Puerto Rico, Dominican Republic and Cuba has announced plans to build coal fired units. The

Republic of Colombia is moving toward becoming a major coal supply for the region. The study of the energy/environmental management of this alternative becomes a high priority.

Energy production which might mobilize agricultural products brings with it three specific environmental effects in the Caribbean: erosion, or siltation, depletion of fresh water and effluent discharge. Currently, both Puerto Rico and Virgin Islands distilleries are having serious problems meeting water-quality standards for the effluent from the distilleries. CEER conducted an investigation of the effects on the marine environment of rum distilleries slops in Puerto Rico and in St. Croix. Both water and air pollution problems have been cited as primary obstacles to the reactivation of the old Pott Rum distillery in downtown St. Thomas. (Towle, 1979).

Other examples of environment degradation caused by energy activities would be losses to fisheries due to power plant siting, whether ocean thermal energy conversion (OTEC), nuclear/thermal or traditional petroleum/thermal impacts. These pollution effects are one aspect of the whole ecosystem, a system that must be considered in its totality, particularly on an island. And totality includes human resources along with natural resources. This is the broader perspective.

A Framework for Energy/Environment Management

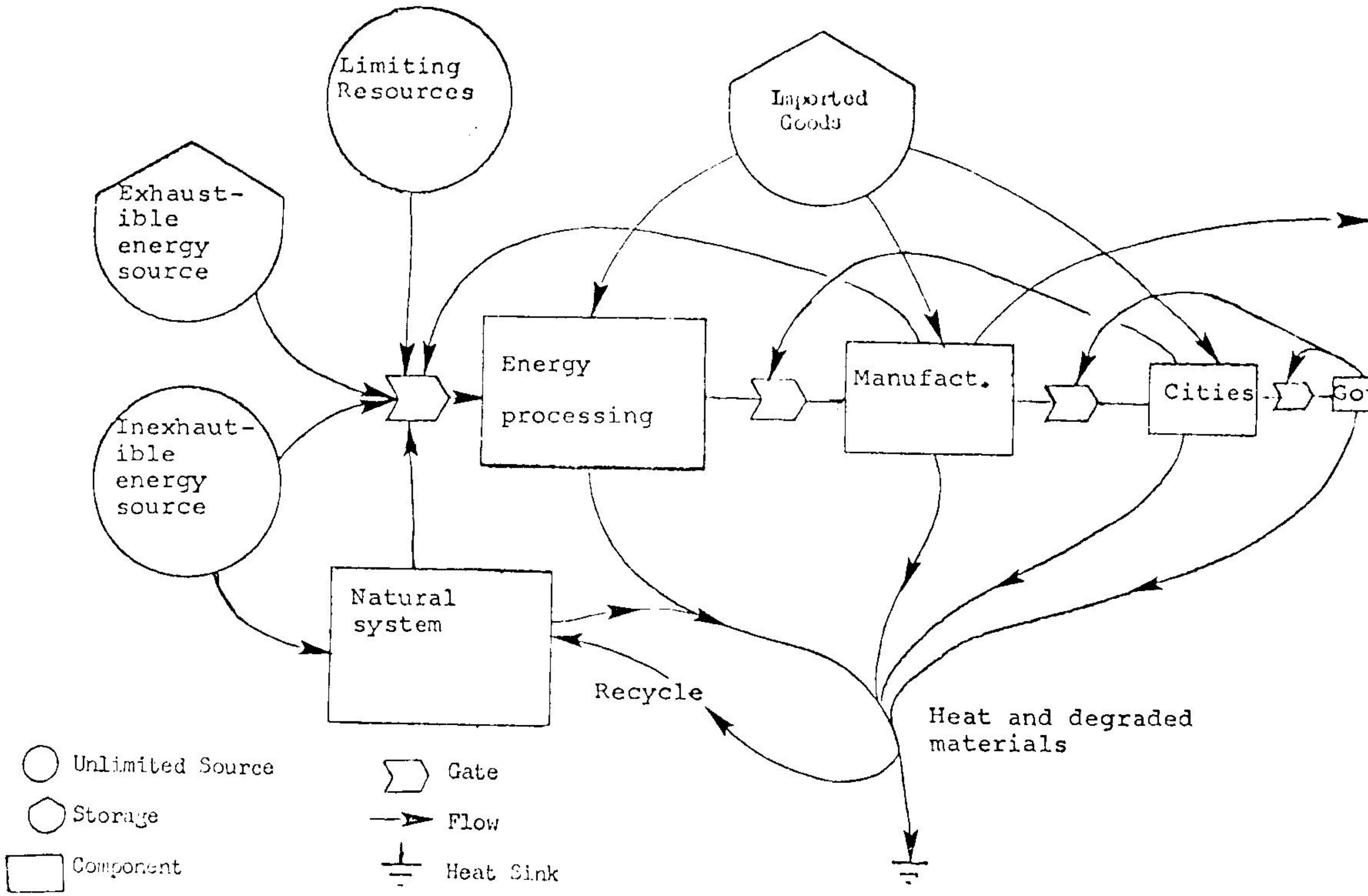
Looking at environmental issues from this new perspective brings to mind some interesting questions on just what is the environment. We can no longer take for granted a common understanding of that term. Language, perceptions and attitudes may be very different within cultures, as well as between cultures. As these value systems are developed they are structured by human interaction with natural environment.

Chartock has developed an ecosystems approach to energy-related environmental research planning which stresses this coupled man-nature island system (Chartock, 1980). This framework was developed as an adjunct to CEER's Guayanilla Bay project but is of greater applicability to the Caribbean. It emphasizes energy flows and materials cycles in the linked natural and man-dominated ecosystem. Figure 1 illustrates the form, distribution and activity of energy flows upward through the hierarchy of Puerto Rican components of the man-nature system and the counterflows which exert a feedback control over it.

A framework for energy/environmental management to be considered is the ecodevelopment approach. Sachs contrasts the traditional rationale such as free market and resource management, with the more comprehensive goals of ecodevelopment. (Sachs, 1979)

FIGURE 1

GENERALIZED COMPONENTS OF THE PUERTO RICO ISLAND SYSTEMS



ECODEVELOPMENT IS:

- an approach to development aimed at:

  harmonizing social and economic objectives with ecologically sound management in a spirit of solidarity with future generations

- based on the principles of:

  self-reliance

  satisfaction of basic needs, a new symbiosis of man and earth

- another kind of qualitative growth:

  not zero growth

  not negative growth

ECODEVELOPMENT REQUIRES:

- harmonization of consumption patterns, time use, life styles
- low energy profile, promotion of renewable energy base
- new uses for environmental resources
- careful husbandry of resources, recycling
- ecological principles to guide settlement patterns and land uses
- participatory planning and grass-root activation

  (Sachs, 1977)

Some further comments on ecodevelopment:

"Ecodevelopment does not lead to any ultimate state of 'ecodeveloped.' Adoption of the concept recognizes that a cultural-ecological system cannot undergo unregulated growth of any of its parts without being constrained by the need for related adjustments and adaptations in the other parts of the system. Growth need not be abandoned in this view; rather, a strategic look at all the consequences of growth be taken in order to make both sound judgments about the desirability of change and informal choices relative to the kinds of change." (UNEP, IFIAS, 1976)

"One of the fundamental points about ecodevelopment is the role of the local population. The strategy calls for not only the local peoples' participation, but also their control over the decisions that are made in the process of development which affects their future, their control of their resources, and their control over the process of converting those resources into economically viable products." (Farvan, 1977)

"Ecodevelopment is not just a direction that peoples of the Third and Fourth World may follow, but is also one that must be pursued in the industrialized world. It is our particular responsibility to bring it to reality in our own country - to reshape and reassemble our own technological society so that it will no longer be destructive to poor nations, a drain on their resources, but will find socially and environmentally acceptable directions to pursue." (Desmann, 1977)

At a workshop of the Canadian International Development Agency on Environment and Development, Prospective and Ecodevelopment, Strategies for Action, those issues were again reinforced.

Part of the reason for our lack of success is related to the existence of a powerful combination of constraints that limits our ability to fully assess new approaches to development. We appear to be locked into the analytical techniques and perceptions of the past which tend to disregard the self-reliance postulate implicit in ecodevelopment concepts.

Our institutions in many cases tend to pursue narrowly defined, single-sector policy objectives which often preclude the attainment of an optimal set of multiple objectives.

There is a prevailing trust in the ability of science management and the marketplace to resolve problems whenever they arise. This faith now underlies current government incentives; the selection of options is towards large scale, high technology, institutionally directed solutions instead of flexible, varied-scale, individually chosen activites.

Public awareness of resource development issues and the extent to which individual and societal well-being is dependent on the wise use of resources is not sufficiently developed. There is an inadequate sense of individual and collective responsibility towards these issues, which calls for greater efforts to increase public knowledge and to make public participation an essential part of decision-making processes concerning resources. The CEER project funded by the National Academy of Sciences, "Community Participation in the Development of energy self-sufficiency for the island of Culebra," is an effort on community participation on a decision-making process. The study,"Puerto Rico and the Sea", is another example. The emphasis is on resource management and environmental quality to be much more directly part of public decision-making, and less the prerogative of specialist authorities.' (CIDA, 1977)

Management agencies in both renewable and non-renewable resources are faced with a dual role: On the one hand, to put resources to optimal economic use, and on the other hand to conserve them. Ecodevelopment approaches can provide the guidelines to minimize these apparent management contradictions through integrated management approaches involving agencies and interest groups which are currently operating separately or in confrontation one with another. They must be adapted at all levels of management and program support to be effective.

A technical subsidiary of this view and approach is the adoption of the "assimilative capacity" approach to regulation and development. This implies that we must measure what insults the systems can bear without significant degradation or loss of "ecological integrity". (Cairns, 1979).

Energy Technologies

In this broader view, we can re-examine some familiar energy technologies with respect to the Caribbean. (Bonnet, 1981) High technologies proposed for Puerto Rico or the Virgin Islands include ocean thermal energy conversion (OTEC) with which we are very familiar in Puerto Rico. CEER has a floating OTEC Laboratory off the southeast coast of Puerto Rico at Punta Tuna. OTEC is a high-technology development with great potential for the islands because of its reliance on an inexhaustible and renewable resource, the temperature difference of the ocean, and because of the preliminary evidence that its environmental impact will be small.

In one sense it is a proven concept -- it briefly generated electricity a long time ago and again recently with mini-OTEC. In another sense it is brand new and unexplored. At the scale required for commercialization there remain uncertainties with respect to the effect of the environment upon the OTEC plant and its operation and with regard to the effects of many large plants upon the marine environment. These questions deserve further research effort because of the promise the technology holds.

CEER has been involved in both ends of that research.

A main question is whether accumulations of biofilms and corrosive action from the seawater will cripple the heat transfer process. Another major question is whether the biota exposed to multiple OTEC discharge plumes can continue to function normally. There is a possibility that the discharge, treated correctly, may be used for economic benefit through use in the culturing of commercial marine species.

Another sophisticated technology is solar cooling. The viability and commercialization of solar cooling has always received a high priority on the Caribbean tourism-dependent list.

Other energy technologies including solar steam production, solar ponds, combustion of biomass and municipal garbage, and biogas are possibilities for the islands. CEER has active programs (Bonnet, 1979) in solar data collection and analysis, solar water heaters, solar parabolic compounded collectors for industrial process heat and solar air cooling. Other programs involve energy and environmental assessments. Strong programs exist in biomass, sugar cane and tropical grasses, forestry and bioconversion. Extensive marine, terrestrial and human ecology programs are also under way. More than $18 million in five years (1977-81) has been spent on this research

(CEER 1980 Annual Report). One of the main goals of CEER is to develop indigenous energy resources which are compatible with their fragile tropical environment for the wide caribbean region complex technology.

In addition, the Solid Waste Authority in Puerto Rico has completed a solid waste plan for the Island and a similar plan has been published in the Virgin Islands.

The Caribbean appears well suited to take advantage of this renewable energy resources as a substitute for petroleum (AID, 1979). The Caribbean's natural energy resource base consists of high levels of insolation (solar energy), excellent biomass growth rates, trade winds and geothermal energy potential. In a number of countries, significant hydro power potential also exists. The conversion of these indigenous resources may become cost competitive sooner in some economic sectors in the Caribbean than in industrially advanced countries because of the comparatively higher costs and almost total dependence of the region on imported petroleum fuels. These economic and resource factors, if combined with the necessary technical expertise, managerial skills, financial resources, and government and institutional support to effectively address the energy problem could allow the Caribbean to be one of the first areas to take advantage of alternative energy options.

Several alternative energy conversion processes are already in use in the region. In a number of Caribbean countries hydropower is already an important indigenous energy resource and provides electricity in significant proportions of total electricity generation, both as large scale and micro-hydro.

Wood and charcoal (biomass fuels) provide significant amounts of energy in heavily rural and/or forested countries (Haiti, Belize, Dominica, Dominican Republic, Grenada, Guyana and St. Lucia). Efforts to increase utilization of these resources must concentrate on production, transport, and marketing efficiencies in order to make an additional contribution. These efforts must also be accompanied by integrated reforestation programs to avoid further ecological damage (e.g., Haiti). Other biomass options include the combustion of bagasse (sugar cane wastes) and other plant wastes for electricity and steam cogeneration, the conversion of plant and animal waste to gaseous fuels through digestion and the production of liquid (alcohol) and solid fuels from agricultural and timber wastes. CEER has an extensive and sophisticated program developing energy cane and tropical grasses. The four year study results have been very encouraging. (Alexander, 1980).

Solar energy has substantital potential throughout the region. Commercial enterprises are underway in hot water heating (Puerto Rico, Barbados, Dominican Republic, St. Kitts, etc.), water distillation (Trinidad), air conditioning (Barbados), and crop drying (Jamaica, Trinidad, St. Lucia, etc). Each of these options can be effectively used in a number of residential, commercial and industrial applications, but incentive schemes may be necessary to assist widespread development. Similarly, wind energy potential exists in many Caribbean countries and was, in fact, used throughout the region in the past for water pumping and mechanical power. Wind power for pumping water (e.g., irrigation use) and on-site electricity generation in remote sites are the likely applications for this resource. One of the early U.S. Department of Energy wind power demonstration machines of 200 KWe has been installed in Puerto Rico's offshore island of Culebra.

Finally, geothermal energy represents a potential resource in several Caribbean countries (St. Lucia, Dominica, Martinique, Haiti, and St. Vincent). (AID, 1979)

A Broader Perspective on Island Energy Planning

I think it's clear as we review these technologies that some are more useful, or more suitable, than others. In the broader context, we find we deliberately chose one technology over another, or one group of technologies instead of another. This choice can be made on any number of bases.

We could use a least-cost criterion. Lack of pertinent or accurate data could prevent a country from using a particular energy device. We might decide on the basis of environmental impacts, or health risks. Our reasons for adopting one technological mix instead of another may be political or, because of economic constraints, we may have no choice at all.

The broader view, however, is consistent: All of these reasons should be considered in making the decision to employ any particular energy strategy. Once again, we should not fall into the trap of a restricted or narrow view.

Oil spills are part of a dynamic ecosystem which includes humans who utilize specific energy sources that might cause oil spills. This interdependence is part of a larger process.

Countries, especially of small size and extremely narrow resource bases made even more critical by man-made or natural degradation of critical habitats and having at the same time high human population densities, cannot afford to experiment with only a few ecodevelopment projects. Rather, ecodevelopment must become the umbrella concept for future growth and must be fully integrated into national planning. In fact, this might be the only hope for peaceful and comfortable survival of human populations on small islands in the 21st century.

Jackson points out that the thrust of national planning varies from one territory to the next. It is, however, possible to identify, for the islands under focus, five (5) broad categories of planning that are either fully institutionalized or occur informally or sporadically. These are:

> Economic planning - Frequently with very little integration of key sectors, such as agriculture, fisheries, forestry, tourism and industry.
>
> Physical planning - introduced to most territories in the past decade.
>
> Infrastructure planning (physical and social) - physical; including transport facilities, water and electricity; social; including schools, hospitals, clinics and administrative buildings.
>
> Human resource planning - not usually defined as such but embracing education, health, culture and recreation.
>
> Environmental planning - not always present, but critical to the larger scope of ecodevelopment.
> (Jackson, 1980)

Developing Countries

The case of developing countries presents some special considerations. As Raymond Goodman of the World Bank points out, developing countries consume a small share - 12 percent of the world's commercial energy. However, their economies are growing faster than those of the industrial countries, and the rapid growth of cities, industries, motorized transport and other energy-intensive developments has in the past caused their demand for commercial energy to grow faster than their gross national product. Much of the increased demand has been met by oil, and the great majority of developing countries must import all or a portion of their oil requirements. (Goodman, 1980)

However, this factor should be weighed against a general trend to reduce the levels of energy demand which is evident from energy forecasts compared in 1972 and in 1978 in "Low Energy Futures". (Holt, 1980) The trend, as Table II shows, is for the energy conservation optimists and skeptics alike to revise downward their estimates of U.S. energy requirements. The Caribbean developing countries will undoubtedly increase their energy demand in order to be able to develop, and consequently greater reliance on renewable energy sources must be considered. However, any growth prediction of Caribbean energy demand should be tempered by this experience of downward revisions of future energy demand occurring in the developed countries. A comprehensive energy planning process integrates demand

Table II -- Trends in the Forecast of Energy Requirements by the year 2000 (in quads per year)

Year of Forecast	Beyond the Pale	Heresy	Conventional Wisdom	Superstition
1972	125 (Lovins)	140 (Sierra)	160 (AEC)	190 (FPC)
1974	100 (Ford zeg)	124 (Ford tf)	140 (ERDA)	160 (EEI)
1976	75 (Lovins)	89-95 (Von Hippel)	124 (ERDA)	140 (EEI)
1977-78	33 (Steinhart, 2050)	67-77 (NAS I, II)	96-101 (NAS III, AW)	124 (Lapp)

Abbreviations:

Sierra--Sierra Club; AEC--Atomic Energy Commission, FPC--Federal Power Commission; Ford zeg--Ford Foundation zero energy growth scenario; Ford tf--Ford technical fix scenario; Von Hippel--Von Hippel and Williams, Center for Environmental Studies, Princeton University; NAS I, II, III--The National Academy of Science Committee on Nuclear and Alternative Energy Systems (CONAES); AW--Alvin Weinberg, the Institute for Energy Analysis, Oak Ridge.

Amory Lovins' matrix of enery forecast as published in J. Steinhart et al., Pathway to Energy Sufficiency: The 2050 Study (Friends of the Earth, 1979) p. 4

From "Low Energy Future, 1980 DOE/PE-0020" p.3

and need in its supply and resource mix recommendations. It would be foolhardy to continue to forecast a seven year doubling rate in installed electric capacity. Some years ago, technicians habitually predicted these straight-line figures. They did not take into consideration the very realistic user demand of the population for whom they were making these predictions.

Developing countries present several other constraints to the comprehensive process: There are economies of scale which cannot be realized in the case of small areas, such as most Caribbean islands.

Klein comments that when we consider energy supply and demand in developing countries it is helpful to keep two important points in mind.

First, the energy supply/demand balances in developing countries are not homogeneous. These countries have a diversity of energy resources ranging from plentiful fossil fuels to no fossil fuels, from abundant water, or wind, or sunshine, or biomass, to limited quantities of one or another of these resources. Infra-structure and human skills vary greatly. Developing country demands for energy also differ vastly, depending on the nature of their economies, from near subsistence levels in some African countries to the large modern sectors in countries of Latin America and Asia.

Second, because a country's energy supply and its energy demands resemble mosaics of discrete resources and needs, careful attention must be paid to the matching of the forms of energy supply with energy demand. Unless energy demand is disaggregated into the form and amounts of energy required for the tasks to be done, the full potential for application of renewable energy resources is often overlooked. (Klein, 1980)

Technology transfer, a primary component of any energy development process, is a prickly item when we are viewing the process from a holistic point of view.

There is a strong historical tendency to look toward the mother country for guidance, and, of course, technology transfer. For example, the electric utilities rely on foreign technology for their systems. The French Islands have French equipment and former British colonies have equipment from Britain or other Commonwealth countries. Consequently, one finds a mixture of 120 volts, 220 volts, 50 cycle, and 60 cycle systems throughout the region. In short, the region utilizes not what it really needs, but what it inherited.

The United States of America's position paper for the United Nations Conference on Science and Technology for Development suggests several standards of fairness in technology transfer.

In order to have an effective transfer, the information base in the developing countries must be broadened to permit them to select what they need from the international supermarket of technology. They must be able to reject what they do not need, to choose among competitive offerings and to acquire what is most appropriate and economical for their development needs.

The transfer must include an increasing shift in research and development to the developing countries. Research and development that are locally based and oriented toward indigenous resources, needs and demands contribute not only to the growth of self-reliant capacities, but to a widening of markets and technological innovations as well.

Islands

If developing countries present constraints in designing and managing the energy development process, islands present special cases. No component of an island ecosystem can be isolated from the matrix. It is futile to speculate on energy development in the Caribbean island countries without integrating recommendations and newly acquired data into the whole island context; its human resources and natural resources. Towle observed at the First Caribbean Conference on Energy for Development that, first, in the past the islands were energy self-sufficient and the ecological systems in balance. Second, the island ecosystems are of such a small scale that if a large investment project proves to be a mistake, that one mistake in many cases is the only chance one will have had. Consequently, in the first case, strong efforts should be made to reachieve natural balances in the islands. In the second, thorough analysis of all possible impacts should accompany any plans for large projects in the region. The consequences of past mistakes are evident, and any large new ones are likely to be irreparable. (Towle, 1979)

It is evident that any consequence within a chain of events is always going to be more exaggerated in an island setting. These same consequences can be seen in the case of imported petroleum dependence, as discussed in the Caribbean Energy Supply of the World Bank. The countries of the region - again with the exception of Trinidad and Tobago - have some common characteristics which determine their energy position. Among these characteristics are: (i) almost total dependence on imported petroleum for meeting requirements of commercial energy; (ii) the subcritical size of most energy systems which constraints the choice of least-cost solutions; (iii) the absence of organized markets for indigenous fuels, and (iv) the replacement of indigenous fuels by imported petroleum. (World Bank, 1979)

Energy/Environment Planning in the Caribbean

In the past, agencies that have focused their attention on the Caribbean have presented a variety of energy development schemes to Puerto Rico, the Virgin Islands other island territories and the wider Caribbean area. In most cases these were, or are, schemes that address only part of a system we have described as comprehensive, interactive, holistic and dynamic.

For instance, in its reports on the Caribbean, the World Bank recommends elimination of subsidy pricing. (Goodman, 1980) Yet the rural and urban poor in Puerto Rico and the Virgin Islands require subsidies - and lifeline utility rates, in particular. Puerto Rico has been one of the earliest in existence. Puerto Rico has being a pioneer in establishing lifeline electric utility rates. Another example from the past is the commercialization effort which the Department of Energy encouraged for active solar cooling systems. What the islanders had wanted and needed were far simpler and more applicable demonstrations. What they got was Frenchman's Reef Hotel in St. Thomas early high-tech failure. Since then the system has been revamped and is being tested again.

Increasing tourism is a seductive, single-sector basis for a national energy growth strategy. The pitfalls here are developed by Jackson, who states that national planning rarely enjoys the success it seeks. Perhaps the most critical factor limiting desired effects is the lack of enough qualified local professionals to help draft plans, especially those beyond a one-year timeframe and to execute plans once developed.

National planning is otherwise not highly effective because it:

1. Is usually not well integrated
2. Does not always develop distinct objectives
3. Is mostly short term, linked to annual budgets and not having the proper criteria for ordering priorities.
4. Is highly dependent on external technical assistance, aid and external private-sector investment.
5. Is mainly concerned with maximizing benefits to local populations (but frequently does not) and is rarely concerned with minimizing the impacts on ecosystems or natural processes.
6. Lacks the controls to protect critical natural areas and processes and to derive the greatest possible benefits to human populations from local resource use.

(Jackson, 1980)

A less familiar but more comprehensive strategy is energy self-sufficiency or self-reliance, as proposed by participants at the Energy Self-Sufficiency Conference in the Virgin Islands in December, 1978. Painter, summarizing the attitudes at the time, stated the possibility that an agrressive self-sufficiency program and alternate energy strategy which could renew, change or preserye an island lifestyle and even change Virgin Islands society, are very real and very appealing. (Painter, 1978)

In Hawaii, an energy independence strategy has already been implemented. Hawaii's goal is to achieve 50% electrical energy self-sufficiency by 1990 and 50% total energy self-sufficiency, including jet fuel by 2000, (Shupe, et al., 1980) and this with the highest environmental impact and ecodevelopment standards.

One truth that these efforts are discovering is the fact that islands can, in a very constructive way, be viewed as laboratories, as micro-scaled models of the world which illustrate how to solve global problems.

Contributing to the view that island environments are logical locations for the introduction of emerging energy technologies are other factors. Unit energy costs on islands are often substantially higher than on the mainland, so energy alternatives may become cost competitive more readily in this elevated market. Also, the well-defined boundary conditions of an island facilitate rapid evaluation of the impact of new technologies. And finally, many island communities that are heavily frequented by tourists can serve as showcases to give high visibility to the development of renewable energy alternatives. (Shupe, et al., 1980) There is a kernel of truth in such a viewpoint - I'll return to this concept later.

Caribbean Energy/Environmental Planning Efforts

In the last few years, a number of studies of various energy and energy/environment aspects relating to the Caribbean has been done: the World Bank efforts including the Caribbean Energy Survey (World Bank, 1979), the United Nations Environment Programme Caribbean Environment Program Action Plan on Energy and Environment in the Caribbean for UNEP/CEPAL (UNIDO, 1979), the Caribbean Development and Cooperation Committee's study on Energy Resources in the CDCC Member Countries (ECLA, 1980), the DOE/NASA Study on Applications of Solar Technologies for Remote Areas (PRC, 1979), U.S. Dept. of State/AID/CARICOM/CDB Caribbean Regional Paper on Alternative Energy Systems (AID/C/C, 1979), Caribbean Region Solar Cooperation Study for DOE/SERI (Donovan et al., 1970). Specific local studies such as Energy in Puerto Rico's Future by the National Academy of Science (NAS, 1980),"Puerto Rico State Energy Plan", Energy Analysis and Socio-Economic Considerations for P.R. (CEER, 1980), the Virgin Islands Energy Conservation Plan (U.S.V.I.E.O., 1979), Technology Assessment of Alternate Energy Sources in the Virgin Islands (CANOY, 1978), Proceedings of the Conference on Energy Self-Sufficiency and the Virgin Islands (CRI, 1978), Superport, Oil Spills in the V.I. (IRF, 1978) and other studies listed in the references.

An example of a private effort in the Caribbean, the Island Resources Foundation (IRF) in St. Thomas in the U.S.

Virgin Islands has been active throughout the Caribbean in four general project activity areas: (1) Island resources planning, management and ecodevelopment (including energy systems); (2) island ecosystems; (3) education, evaluation and communication; and (4) history, culture and human resources. IRF is a non-profit research and technical assistance organization.

The UNIDO Energy and Environment Study for the Caribbean Environment Project of UNEP/CEPAL is comprehensive in area, covering the six subregions surrounding the wider Caribbean area of which subregion one, the Caribbean islands, is the area on which I will concentrate. This overview on energy and environment was presented as an initial data effort for the formulation of energy/environment strategies in the area. Covering each subregion and county on energy resources, policies, plans, problems, environmental issues, typologies of technologies and their environmental impacts, it is a start toward a comprehensive base but is restricted primarily to considerations of the physical environment.

The relative inadequacies of many of these other specific plans and studies are painfully familiar to those of us who have worked in energy planning in the Caribbean. Indeed, as mentioned earlier, these plans are characteristic of restrictive national planning approaches when a regional approach is needed.

The Association of Caribbean Universities and Research Institutes (UNICA) provides an academic link to such a regional approach for the Caribbean. The Association was formed in 1940 in Jamaica and include the main universities and research institutes in the region including French, Dutch, Spanish and English speaking Islands. The Committee of Science and Technology of the Association has already started a project entitled "Development of Alternative Energy Science and Engineering in the Caribbean". This effort is funded by the U.S. National Science Foundation (NSF) and the UNICA Foundation.

Another study I would like to call to your attention is that of the Pacific Basin Development Council, which states that in anticipation of increased economic activities and population increases the island governments have established policies to encourage the development of an energy conservation ethic. In guaranteeing the economic growth, safety and welfare of the people and to minimize the degradation of the environment, energy supply sources and usages should be diversified. While assessing and demonstrating the viability of the indigenous sources of renewable energy, gas and coal should be studied as transitional fuels, and oil supplies should be secured for the immediate future. (Actouka, et al., 1980). This territory is shopping in the supermarket for technologies it wants; further, it is incorporating an ethic directly into their operating text!

Finally, I would like to examine the U.S./AID/CARICOM/ CDB Regional Project on Alternative Energy Systems for the Caribbean Islands. The rationale behind this study is that alternative energy research and development efforts must be cooperative and regional in nature and must be accompanied by serious efforts in: (1) the development of general as well as alternative energy policy, (2) establishing effective communications networks in energy areas, and (3) developing a skills base through technical, managerial and professional training.

The small Less Developed Countries (LDC) face particular constraints due to their size and limited capabilities which often prevent the development and utilization of least-cost energy supply options. Addressing energy problems and alternative energy development on a regional level allows the achievement of certain economies of scale by directing development efforts toward wider applications.

In few instances have multilateral or bilateral programs sought to involve international cooperation within the region. Nor have energy programs been carried out as part of an integrated alternate energy initiative. (AID/C/C, 1979).

Although this CARICOM/CDB Project is dealing primarily with alternative energy systems, its approach is based on a context, close to the definition which Sachs provided for comprehensive ecodevelopment planning.

I am convinced that the critical long-term transition issue in energy/environment management in the Caribbean Islands is the active development of indigenous energy resources in a holistic environmental context through integrated regional projects such as this CARICOM/CDB Project.

It is interesting to mention that the French-speaking islands are presently considering such an approach and recently invited their English-speaking counterparts to the First Caribbean/European contacts meeting (February 21-24, 1981) at Guadaloupe.

The Omnibus Territorial Act

Focusing now from quite another political viewpoint. i.e. from that of the internal energy policies for the states and territories of the United States concern has grown over the last several years for the economic and social well being of the territories (including the Virgin Islands) and the Commonwealth of Puerto Rico because of their particularly acute problems as island entities. As we have discussed, energy is one of the most critical problems. (Last month, in February 1981, the domestic electric rate in the U.S. Virgin Islands rose to 21¢ and in Puerto Rico to 11¢/KWho.

Accordingly, a bill was introduced in Congress, the Omnibus Territorial Bill HR-8444. This was passed by Congress and signed by President Carter Dec. 5, 1980 and is now The Omnibus Territorial Act.

This Act states that it is the policy of the Federal Government to: (1) develop the renewable energy resources of the Caribbean and Pacific insular areas of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Northern Mariana Islands, the Federated States of Micronesia, the Marshall Islands and Palau; and (2) to assist other insular areas in the Caribbean and Pacific Basin in the development of their renewable energy resources. The Secretary of Energy is directed to prepare a comprehensive energy plan with emphasis on indigenous renewable sources of energy in each of these territories and for Puerto Rico. CEER is the only U.S. Department of energy facility in a Caribbean Island.

The conclusions of the Congress underscore what we have been saying here ... that comprehensive energy development planning is critical to this region for environmental as well as social, economic and political reasons. I think it is clear too that this legislation presents the Caribbean and Pacific islands with an unequalled opportunity to become exemplars of comprehensive renewable energy development.

Prospect for Synergy: Energy development in a regional system framework

It appears that a unique opportunity exists for a great synergistic reenforcement of the UNEP Caribbean Energy Plan, the CARICOM/CDB program and the OTA/PR/VI program from interactions between them.

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

However, we also feel that the key to the long-term solutions can only be found in a comprehensive and active development program interacting between the diversity of human needs and demands of the social equations and the energy technologies and resources available, determining the delicate appropriateness of subtle and variable mixes of many and discrete solutions to particular regional, local and site-specific problems. This will be a continuing active process in a long transition requiring a continuous interchange at each development phase with all the environmental factors and among all the human participants. a broad, multi-sector analysis is the only foundation upon which one can build such a continuing development of energy systems solutions for the future.

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