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THE SOCIO-ECONOMIC AND THE ENVIRONMENTAL IMPACT OF ENERGY FACILITIES AND COSTS IN THE U.S. VIRGIN ISLANDS

Prepared by

TRI-ISLAND ECONOMIC DEVELOPMENT COUNCIL
For the Federal Programs Office,
OFFICE OF THE GOVERNOR, U.S. VIRGIN ISLANDS

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PART I

INTRODUCTION

Without question, there is a strong linkage between the use and production of energy and the economic and social development of a society. The amount of energy alone will not determine qualitative increases in an economy and in a country's style of life. Only recently, scholars have found that in developed countries more is not necessarily going to lead to better. Sweden, for example, has a life style and economic standard comparable to the United States, which consumes the largest portion of energy in the world. However, Sweden uses only seventy-five percent of the energy that the United States does, despite the fact that its economy is reliant upon more energy intensive industries than the U.S. We have come to learn that efficiency in our energy usage and an efficient source of energy are just as critical to our material well-being as the amount of energy at our disposal. This is a significant lesson for both developed and developing countries.

Equally important, though, is that without sufficient energy sources and efficient energy usage economic and social development, on any level, may not occur. Indeed, inadequate energy and other natural resources may be among the most important, though not the only, constraints on a variety of development factors. It should be understood at the outset that 'development' itself does not necessarily mean bigger

(unlimited and uncontrolled) growth, though, we certainly hope that it will help to generate qualitatively better social conditions by insuring a skilled, educated, self-reliant citizenry that is able to control its own environment and resources to produce possibilities for improved life chances. Energy, then, not only can help fuel development, but, it also can insure a high level of control over that development.

The Virgin Islands is a good example of an area in which severe limitations of energy production, inefficient energy management and use, and inadequate potable water resources provide serious constraints on development. Possibilities for development are limited even further because these resource difficulties are associated with problems which include an insufficient and deteriorating infrastructure, a less than generous degree of federal assistance, and an undiversified economy that is reliant upon tourism as its major private sector industry, an industry that provides low wages, low weekly hours, and low security employment. All of these problems are interrelated in fundamental ways. They make the Virgin Islands very vulnerable in the face of world resource problems created by fluctuations in resource price and availability. Given these conditions, investment sources (private and public) are more likely to be driven away than attracted. Certainly the U.S. Virgin Islands cannot be considered to possess community entrepreneurship as defined by economist Albert Shapero.[1] The characteristics of resilience, diversity, creativity and risk

taking, all traits which may make a community's economic base dynamic and self-renewing, are lacking not because they are not possible, but, because the variety of factors mentioned already have constrained their development. Energy, both as a fuel source and a potential vehicle for development, may help to provide the necessary ingredient to such communal entrepreneurship.

By itself, though, work on new energy sources and usage patterns is insufficient. To address only one area is to lessen the likelihood of sustained development of life chances and opportunities for Island residents. Only the efforts of the territorial and federal governments in concert with the private sector can bring about a transformation of any magnitude in the patterns of energy consumption and its production, as well as on the effect this change might have on the ability of Islanders to diversify their economic base. The problems are serious and a half-hearted effort to correct them will result in frustration and in the loss of an opportunity for the self-reliance of the Islands in many areas of social life. It will mean a hard reassessment of U.S. territorial relations, educational and training programs, tax systems, industrial and development incentive plans, resource production and use, and the mechanisms for marketing and distributing energy and water resources.

PART II

THE OBJECTIVES OF THE STUDY

The U.S. Virgin Islands has a very limited geographical area. Therefore, population growth and the need for expansion or development of new energy related facilities has a major impact on the citizens and environment.

This study will focus on a number of areas that affect the economic, social and the environment of the U.S. Virgin Islands. It will provide an overview of the social and economic conditions prevalent in the VI today, the growth of the population, the economy and its dependence on high cost energy. The study analyzes the use of energy resources and its cost on firms conducting business in the islands.

It will also include data and analysis of the responses and recommendations on the present and future use of energy given by representatives from VI Government agencies, island wide organizations and private citizens.

The concluding parts of the study include recommendations on the possible use of alternative energy sources, and the development and management of future energy resources in the U.S. Virgin Islands. Special references are directed toward the recent publication on the subject, the Territorial Energy Assessment, Final Report, Department of Energy, December, 1982 and the recent conference on Energy Planning in the U.S. Insular areas, sponsored by the Congressional Research Service on May 12 and 13, 1983, and

will suggest what roles have been taken and might be played in the development of energy resources and in the development of the Virgin Islands by the Territorial Government, the U.S. Federal Government, and the private sector.

It is our objective that the end result of this study will provide data that can be used in mitigation strategies to solve the energy problems of the United States Virgin Islands.

PART III

THE FUNDING FOR THE STUDY

Funds for this study were provided through the Coastal Zone Management Act of 1972, administered by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Washington, D.C.

The Federal Programs Office, Office of the Governor was instrumental in developing the proposal, obtaining the funds and gave guidance in the specific areas the study should cover. It also provided in kind assistance in preparing financial and performance reports to the U.S. Department of Commerce.

PART IV

METHODOLOGY USED IN STUDY

In conducting the study the following methodology was used:

1. Review of literature - an exhaustive review of published literature available in VI Government agencies, Federal agencies, libraries, organizations, universities

and colleges and private individuals was made. We directed our attention particularly to the plans that have been prepared, the recordings of hearings, meetings and seminars, obtaining the most current data available.

2. Questionnaire Development - We prepared four separate questionnaires. The four questionnaires were for private businesses, Island-wide private organizations, VI Government agencies and for private residences.

3. Selection of the sample - Our effort was directed toward four categories of respondents: businesses, organizations, VI agencies and private residences.

   In the business category we focused our efforts so that we could obtain a cross section of the various types of businesses in the islands. We utilized the lists published by the VI Department of Labor and data in the VI Department of Commerce in selecting our samples. The sample was made on a judgment basis. Considerations were given to island location, availability of key management personnel and the willingness of the respondents to grant interviews.

   Our goal was to complete a questionnaire on ten of the 100 largest business firms in the Virgin Islands based on the number of employees. We were able to complete survey questionnaires on seven of the ten largest as

of the December 31, 1983 reporting date. Business size, when based on the number of employees in the Virgin Islands, changes rapidly due to seasonal demand for labor in a tourist oriented economy. For example, if a particular hotel has heavy guest bookings, the number of employees will be increased or decreased during low booking periods.

4. Field interviews - A personal visit was made to the office of each firm,organization or VI agency included in the sample. The questionnaire was completed after a brief explanatory visit with a key management representative. The questionnaires for the private residences were completed during a personal interview, generally at their place of work.

Table 1 shows a breakdown of the 86 respondents in the sample. The business firms were further subdivided into four categories. Category one includes seven of the ten largest firms in the U.S. Virgin Islands and three other large firms that are not in the ten largest and the College of the Virgin Islands, all with more than 150 employees. We completed a business questionnaire on the College of the VI rather than an agency questionnaire because it was more similar to a business than a VI agency for the purposes of our analysis. It is, however, not listed in the Department of Labor or Commerce as a commercial business. The second category was for business

firms with 35 to 149 employees. This group represents firms that are listed in the 100 largest businesses in the islands but with fewer employees than the ten largest (remaining 90 firms). The third category includes those firms with 11 to 34 employees and the fourth category are firms with 10 or less employees. This group constitutes the largest number of business firms in the islands.

Table 1

Sample Taken For Study

Questionnaire Category	St. Thomas	St. Croix	St.Thomas-St. John	Virgin Islands[1]	Total
	number				
Eleven largest firms[2]	5	2		4	11
Firms with 35-149 employees	6	5			11
Firms with 11-34 employees	3	5			8
Firms with less than 10 employees	6	8			14
Organizations	4		1		5
VI Agencies				7	7
Residences	19	11			30
Total	43	31	1	11	86

[1] Includes all three islands.

[2] A sample of 10 firms and the College of the Virgin Islands with more than 150 employees are included in this category.

The larger number of respondents on St. Thomas reflects the concentration of business. Survey data was not obtained from respondents on St. John because of the very limited business, organization and residential activity on the island. The population of St. John constitutes approximately 2% of the population of the U.S. Virgin Islands. The VI Government agencies of course, represent all three islands.

PART V

A REVIEW OF SOCIAL AND ECONOMIC CONDITIONS, GROWTH OF THE ECONOMY AND ITS DEPENDENCE ON HIGH COST ENERGY

In 1917 the United States purchased the islands of St. Thomas, St. Croix and St. John. They comprise the United States Virgin Islands. The purchase was made from Denmark at a cost of twenty-five million dollars. They are an American territorial possession.[2] Although this territory now has an independently elected Governor (1970) and a unicameral legislature (1954), it is not quite independent nor does it have full federal status within the United States government, having a nonvoting Representative in the U.S. House since 1972. The very nature of its territorial status presents numerous problems for the economic base and development in the Virgin Islands. On a very practical level, because the Islands are a U.S. possession, they really do not qualify for the full range of assistance from a variety of international organizations such as the World Bank or the International Monetary Fund. And because they are a territory, the Islands frequently do not have the capacity to organize enough political support in the mainland in order to insure development activities in the territory. In addition, territorial status can, and has, led to an artificial dependency on the goodwill of the United States. Finally, the Islands are caught in three sets of exogenous marketing and distribution systems which make internal control over development quite difficult.

The Islands depend on each system for some large part of their sustenance. The world market is crucial because it determines the prices of energy resources (oil). The United States market is critical to the Virgin Islands as a place to export manufactured goods (especially watches and rum) and as the supplier of ninety percent of the tourists who visit the territory. In addition, decisions by the U.S. federal government to protect and/or enhance mainland industries (i.e., sugar and watches) will have major ramifications for the islands. The local Caribbean markets are critical because they supply fresh food produce and also may compete directly with key Virgin Islands industries such as rum, tourism, watch assembly, and sugar.[3]

Importing all of its oil needs and approximately ninety-eight percent of its food needs, the Virgin Islands has an open economy in which there is a large inflow and outflow of goods, services, and money. As Edward Miller explains in his report, The Economy of the Virgin Islands, it is a "small economy that consumes a large quantity of imported goods and pays for them through tourism, export earnings and transfers from the Federal Government."[4] Complicating the flow of goods and money are "leakages" of profits generated inside the Islands but that flow to absentee owners of territorial businesses who live outside the Islands.[5] Miller reports that many of the hotels and tourist attractions are owned by nonresidents. The result is that income created by the major private sector industry of the territory flows out of the Islands, lessening the "multiplier effect" of dollars expended which might

increase domestic manufacturing and create jobs if reinvested internally. Thus, the territory cannot control either external pressures, or, to a certain extent, internal enterprise development.[6] These factors make fashioning development plans difficult. Anything from OPEC oil prices to the desire of absentee landlords to invest Island made profits elsewhere may threaten the economic well-being of the territory. It is this fact which should encourage and stimulate the effort to diversify and coordinate economic activities in the Islands.

The 1960s was a period of great expansion in the Virgin Islands. This growth in almost all economic and social areas resulted from several different causes: changes in laws governing the territory; the deterioration and elimination of U.S. trade and relations with Cuba; the dramatic expansion of tourism in the Islands; and, the migration of thousands to the Islands from other less developed Caribbean islands interested in participating in the increased opportunities created by the growing tourism trade.[7] Population grew at a yearly average rate of 8.9% during the 1960s, from 32,099 in 1960 to a total of 75,151 in 1970.[8] Approximately 64% of the 43,052 person population increase was due to migration. By the 1970s, the percentage of non-native Islanders (63.5%) exceeded that of native born Islanders (46.5%).[9] Population density increased greatly in the 1960s as a result of this growth. By 1970 St. Thomas had become the second most densely populated Caribbean island after Barbados, growing from 506 people/square

mile in 1960 to 1,165 people/square mile in 1970. St. Croix also doubled its population density from 187 people/square mile in 1960 to 449 people/square mile in 1970.[10]

Significantly, the large migration increased the percentage of population of work age (25-44) from 22% in 1960 to 30% in 1970, a factor which exacerbated high unemployment during the 1970s.[11] During the 1960s the labor force grew 12.2% annually.[12] Fortunately, employment opportunities expanded by an even larger margin, 12.5% annually, which permitted a very low unemployment rate to persist throughout the decade (3.4% in 1960, 0.9% in 1965, and 1.3% in 1970). During this same period of time, the gross territorial product (GTP) also grew enormously, from $25 M in 1960 to $68.7 M in 1965, and to $242.3 M in 1977.[13]

Perhaps the most important political and economic development for the Islands came in 1954 with the revision of the Organic Act which reorganized the Virgin Islands. In particular, the 1954 legislation, as well as Headnote 3(a) of the U.S. Tariff Schedule had important implications for the development of the economic base of the islands. Significantly, the 1954 Organic Act stated that the U.S. would return the Virgin Islands internal revenue service taxes collected on Island produced goods sold in the U.S. mainland. This was especially important to the small, but significant "light industries" of the territory, including the watch and rum industries. In addition, the 1954 law permitted Virgin Island residents to pay taxes on all income directly to the territorial government to fulfill federal tax obligations even

on monies earned outside the Islands. Equally important, the Organic Act modified U.S. tariff laws by raising the percentage of foreign components an Island produced good could contain (from 20% to 50%) and still qualify as a duty free import. While tariff changes in 1963 extended some trade benefits to other U.S. insular territories, Headnote 3(a) once again increased the percentage of foreign components allowable in a duty free Island produced watch to 70%.[14]

Also stimulating economic activity in 1962 was the agreement made with Harvey Aluminua to construct a plant in the Virgin Islands to process aluminum oxide, the source of aluminum, from bauxite. The territorial government provided a large range of incentives and subsidies to Harvey. Included in the agreement was the allotment of some land, exemption from taxes for a sixteen year period, subsidies amounting to 100% of import duties and 75% income taxes, as well as tax subsidies for stockholders of the company who were residents of the Islands. In return, Harvey would employ a large number of people, 75% of whom had to be residents of the Islands. The Martin Marietta Corporation purchased the Harvey plant in 1970.[15]

A similar arrangement was made with the Hess Oil Company creating the Hess Oil Virgin Islands Corporation (HOVIC) in 1965, also located in St. Croix. Hess received various tax exemptions for a sixteen year period, a subsidy on all income taxes paid by Hess or its resident stockholders, rebates on import duties levied on raw materials and help with land permits and rights of

way. For these advantages Hess agreed to employ 75% of its work force with resident Islanders. Under an arrangement made in 1968, Hess said it would raise that figure to 90% over a five-year period. As Miller points out, though, "the commencement of refinery operations in 1967 coincided with a serious labor shortage and, in spite of its efforts, Hess was unable to meet either the 75% or the 90% test for several years."[16] Instead, Hess hired mostly immigrants for their positions. Today HOVIC is the third largest oil refinery in the world, with a capacity to produce well over 700,000 barrels of oil a day. Both HOVIC and Martin Marietta now contribute a substantial portion of the corporate income taxes on the Islands, and employ approximately 2,600 people, about 6.5% of the labor force. They also constitute the only traditional "heavy" industrial production in the islands.

Signs of this growth emerged quite early in the transformation of the structure of employment in the Virgin Islands during the 1960's. In the 1950s agriculture accounted for 20% of the employment in the territory. By 1960 that figure had dropped to 5.6%. This trend in agricultural activity continued at an accelerated pace, accounting for less than ½ of 1% of the jobs in 1970. This development was followed by enormous increases in the importation of agricultural products from other Caribbean countries. Between 1971 and 1972 alone, agricultural imports from other Caribbean countries increased 134%, from 758,567 lbs. to 1,777,993 lbs. Although importation dropped significantly,

in 1974 and 1975, it increased again the following year by 45.6%, a large rise from the figure only five years before in 1971.[17]

At the same time the tourism, government and manufacturing sectors grew. From 1960 to 1970, there were significant and continual increases in total operating revenues, income taxes, and real property taxes. Even though gross income from exports increased from $8,335,012 in 1960 to $261,983,506 in 1970, imports still exceeded exports ($400,615,068).[18] Construction increased dramatically between 1960 and 1970, as demonstrated by increases in both the number of permits and their values. The sharp decline in the two categories indicated for 1975 in Table 2 indicates that the impact of a recession which occurred in the United States also affected the Virgin Islands. This is true as well for the increase in business licenses authorized from 1960 to 1970, and the slower increase that occurred between 1970 and 1975. Tourism expanded at a fast pace, as indicated by sharp rises in the expenditures by visitors, the increase in the number of air/cruise visitors, and the increase in the number of hotel rooms, which leveled off with economic difficulties in the 1970s.

By 1970, manufacturing-construction and mining, government, and tourism accounted for 88.8% of the work force population. Manufacturing comprised 8.5%. Construction-manufacturing comprised 25.3% of the labor force; government 29.6%; and tourism, the largest sector of the economy up until 1970, 33.9%.[19]

Table 2

Growth in Selected Areas in the U.S. Virgin Islands, 1960-1980

Growth Area	1960	1965	1970	1975	1980
1. Total Imports	$ 42,282,052	$118,675,918	$ 400,615,068	$2,197,510,002	
Total Exports	8,335,012	N.A.	261,983,506	1,933,332,786	
2. Tourism:					
Total expenditures	$ 24,780,000	$ 54,014,852	$ 129,600,000	$ 165,700,000	
No. of air visitors	124,044	354,644	572,876	455,872	525,908
No. of cruise ship visitors	56,000	109,341	255,957	451,403	695,220
No. of hotel rooms	1,397	2,099	3,079	4,552	4,752
3. Construction permits	588	992	1,880	967	
Value of permits	$ 5,190,527	$ 27,177,903	$ 66,534,235	$ 29,207,965	
4. Electricity (mil, KwH)	34.4	90.5	256.0	397.7	448.7
Water (gallons)	115,818,748	247,900,000	1,023,807,313	1,565,006,206	
5. No. of business licenses issued	2,113	3,735	6,956	9,226	
6. School enrollment	9,433	N.A.	23,001	30,876	
7. Government employees:					
V.I. Government	N.A.	N.A.	8,649	11,200	13,440
U.S. Government	N.A.	N.A.	359	500	
8. Unemployment (percent)	N.A.	N.A.	1.3	8.0	6.0

Source: U.S./USVI Growth Statistics 1977 and 1981.

Throughout this period of time, an increasing population made great demands on the infrastructure, resources, and social services of the Islands. Both water consumption and electricity production increased dramatically. Between 1960 and 1970, water consumption rose 784% and electricity increased from 34.4 million kilowatts to 256 million by 1970. School enrollment also increased dramatically from 9,433 in 1960 to 23,001 in 1970. The school enrollment figures continued until 1975, when it begins to level off after 1975.[20]

As a result the growth experienced by the Virgin Islands during the 1960s was unbalanced. The legacy was a less than spectacular performance by the Virgin Islands' economy when recession hit in the 1970s. More than that the inability of the Islands' government to coordinate and manage growth in the 1960s has affected the very nature of the economy and left it unable to support its population. In fact, the very transformation in economic life that brought prosperity in the 1960s contained within them major structural weaknesses that became apparent with the increasing pressures created by continued immigration, serious education problems, and poorly managed public utilities. Unfortunately, the expansion of the economy was not accompanied by a concomitant increase in the planning and resource management capacity. The result was that growth was not transformed into long-term development. In effect, the Virgin Islands were caught in a paradoxical spiral in which growth necessitated even larger growth.

When the recession of the 1970s slowed economic activity in the United States, the Virgin Islands were adversely affected and suffered serious economic difficulties as well. As James Pobicki suggests, inflation as well as U.S. trade concessions made to other Caribbean nations helped to fuel the

recession. As shown in the following consumer index chart, inflation increased by an average annual rate of 8% between 1970 and 1977.

Table 3

Inflation in the Virgin Islands

	Consumer Price Index (CPI)		CPI Annual Change, %	
Year	Virgin Islands	Mainland U.S.	Virgin Islands	Mainland U.S.
1970	100.0	100.0	-	5.9
1971	106.5	104.3	6.5	4.3
1972	118.8	107.7	11.5	3.3
1973	132.2	114.4	11.3	6.2
1974	148.7	127.0	12.5	11.0
1975	160.9	138.6	8.1	9.1
1976	163.0	146.6	1.3	5.8
1977	170.9	156.1	4.8	6.5

Source: "The Economy of the U.S. Virgin Islands", U.S. Department of the Interior, p. 53.

Chart in Territorial Energy Assessment, p. 155.

The decline in economic activity can be seen most dramatically in the unemployment rates during the 1970s. Unemployment, in the 1970s saw a steady rise peaking in 1976 at 10.8%, and then dropping to 7.9% in 1977, and to 6.4% in 1978.

Other important growth indicators fell as well. In a positive sense population began to level off with yearly average increases of 2.5% for the decade. This helped construct the labor force during the 1970s which averaged 1.8%. The cost of living was high during much of the 1970s, though, costs were somewhat moderated in comparison to the U.S. in the late 1970s. According to one survey, food products in the Islands during 1974 were 20% higher than on the mainland. Despite the fact the Territorial cost increases were

less than those in the U.S. during the late 1970s, Miller reports even higher food price differentials in 1978.[21]

Equally significant, Islanders were making only 75% of the average hourly wage of residents of the mainland. Although the Virgin Islands is subject to the same minimum wage laws as the federal states, a "special industrial commission" of the territory has been permitted to allow for lower wages in certain occupations. Miller argues that unskilled workers receive less than the mainland level. Further, "this has the inevitable effect of encouraging immigration of unskilled 'down islanders' and emigration to the mainland of skilled and better educated workers.[22] The end result of the influx of unskilled laborers and outflow of skilled workers discouraged labor intensive development in favor of capital intensive production by investors.

Several other indicators of economic growth experienced sharp declines, or, a slowing of annual increases. Construction, for example, dropped off dramatically, as suggested by the decline in the number of new construction permits from 1,880 in 1970 to 967 in 1975. The value of these permits also fell considerably, from $80,200,000 in 1970 to $28,200,000 in 1975. While the number of hotel rooms did increase by 26.5% between 1970 and 1975 they levelled off during the rest of the decade. There was a similar slow growth in the number of tourist air arrivals, an average figure that was 0.9%. This slow growth was crucial despite the dramatic rise in the number of cruise passenger arrivals throughout the decade, from 255,957 in 1970 to 695,220 in 1981. However,

the critical factor, as William Newbold, Jr. and Edward Rozunski argue in their article, "Tourism in the Virgin Islands: 1980 Status Report," was that the "average overnight visitor spent an estimated $592 during his stay, while the average cruise ship passenger spent $85," or, one-seventh of those staying overnight for more extended periods of time.[23]

Energy consumption also was moderated, despite absolute increases in total consumption between 1974 and 1980. As shown on the table below, fuel consumption increases averaged only 3.2% between 1974 and 1979, until the high jump of 45% between 1980 and 1981. Also oil importation stabilized between 1975 and 1978.

Table 4

FUEL CONSUMPTION FROM 1974-1981, USVI

Fiscal Year	Fuel Consumption (x 1000 bbls)
1974	1,102
1975	1,114
1976	1,076
1977	1,112
1978	1,095
1979	1,274
1980	1,273
July 1980-Feb. 1981	1,847

Source: Water and Power Plan, April, 1981, p. 12.

From this overview we begin to see fundamental weaknesses in the employment structure of the 1970s which resulted from changes in the 1960s. Business enterprises that did expand created low skilled and low paying jobs that would attract immigrant workers. These jobs did not provide for the learning of a better and more complex range of skills to allow for greater self-reliance.

These points are echoed in the Economic Development Policy Guidelines, published in 1979. The report indicated that private employment opportunities, especially in comparison to governmental jobs, were not attractive options for Virgin Islanders because they offered low wages, low fringe benefits, and often were transient, seasonal, or cyclical in nature. Despite the efforts of some training programs, such as the one instituted at Martin Marietta, those who were able to complete highly advanced training and educational programs often left the territory. As the Guidelines state:

> The alternative employment opportunities in the private sector have had severe shortcomings in terms of choosing a career goal and becoming a reliable long-term employee. The transience of many businesses, plus the low wage structure and lack of fringe benefits has made it a rather tenuous choice for long term residents. The construction industry has been subjected to wide cyclical fluctuations, uncertainty and a doubtful future. Tourist enterprises seem to present little by way of a career ladder. One of the few rays of sunshine appears to be the professions ranging from accounting through law. The large industries led by the efforts of Martin Marietta are beginning to provide training programs with some future. In summary, the opportunities in the private sector are broadening slowly.[24]

Only if those opportunities increase will the Islands be able to develop its entrepreneurial talents. Otherwise, there are limited opportunities that could lead to achieving economic diversity, risk taking and creativity. Instead of building self-reliance these limited private sector opportunities inhibit those traits. Interferring with the development process all along have been

difficulties with the educational system, impacted by the large wave of immigration to the Islands. Both Miller and the Economic Development Policy Guidelines stress that employers have complained constantly of workers who lack basic verbal and math skills. In particular, the Policy Guidelines report noted that attrition in school was very high, perhaps as much as 50% at times. Large numbers of students who entered one grade never got to the next highest academic level. Of those who did make it to the next level, many do not continue to the following one.[25] It is for this reason that the Policy Guidelines report defined "human resource development" not as vocational training but as an educational process that may produce the traits that can help build entrepreneurial capabilities.

James Pobicki points out that the greatest number of new jobs created in the 1970s (95.3%) occurred in the public sector.[26] Although private sector employment in the late 1970s rebounded from the sharp recession of the middle 1970s, increasing at 10.9%, the large number of jobs lost in the construction industry helped to offset some of these gains.[27] While total employment grew at only 1.3% throughout the decade, public sector employment expanded at a higher rate (4.1%). With 13,440 employees in 1980, the public sector comprised the largest portion of total employment (over one-third). In sharp contrast to many other work opportunities, governmental jobs paid well, offered better fringe benefits and greater employment security. Moreover, governmental employment is able to withstand the market pressures of a recession

that adversely affected most of the jobs. Consequently government became an attractive place to seek employment, particularly for the educated and trained. The next largest segment of employment is tourism as shown in Table 5. Today, tourism accounts for nearly 50% of all private sector employment.

Table 5

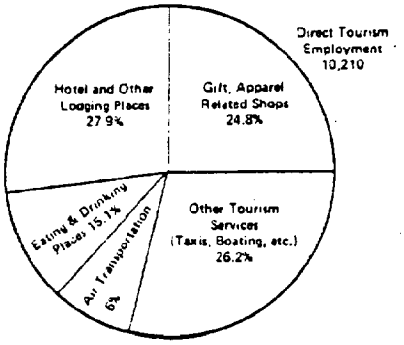
U.S. Virgin Islands Employment by Industry

Industry	No.	%
Tourism	10,210	25.7
Manufacturing	3,240	8.1
Construction	3,160	8.0
Local Trade	3,670	9.2
Local Services	3,130	7.9
Local Trans. & Utilities	1,400	3.5
Fin. Ins., R.E.	1,520	3.8
Total Private	26,330	66.2
Government	13,440	33.8
Total Employment	39,770	100.00

Source: James Pobicki, U.S. Virgin Islands Economy - A Review of the 1970s and Outlook for the 1980s, Annual Economic Review, 1980, p. 17.

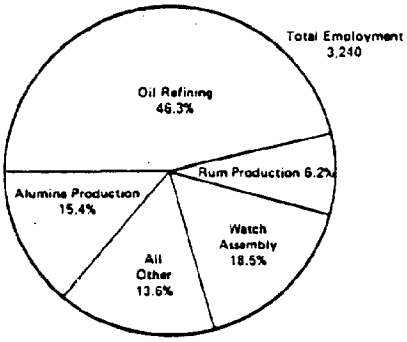
The following two figures, from James Pobicki, provide a breakdown for the tourism industry and the manufacturing sector.

Figure 1: Direct Tourism Employment (1980)



Source: V.I. Bureau of Labor Statistics, Office of Policy, Planning and Research, V.I. Department of Commerce

Figure 2: Distribution of Manufacturing Employment (1980)



Source: Office of Policy, Planning and Research, V.I. Department of Commerce.

The annual average gross income for the Islands in 1981 was $12,639.[26] Pobicki indicates that the annual average salary for hotel employees in 1980 was $7,455, while that for employees in eating and drinking establishments was $6,065. For construction workers the average salary was $13,908, while for transportation-utility workers the average was $12,380.[27] It should be noted that these averages differ somewhat from those gross annual average salaries provided in table 6 of the Virgin Islands Labor Market Review for 1982, which also was produced by the Department of Labor, Bureau of Labor Statistics, Virgin Islands.[28]

Regardless of which range of figures are used, however, they point to a similar conclusion: tourism, government and manufacturing dominate Virgin Islands employment, with the first two being increasingly important in the late 1970s. Regardless of whose numbers are used, Pobicki's or the 1982 Labor Market Review, it appears that hotel and other tourist related salaries are among the lowest. This is highly significant because of the large number of people employed in this occupation group. Approximately one-quarter (27.9%, according to Pobicki) of all tourism employees work in hotels and other lodging places. It is highly likely that those employed in restaurants and other eating places, accounting for 15.1% of the tourism work force, receive similar wages. Thus, approximately 43% of all private sector employees receive lower hourly wages and work fewer hours and are among the lowest paid in the Islands.

Table 6

AVERAGE ANNUAL PAY AND PERCENT CHANGE 1977-1982

INDUSTRY DIVISION	ANNUAL AVERAGE PAY 1977	1978	1979	1980	1981	PERCENT CHANGE 1977 to 1978	1978 to 1979	1979 to 1980	1980 to 1981	1977 to 1981
Total Virgin Islands	$ 8,581	$ 9,018	$10,127	$11,285	$12,639	5.1	12.3	11.4	12.0	47.3
Private Sector:	8,925	9,093	9,931	11,082	12,331	1.9	9.2	11.6	11.3	38.2
Agriculture, Forestry, and Fishing	6,321	5,324	5,622	6,399	7,299	-15.8	5.6	13.8	14.1	15.5
Construction and Mining	10,403	9,936	11,968	14,150	15,476	- 4.5	20.4	18.2	9.4	48.8
Manufacturing	12,774	14,383	15,895	17,445	20,711	12.6	10.5	9.8	18.7	62.1
Transportation and Public Utilities	9,990	10,745	11,286	12,175	13,300	7.6	5.0	7.9	9.2	33.1
Wholesale Trade	9,017	9, 916	10,525	11,235	12,188	10.0	6.1	6.7	8.5	35.2
Retail Trade	6,672	7,066	7,613	8,516	9,205	5.9	7.7	11.9	8.1	38.0
Finance, Insurance, and Real Estate	9,033	9,262	10,084	11,216	12,284	2.5	8.9	11.2	9.5	36.0
Services	6,800	7,238	7,761	8,763	9,496	7.8	5.9	12.9	8.4	39.6
Public Sector:	8,498	8,907	10,453	11,634	13,173	4.8	17.4	11.3	13.2	55.0
Federal Government	16,183	16,581	17,820	19,836	22,112	2.5	7.5	11.3	11.5	36.6
Territorial Government	8,148	8,537	10,074	11,222	12,749	4.8	18.0	11.4	13.6	56.5

SOURCE: 1982 Labor Market Review - V.I. Bureau of Labor Statistics, Department of Labor.

TABLE 7

Component Parts of the Economy

Component	1970	1975	1980	1981
		Percentage		
Manufacturing	8.5	9.2	8.5	8.2
Construction/Mining	16.8	13.5	9.3	9.6
Transportation/Utilities	6.4	5.3	5.5	5.5
Retail/Wholesale Trade	18.2	19.0	20.0	20.2
Finance, insurance, real estate	4.6	4.0	4.2	4.4
Hotels/Other	9.2	6.2	8.1	7.3
Other Services	6.6	7.3	8.2	8.3
Government (Federal)	1.2	1.5	1.7	1.7
Government (Territorial)	28.4	33.9	34.3	34.8

Source: U.S.V.I. Growth Statistics, 1981, Office of Policy, Planning and Research

Note : Figures carried to third decimal and rounded.

Based on our review of the literature we conclude that growth in the Virgin Islands proceeded in an uncoordinated, haphazard and unsystematic manner. As a result the Virgin Islands have a poorly maintained and deteriorating infrastructure, an unstable and dependent economy, and inefficient public utilities that are symptomatic of such growth patterns. These points are repeated emphatically throughout Miller's report on The Economy of the Virgin Islands (1979), the Economic Development and Policy Guidelines (1979), the Water and Power Plan, Office of Energy, U.S. Virgin Islands (1981), and the Territorial Energy Assessment, Final Report, U.S. Department of Energy (1982).

There have been serious consequences resulting from these problems including inadequate electric production, insufficient

water supply, health care, and education. Private industry is not likely to respond favorably with capital investments in any region that suffers from such difficulties. The Economic Development Policy Guidelines (EDPG) argues that the territory has been hurt by its lack of a capital budget process, and by the inability of territorial officials to hold to the deadlines and procedures of the budget process. A capital budget process would not only insure monies for the construction of infrastructure facilities, but, for their maintenance as well. In general, the EDPG suggests this problem "reflects the lack of coordination between the executive and legislative branches."[29]

Moreover, inexactitude and inefficiency in the implementation and supervision of programs also have caused problems. For example, the EDPG noted the following deficiencies in territorial capital infrastructure projects: a) no accurate records were kept of actual costs; b) federal monies were spent for several different projects without an accounting of the total expended on each project; c) budgetary restrictions frequently forbade the implementation of projects for which the legislature had appropriated money; and d) prevailing economic conditions in the Islands made it impossible to provide 25% funding for projects in order to receive a 75% match from the federal government.[30] This points out not only the problem in efficiency, but the necessity for a diversified and resilient economy that can provide the government with sufficient revenues to leverage other funds from public and private sources. Significantly, it suggests the paradox of the

Virgin Islands' position: it needs federal and private funds to increase its ability to plan, implement, and maintain capital projects, but, it cannot acquire those funds because its social and economic infrastructure cannot support its economy and social system.

Lack of coordination occurs not only at the territorial level. One issue that arose several times during the recent Conference on Energy Planning in the U.S. Insular Areas (May, 1983), was the want of direction and specified responsibility from a particular federal government department. The Virgin Islands, not unlike other U.S. insular territories has not had a clear sense of which federal department is responsible for their area. Depending upon the particular issue, different departments seem to have often overlapping jurisdiction including the Departments of Commerce, Interior, Energy, and Housing and Urban Development. This has been confusing to the territorial government and has made planning a very difficult task.

Another area cited by the EDPG is land use. Haphazard planning at one point has led to the growth of industries and businesses which separated from one another, instead of clustered together in industrial parks. Through FY 1982, the Department of Commerce has provided the Virgin Islands with only 23 grants out of a total of 28,045, the lowest number any U.S. state or insular territory.[31]

Miller has argued that tax incentives have been very important in the recruitment of businesses to the Islands. However, the

incentive plan he outlines may have helped to account for the leakages in profits that he and others mention. In 1975, by an act of the legislature of the Virgin Islands, the Industrial Development Commission was created. It was designed to provide benefits to applicants who provided a $50,000 investment, had Virgin Island and U.S. citizenship, and would employ at least 10 Virgin Islands residents. In return, the business would receive the following benefits: exemption from taxes on real property used in business; exemption from taxes on gross receipts for business operations; exemption from taxes on building materials and plant equipment; and, a return of 90% of custom duties and other taxes on raw materials. Extension could be granted, and the applicant, if successful, could have a large say in determining the specific benefits for his business.[32] It is not at all clear that such provisions have provided any greater control for Virgin Islanders over their own economy.

Symbolic of the diversity of difficulties in business operations, management, adequate infrastructure, and energy conservation is the immense problems of the only public utility in the Virgin Islands, the Water and Power Authority (WAPA). Two figures summarize WAPA's performance: WAPA runs its electric power operations at 20% efficiency; the electric rates are approximately 16.5¢ per kilowatt/hour which is the highest in the United States mainland or its territories. According to a recent report by the Edison Electric Institute, the average cost of a kilowatt hour for U.S. residences in 1982 was 6.41¢. The Water and Power Plan (1981)

attributes the electric problem to poor maintenance, which do not reflect their cost. The situation for the water system essentially is the same. Potable water is produced at great cost through desalinization. Perhaps three quotations from the Water and Power Plan and the most recently completed Territorial Energy Assessment, Final Report (December, 1982) will serve as representations of how the literature portrays WAPA. The Water and Power Plan asserted:

> Although installed capacity of our utility are more than three times the actual demand, energy demands for the next one or two years will not be satisfactorily met unless rapid changes are made. Basically, it is a problem of repairing those system components which are not operating up to specifications and then, to provide proper maintenance techniques that will insure that the whole system performs as intended.[35]

This analysis is repeated in the Territorial Energy Assessment which reports:

> Although more than sufficient standby capacity is physically available at the plant site, these units are often in a state of disrepair and not available to permit a systematic program for removing major units from service for extended periods... Units are often run to the point of failure or fatigue and removed from service only in crisis situations. Having a mixture of diesel, steam, and gas generation results in the need for excessive inventory, different operating and maintenance procedures and operator training methods.[36]

Similar statements have been made about the capacity of WAPA to produce and deliver potable water. The Water and Power Plan reports that water distribution has not been well planned, well sealed, nor well managed. There have been frequent shortages and the need for increased supplies is constant.

Although HOVIC and Martin Marietta use 90% of all total energy production in the territory, they do not draw heavily on the Islands' resources because they have self-sustaining power systems. Even though the Islands have the third largest oil refinery in the world in HOVIC, the overwhelming majority of petroleum products processed there are exported directly to the United States mainland. Despite the presence of HOVIC, Islanders pay almost $1.60 for a gallon of gasoline.[37]

As shown in Table 8, 65% of all energy resources is used to produce electricity. The other 35% is accounted for by direct consumption of petroleum products.

There is very little use of alternative or renewable resources, so almost all power for commercial, residential, and social service uses is supplied by WAPA, which uses diesel, steam, and gas driven generation units. Two major electric grids exist for the territory, one for St. Thomas and St. John, and one for St. Croix. St. John is connected to St. Thomas' grid by an underwater cable, although it has a backup generation unit of its own (that provides 1.5 Mw). Because of its distance from St. Thomas, St. Croix cannot be connected to the St. Thomas and St. John power grid. Tables 9 and 10 show the power capacities designed and in operation for these two grids. Perhaps most significant is that design capacity does not equal either current operable capacity, or, the amount of

Table 8

Consumption Total
(In Gals. Except kWh for Electricity)

Energy Source	1978 Amt ($x10^{o}$)	1978 Btu ($x10^{12}$)	1978 %	1979 Amt ($x10^{o}$)	1979 Btu ($x10^{12}$)	1979 %	1980 Amt ($x10^{5}$)	1980 Btu ($x10^{12}$)	1980 %
Diesel Fuel	100	13.8	20	141	17.6	24	17.3	21.6	28
Gasoline	25.4	3.3	4.8	25.6	3.3	4.5	25.9	3.4	4.4
Propane Gas	3.22	0.3	0.4	3.59	0.3	0.4	4.0	0.37	0.5
Jet Fuel	13.0	1.7	2.5	14.2	1.9	2.6	11.1	1.4	1.8
Aviation Gas	2.40	0.3	0.4	2.38	0.3	0.4	2.2	0.3	0.4
Electricity[a]	539	49	72	445	49.6	68	443	49.4	65
Total	-	68.4	100	-	73	100	-	76.5	100

Conversion Factors: Diesel - 125,000 Btu/Gal., Gasoline - 130,000 Btu/Gal., Propane - 92,000 Btu/Gal., Jet Fuel - 130,000 Btu/Gal., Aviation Gas - 130,500 Btu/Gal., Electricity - 11,150 Btu/kWh.

[a]Does not include figures from Hess Oil and Martin Marietta who generate their own electricity.

electricity which actually is available on a daily basis. For the St. Thomas-St. John power grid, there is a design capacity of 115.5 Mw. As of April 1, 1981, the "current capacity" of these plants was 94.7 Megawatts. However, the Territorial Energy Assessment and the Water and Power Plan report that only 74 Mw is available on a day to day basis.[38] This works out for St. Thomas and St. John because their average peak demand is only 42 Mw.

The situation in St. Croix is more tenuous. The total design capacity of their generating units is 67 Mw. However, only 54.5 Mws are in current capacity, and, only 33 or 34 Mws actually are available for day to day use.[39] Peak demand is 32 Mw. Any "small loss often result in power rotation or complete outages." Indeed, the Virgin Islands have a fairly high "loss of load production" (LOLP), and there are two to three day rotating power outages experienced throughout the year in the Islands. St. Thomas-St. John has an average LOLP of 5.29 days per year, while St. Croix averages 6.96 days per year. This is a considerable figure when compared with the U.S. mainland whose average LOLP is 0.1 days per year.[40]

Table 9

St. Thomas-St. John Electric Grid

Generating Unit	Year Installed	Design Capacity (MW)	Current Capacity**
No. 7 - Diesel*	1966	2.0	1.7
No. 9 - Diesel	1960	3.0	-
No. 10 - Steam	1966	7.5	6.5
No. 11 - Steam	1968	18.0	14.0
No. 12 - Gas	1970	15.0	13.0
No. 13 - Steam	1974	3.0	26.0
No. 14 - Gas	1971	15.0	12.5
No. 15 - Gas	1981	20.0	21.0

*Standby only.

**As of April 1, 1981.

Table 10

St. Croix Electric Grid

Generating Unit	Year Installed	Design Capacity (MW)	Current* Capacity
No. 6 - Diesel*	1969	4.5	4.0
No. 7 - Diesel	1962	2.2	-
No. 10 - Steam	1967	7.5	7.5
No. 11 - Steam	1970	18.0	18.0
No. 12 - Diesel	1968	4.5	4.0
No. 13 - Gas	1971	15.0	-
No. 14 - Gas	1972	15.0	-
No. 16 - Gas	1981	2.0	21.0

*As of April 1, 1982.

Source: Territorial Energy Assessment, p. 71.

As suggested by the quotations above about WAPA, the literature suggests interruptions in a continuous supply of electricity are caused by inadequate maintenance, unskilled technicians, lack of parts, inefficient management, electric rates which do not cover WAPA costs - despite the fact that they are

so high, and the low thermal efficiency of the generation processes used. These problems are exacerbated (and, in part, result from) the fact the Islands are dependent upon outside sources for oil, replacement parts, technological improvements, and for training. Thus, it has become impossible for the Virgin Islands to gain any large degree of control over the critical area of energy. Significantly, these dependencies will be reproduced in the future if inappropriate forms of renewable resources are employed in the territory, a crucial point we shall discuss later. These problems account for the high kilowat hour electric rate in the Islands.

These energy related difficulties are all the more alarming because they are occurring in Islands that require very little intensive energy per capita, for there are only "light" industries in the territory with the exception of those heavy industries that are energy self-sufficient. There are no space heating needs in the Virgin Islands, and very few of the native residents have air conditioning units, factors which account for a significant portion of electricity use in other areas. Of the 65% of energy that is electricity, 42% is consumed by industry, 40% by residences, and 15% by the tourism industry. According to the Territorial Energy Assessment, 35% of residential end use of electricity is for heating hot water. 2% went for refrigeration, while 19% was used for cooking, "with lighting and appliance use accounting for the remaining percentage."[41] End use in the tourist industry went primarily for air-conditioning, refrigeration, heating water, lighting, appliance use and for other purposes. In addition, approximately 37% of the energy used by tourism went for liquid propane gas (for "water heating, cooking, laundry"), and for diesel and fuel oil (for water heating, steam generation - also for hot water heating, central air conditioning, emergency backup generators, emergency lighting and elevators).[42]

Transportation accounted for only 5% of energy consumption in the form of gasoline for cars, airplanes, boats, taxis, buses, public service vehicles, and freight transport vehicles. Agriculture, lumber, and fishing accounted for a marginal amount of energy consumption. The Virgin Islands which imports 98% of its finished goods, has small, light industries which do not consume much energy. The food industry, primarily the manufacture of rum, however, uses its share of energy. The watch industry, accounting for fifteen of the seventeen "instruments and related" industries businesses identified by the Territorial Energy Assessment, used electricity for "motor driven devices, air conditioning, and lighting." The only industry which really seemed to have a direct impact on energy use was construction. Not only was electricity and petroleum required for plant and motor operations, but, many of the materials demanded by the industry needed energy (petroleum) in their production.[43]

The flow of water resources also is a crucial problem in the Islands. The Virgin Islands receives about forty inches of rain per year. Because of its small land mass, diffuse population, and hilly terrain, the territory is unable to collect and store rainwater sufficient for its population. As the Water and Power Plan states:

> Rapid run-offs resulting from a hilly terrain, and evaporation due to the tradewinds and year-round temperatures of 80°F, make only about 10% of the total rainfall available for utilization by approximately 100,000 residents through roof catchments and storage in cisterns.[44]

Instead, the territory must rely on the desalination of sea water and importations of fresh water from Puerto Rico for its potable water supplies. However, WAPA loses approximately 50% of this water, in the distribution processes through pipes and trucking. Significantly, the desalination process

used in the Islands are themselves heavily energy intensive, and require power to generate potable water. At times, this fact will reduce even further the thermal efficiency of converting one form of energy (oil or diesel fuel) into power for work (steam to drive motors). Like their rates for electricity, WAPA does charge rates for water which include capital and distribution costs.[45]

The utility, the territorial government, the federal government, and the forces of the private market all seem to have interacted together, implicitly and sometimes explicitly reinforcing one another, to permit these problems to develop. The Economic Development Policy Guidelines state:

> There is a serious lack of overall coordination in the local approach to providing the necessary services a modern society needs in order to function properly. Over the past six years there have been many infrastructure improvements, but also many areas where the facilities have not kept pace with ever increasing demands. Agencies have been faced with the curtailment of federal funds, local budgetary problems, adjustment of government priorities in spending, a declining economy, and a lack of coordination in both multi-faceted projects and complementary facilities. The entire process has been further handicapped by lack of a sense of direction in the absence of any overall economic development plan, long-range goals or guidelines.[46]

Long-term energy planning is a difficult and complex task. It requires the analysis of a great number of factors which include:

1) economic constraints (the market for energy, how will it be distributed, who will produce energy, and what incentives for production will be provided by federal and territorial governments);
2) a detailed end-use needs assessment (how much energy will be used, by whom, and for what purposes);
3) an analysis of capital resources, present and future;
4) assessment of land and water use;
5) the environmental impact of different sources of energy;

6) the role the private sector might play in production and distribution, and the role of public intervention;

7) assessment of a skilled labor force to operate and maintain generation facilities;

8) the patterns of organization of production;

9) how the population will be educated in energy use and conservation;

10) a detailed assessment of the institutional capacities of government planning agencies, particularly if the market alone is insufficient in eliciting necessary production and equitable distribution.

The manner in which the analyses of some of these issues are interpreted may lead, and often has, to the politicization of critical energy questions. What kind of power to produce, for whom, and for what purposes may pit one group's vision of society against another's. Indeed, the very methodology used in such energy evaluation also has political and ideological content that must be identified. The way future energy demand studies are conducted, the very questions about energy use that are asked, will convey a particular understanding of the world. Some questions will preclude the possibilities of choice, both in energy production and use, while others may enlarge that choice. The end result is that it is very difficult to undertake any evaluation of energy usage.

Although the Territorial Energy Assessment is considered to be a good beginning to a complete energy evaluation, it left many, including governmental officials in the Virgin Islands, unsatisfied because it neglected an analysis of many of the factors listed above. In his statement at the Conference on Energy Planning in the U.S. Insular Areas in May, 1983, John Abramson, Jr., Energy Director of the U.S. Virgin Islands, indicated his

dismay that the report did not provide more detail about "how, when and to what extent" alternative energy sources will be developed in the territory. The energy assessment did not include specific resource forecasts for the year 2020 as it was supposed to have included, and did not propose implementation of its recommendations. Abramson stated:

> It is the general consensus that the report outlines a number of positive alternatives for the Virgin Islands. However, the short time frame allowed for the development of the report and the small amount of financial assistance that was made available, has taken away from the thoroughness and feasibility. All of the energy alternatives mentioned in the report are very applicable to the territory, but the report does not address how, when, and to what extent energy will be developed. The Territorial Energy Assessment Report is a good starting point... The document should include an implementation strategy. The strategy should be geared toward guiding insular government to implement the technologies outlined...[47]

This concern was repeated by representatives at the Conference from other insular territories.

The Territorial Energy Assessment does provide two growth scenarios for employment and energy demand from 1980 to 2020, but, these are not very detailed. They present gross calculations of possible increases in population and employment without the detailed end-use energy assessment. Energy demand was calculated based on the figures for employment growth. The TEA provides the following two scenarios for employment growth from 1980 to 2020:[48]

> 1 - High Growth: the report argues that in a high growth scenario, the economy would expand at a rate twice as fast as it did in the 1970s (2.6%). Thus, the total forecast of jobs for each decade would be: 39,770 - 1980; 51,000 - 1990; 65,280 - 2000; 83,5370 - 2010; and, 107,000 - 2020.
>
> 2 - Low Growth: Essentially, the report estimated increases in employment based on the slow growth figure of 1.3% for the 1970s. Using that percentage, the expanded employment force would be: 39,770 - 1980; 47,100 - 1990; 55,700 - 2000; 67,590 - 2010; and 78,000 - 2020.

James Pobicki predicts that the increases in employment in the high growth scenario from 1980 to 1990 will occur in tourism, manufacturing, construction, local trade, and local service. There will be below average growth in employment in government and in transportation and utilities.[49]

The Territorial Energy Assessment uses these growth figures to help calculate future energy demand. The report states: "The energy demand will be affected by several critical factors, some of which are changes in the economic structure, the availability of different fuels at different prices, and the extent of the improvement in the efficiency of energy use devices.[50] There are several indications that the authors of the report were aware of the many different factors that are essential for any energy demand forecast. For example, the high growth scenario for future energy demand indicates:

> The economy is expected to become more energy intensive as above average growth occurs in manufacturing and construction sectors. Second, the trends in energy conservation as observable in most of the developed countries worldwide are assumed to continue. Some of the improvement in energy efficiency are envisioned in higher mileage from automobiles, higher energy efficiency in household appliances, and improved industrial equipment... In summary, the growth in energy intensive industries will be compensated for by the improved utilization of primary energy resources throughout the economy.[51]

Despite the recognition of these factors, the report still uses the basic calculation of employment growth to determine energy. The report estimated that with high growth energy demands would increase by 2.5% per year. Demand would go from 75.6 trillion Btu's in 1980 to 125.3 trillion in 2000 and to 205.4 trillion Btu's in 2020.[52] Using a 1.3% yearly increase for the low growth scenario, the report estimates that energy demand would rise from 76.5 trillion Btu's in 1980 to 128.2 trillion in 2020.[53]

Their assessment is very problematic. Even though it seems to be cognizant of some crucial variables that have changed load forecasting in

the last decade, these are not included in the analysis. Essentially, the report offers a "top-down" forecast, which is based primarily on large macroeconomic factors. Top-down estimates frequently rely on gross aggregate estimates which do not provide a breakdown of how much energy different sectors will need, how that need might be met, and how changes in that society will affect consumption.

More recently, energy experts have found that a "bottom up" or "end-use" analysis is much more effective in trying to estimate potential energy needs in the future. As James Bridger Robinson argues, there were several factors that forced people to understand why top-down forecasting was no longer effective and why bottom-up analysis was necessary. He observes:

> These changes include rapid depletion of low cost energy supplies accompanied by increasing real prices; significant changes, primarily for the worse, in present and expected future economic conditions; the emergence of OPEC in the world oil market; increased vulnerability to anticipated supply interruptions; growing awareness of the increasingly serious environmental impacts of energy development; the emergence of energy as a significant political issue in international affairs; a growing recognition of the large potential for energy conservation; the development of a substantial public and scholarly debate over alternative energy supply and demand futures.[53]

As a result of its inability to account for these changes in consumption patterns and technological advancement, top-down forecasting has been shown to be a poor predictor of energy needs.

Unlike the top-down approach, the bottom-up method disaggregates all the different sectors of society and examines how much energy each one needs, uses now, and has used in the past.

It is based on the fact that energy is not valued for itself, but, for the work it can provide the user. Significantly, it makes energy policy more flexible because it becomes easier to adjust analysis according to structural changes that might occur in any of the specific component of the economy. Moreover, it provides greater flexibility in the determination of which possible energy source might be used to meet end-use demand by sector and makes it possible to judge when public intervention is needed.[54]

All of these factors have made energy demand analysis a complex procedure. Utility companies even in the United States have had major problems incorporating these factors into forecasts. Without question, the Virgin Islands may be unable to conduct such analyses without federal support in the form of financial and expert assistance. It is this type of evaluation, though, that the Territorial Energy Assessment must lead to.

PART VI

ANALYSIS OF THE BUSINESS FIRMS INCLUDED IN THE STUDY

Although there was substantial data available on energy needs and energy problems, the data had been taken primarily from reports of hearings or meetings and not from primary data obtained directly from firms and individuals. It was for this reason we felt it necessary to conduct field interviews. We interviewed senior staff members of 44 firms as our sample. The firms were divided into four categories. Eleven firms with more than 150 employees, 11 firms with 35 to 149 employees, eight firms with 11 to 34 employees

and fourteen firms with 10 or less employees. Table 11 gives a composite of the firms categorized by size. We interviewed 31 owners or renters of private residences. That data is discussed elsewhere in the study. We also interviewed a management official of WAPA.

The business firms represent the major activities that comprise the island economy. Except for the heavy manufacturing and refining, the business activities are generally supportive of the major industry, tourism.

Business firms with more than 150 employees.

Interviews with senior representatives of these were conducted, those selected by the company as the most knowledgeable about energy selection, use and costs. The positions held by those interviewed, the number of years they have conducted business in the Virgin Islands, the reasons for selecting the Virgin Islands and the number of employees as of the date of the interview are shown in Table 12. The average number of years these firms have operated their businesses in the U.S.V.I. was 19. The oldest firm in the sample, a bank, began operations nearly fifty years ago and the most recent firm began operations seven years ago.

The reason given for selecting the U.S.V.I. were the views given by the interviewee and in some instance, may not represent the true reason for the firm's location in the islands. The

original purpose for locating in the islands and the present may have changed. For example one firm located because of the sugar cane for fuel. Sugar cane is no longer grown in the islands.

The total number of employees of these eleven firms of 4,197 represent 11 percent of the total U.S.V.I. work force.

Electricity is the most frequently used energy resource and comprises 79 percent of the dollar cost for conducting business. Diesel and propane gas are the next most used fuel. All energy costs are a major annual operating cost. The average firm spends $456,444 annually. The data shown in Table 13 generally represents one business location. Firms in this category represent hotels, manufacturing, education, and retail sales. However, some firms provide goods or services for more than one location or on more than one island.

In our interviews we asked representatives of these large firms if energy needs and costs were a factor in selecting the U.S. Virgin Islands as a business location. Only one of the eleven firms indicated that it was a factor considered but there wasn't anything they could do other than use the energy resources readily available. In other words they felt that their energy requirements were a necessity and any possible alternatives were not cost effective. The most frequent answer to the question, "What was the reason for selecting the energy they use," was "no alternative".

Most of the large firms have been operating their business for a long period of time, an average of 19 years, so the energy resource selected occurred before the energy crisis and subsequent

Table 11

SUMMARY OF BUSINESS FIRMS IN STUDY BY TYPE
OF BUSINESS, NUMBER OF EMPLOYEES AND LOCATION

Type of Business	No. of Firms	No. of Employees	Island Location: St. Thomas	St. Croix	All Three Islands
			---------Eleven Largest Firms----------		
Banking	2	520			2
Communication	1	500			1
Construction	1	660		1	
Education	1	522	1		
Hotels	2	750	2		
Manufacturing	1	560		1	
Retail Sales	2	485	2		
Services	1	200			1
Subtotal	11	4,197	5	2	4
			------Firms with 35 to 149 employees---		
Education (Private Sch.)	1	43	1		
Hotels	2	120	1	1	
Manufacturing	3	188		3	
Retail Sales	3	38	3		
Shipping and Trading	1	90			1
Transportation	1	76			1
Subtotal	11	555	5	4	2
			----Firms with 11 to 34 employees-----		
Banking	1	21	1		
Construction	1	11		1	
Insurance	2	30		2	
Manufacturing/Construction	2	25	2		
Retail Sales	1	20		1	
Services	1	18		1	
Subtotal	8	125	3	5	
			----Firms with 10 or less employees----		
Apartments	1	4		1	
Communications	1	6		1	
Farm Production	1	3		1	
Hotel	1	14		1	
Manufacturing	2	12	1	1	
Retail Sales	3	16	3		
Services	5	21	2	3	
Subtotal	14	76	6	8	
Total	44	4,953	19	19	6

Table 12

CHARACTERISTICS OF ELEVEN LARGEST FIRMS
IN SAMPLE, THOSE WITH MORE THAN 150 EMPLOYEES

Type of Business	Position of Person Interviewed	No. of Years in USVI	Reason for Selecting USVI	No. of Employees
1. Construction & Maintenance	Gen. Mgr.	7	To service another co.	660
2. Hotel	Chief Engr.	10	Tourism	600
3. Manufacturing	Engineer	19	Tax benefits	560
4. Education	Engineer	21	Legislation	522
5. Communication	Vice Pres.	24	Economic opportunity	500
6. Retail Grocery	Gen. Mgr.	10	Market demand	300
7. Banking	V.P. Comptroller	49	Purchased bank	270
8. Banking	Finance Mgr.	30	Purchased another co.	250
9. Security Services	Exec. V.P.	18	Climate and environment	200
10. Retail Jewelry Store	Comptroller	20	Unknown	185
11. Hotel	Gen. Mgr.	5	Unknown	150
Total		-		4,197
Ave.		19		382

Table 13

CHARACTERISTICS OF ENERGY USE,
ELEVEN LARGEST FIRMS IN STUDY

Type of Business	Annual Cost of Energy	Energy Costs As Percent of Operating Costs	Percent of Energy Used								
			Electricity	Diesel	Gas	Solar	Coal	Bunker Oil	Fuel Oil	Gasoline	Jet Fuel
Construction & Maintenance	200,000	5.0	45	10	45						
Hotel	2,000,000	20.0		99		1					
Manufacturing	N/A	20.0		1			67	32			
Education	500,000	16.0	95	1	1	2					
Communications	881,000	3.0	84	1	14						
Retail Grocery	50,000	10.0	95	5							
Banking	225,000	2.0	99	1							
Hotel	N/A	N/A	70	15	15						
Banking	240,000	5.5	98	2							
Security Services	40,000	6.0	32	2						66	
Retail Jewelry Store	72,000	5.0	95	4	1						
Ave.	456,444	92.5	79	13	15	1.5	67	32		66	

price spiral in 1973-1974 and the latter price increase in 1977-1978. A substantial number of the firms did consider the use of alternative energy beyond that supplied by the VI Water and Power Authority (WAPA). But the general conclusion reached from their research was that the capital cost of generating equipment and operating cost would be prohibitive except for diesel generators for back-up purposes when the public power source is interrupted. Two of the eleven firms, however, generate their own electricity. One is a large hotel and the other is a heavy industrial manufacturer. The large size of these two firms and the heavy use of energy permits the cost effectiveness of company generated electricity.

During our interviews we asked the respondents what knowledge they had of USVI energy policies, the Energy Conservation Plan or the Territorial Energy Assessment Report. No doubt information developed from meetings, seminars and reports have been made available to business firms, however, the representatives interviewed demonstrate little knowledge of their existence.

The Virgin Islands Energy Conservation Plan was made available to the public by the V.I. Energy Office in 1977. The study's main intent was to promote "efficient energy use". Although limited in scope, it provided insights into energy use by major consumers in the Virgin Islands. Given that accurate data concerning energy consumption by major energy consumers like Hess Oil and Martin Marietta was hard to obtain, the value of the study was lessened. However, some of the information was very useful. Mitigation

factors and data on environmental residuals was of value to serve as a point of departure for an inquiry into energy uses and needs of the Hess Oil and Martin Marietta companies.

The introduction of the study discussed the nature of the natural environment peculiar to the Virgin Islands, economic factors and mitigation factors.

The study noted the "absence of reliable information from the major consumers and suppliers of energy in the Virgin Islands". The study discussed energy consumption and projections of future use. The goal was to save energy by five percent for each sector of energy consumers in oil refining, aluminum production and through power supplied by WAPA.

Program measures were to promote thermal efficiency in buildings under construction and renovation, lighting efficiency, transportation, and efficient procurement practices. Expenditure figures were provided along with projections into the 1980s. It also provided current water and power capacity and demand figures for St. Thomas and St. Croix.

We found that the respondents demonstrated very little knowledge of the government of the Islands' efforts in energy policies or conservation. When asked about the assistance the VI Government had given them in the selection, use or conservation of energy, three of the eleven company representatives stated they had been assisted. Figure 3 gives a brief narrative description of their replies to our questions discussed in the above paragraphs.

Figure 3: Characteristics of Firms, Selection of Types of energy and interviewee's knowledge of USVI's Energy Plans, Policies and Assessment Report, Eleven Largest Firms in Study

Type of Business	Were Energy Needs a Factor in Selecting USVI	Reason for Selecting Energy Used	Other Alternatives Considered	Types of Asst. Received from VI Govt.	Interviewees Knowledge of: VI Energy Policy	VI Energy Conservation Plan	Territorial Energy Assessment Reports
Construction & Maintenance	No	Convenience and cost	Diesel		None	None	None
Hotel	Yes	Neccesity, no alternative	Use diesel and solar	Fuel consumption data	None	None	None
Manufacturing	No	Bunker oil cheapest	Bunker oil and coal	None			
Education	No	No alternative	Diesel but too costly	Energy audit	None	None	None
Communications	No	No alternative	Diesel generator	None	None	None	None
Retail Grocery	No	Convenience	None	None	None	None	None
Banking	No	No alternative	Diesel generator	None	None	None	None
Hotel	No	Lowest cost	Diesel generator	None	None	None	None
Banking	No	Purchased bank	None	None	None	None	None
Security Services	No	No alternative	None	None	Yes	None	None
Retail Jewelry Store	No	Convenience back-up	None	Energy audit	None	None	Yes

Power interruptions and its economic and personal impact on the businesses and family households is most difficult to measure. Some firms and families keep accurate records while most can only recall from memory the number of outages and the possible damages caused by the outages. Two of the eleven largest firms in the study generate all of their energy and one operated a backup generator that was used for office equipment and lights. One of the two firms used WAPA as a back-up energy source while the other firm relied entirely on its own generation. The other firm, a hotel, that relies on WAPA as a back-up source also utilizes solar energy for power, approximately 1%.

The number of interruptions (outages or a severe decrease in voltage) varies by WAPA feeder lines. The feeder line near the WAPA generating facility experiences the most reliable service. That feeder line also supplies the power used in the actual operation of the WAPA facility. The outages ranged from none, the manufacturing plant with their own generating plant, to eight per month for the retail grocery chain store. Outages cause equipment damage, loss of production or sales, security problems for guests or customers. Hotel representatives expressed frustration that they have with unhappy guests during outages, particularly during hot weather or during evening dinner or entertainment periods. A number of those interviewed indicated that reduced or excessive voltage causes the greatest equipment damage. Some firms have installed protective equipment that automatically cuts power off until it stabilizes. Firms with back-up generators have equipment

that automatically activates their system. One banking firm included in the eleven largest firms has installed elaborate equipment at a cost of $275,000 to provide back-up generation so that computers and other essential equipment can remain in operation.

The cost of energy ranges from a low of 2% of annual operating costs to a high of 20% depending on the type of business. Hotels, manufacturers and educational facilities are heavy users of energy. The average energy cost of 9 percent adds that amount of the cost of goods or services sold. Ten of the eleven largest firms provided data on the annual cost of electricity and fuel.

The total cost of damaged equipment or the cost of salaries and wages for employees to be on hand to shut down, switch equipment or otherwise protect equipment is difficult to determine. For example, some companies may need to send employees home when outages occur. Others may need to pay overtime to meet a deadline of production or to provide a service. The loss of business creates a substantial but unmeasurable loss, customers will not enter an unlighted retail store to shop when the lights or air conditioning are inoperable. The cost of damaged equipment when stated as a percent of annual operating costs was less than for companies with fewer than 150 employees. Table 14 summarizes the number and time elapse of electric power interruptions and the economic impact it creates on business.

Table 14

ENERGY INTERRUPTIONS AND ITS IMPACT,
ELEVEN LARGEST FIRMS IN STUDY

Type of Business	Average Number of Energy Int. per mo.	Elapsed Time of Outage (Min)	Economic Impact: Damaged Equipment (dollars per yr)	Spoiled Food (yr)	Time Lost (yr)	Other (yr)	Impact of Energy Costs on Pricing (increase)
Construction & Maintenance	4 1/	30	0	0	0	3/	5.0
Hotel	1 2/	5	0	0	0	0	20.0
Manufacturing	0 2/	0	0	0	0	0	20.0
Education	3	60	25,000	0	0	5,000 4/	16.0
Communications	2	30			1%	0	3.0
Retail Grocery	8	60	N/A	0	0	3/	10.0
Banking	5	25	0	0	0	275,000	2.0
Hotel	2	60	8,000	0	unhappy guests	3/	N/A
Banking	1	60	6,500	0	$10,000	59,000 4/	5.9
Security Services	4	60	0	0	$25,000	42,600 4/	3.5
Retail Jewelry Store	1	45	0	0	0	65,000 4/	5.0
Ave.	3	40	-	-	-	-	9.0

1/ power generated for lights and office equipment

2/ all power generated by firms

3/ cost of protective equipment, but cost not known

4/ cost of back-up generator.

Business firms surveyed with 35 to 149 employees

This category of businesses surveyed included firms with 35 to 149 employees. In our interviews with the representatives of these firms we followed the same methodology as with the eleven large firms. In all cases the interview was conducted with a senior employee, officer or owner of the company. Data on the type of business, the period of time the company has conducted business in the USVI and the reasons for locating in the USVI was documented. The same format as that followed with the large firms for collecting data on the types of energy used, the percentage of each type of energy used, the annual cost of energy and the cost of damaged equipment resulting from electricity outages. Tables 15 through 17 reflect the data collected. Figure 4 summarizes the characteristics of firms in regard to energy selection, the assistance they received from the USVI and their knowledge of the USVI energy policies and programs. There are 11 firms in this category.

Firms in these categories have been established in the Virgin Islands an average of 21 years, approximately the same as the eleven largest firms, 19 years. There is a drastic difference, however, in the average number of employees per firm, 70 in contrast to 418 for the large firms.

Business firms surveyed with 11 to 34 employees and firms with 10 or less employees

We interviewed eight company representatives in the 11 to 34 employee group and fourteen in the group with less than 10 employees.

Table 15

CHARACTERISTICS OF FIRMS WITH 35 to 149 EMPLOYEES

Type of Business	Position of Person Interviewed	No. of Years in USVI	Reason for Selecting USVI	No. of Employees
1. Retail Dept. Store	Operations Manager	20	Viable market	104
2. Shipping and Trading	Comptroller	71	On island before U.S.	90
3. Manufacturing	Gen. Mgr.	8	Tax incentive	90
4. Hotel	Gen. Mgr.	7	Market, tax incentive	83
5. Commuter Airline	Comptroller	4	Needed service	76
6. Retail Convenience Stores	Gen. Mgr.	7	Acquired local firm	75
7. Retail Dept. Store	Associate Manager	11	Unknown	70
8. Distilling	President	50	Sugar cane, labor	63
9. Private School	Headmaster	34	Founded by local resident	43
10. Soft Drink Bottler	Manager	11	Viable market	35
11. Hotel	Manager	5	Resident	37
Average		21		70

Table 16

CHARACTERISTICS OF ENERGY USE,
FIRMS WITH 35 to 149 EMPLOYEES

Type of Business	Annual Cost of Energy	Energy Costs As Percent of Operating Costs	Percent of Energy Used								
			Electricity	Diesel	Gas	Solar	Coal	Bunker Oil	Fuel Oil	Gasoline	Jet Fuel
Hotel	$138,000	10.5	87		13						
Private School	31,000	3.0	100								
Soft Drink Bottler	32,400	16.0	40	10	40					10	
Retail Dept. Store	100,000	12.0	100								
Retail Dept. Store	192,000	2.5	98		2						
Shipping and Trading	100,000	7.5	90	5	5						
Hotel	360,000	14.0	84	6	10						
Retail Convenience Store	240,000	4.0	99	1							
Commuter Airline	734,400		2								98
Manufacturing	22,800	5.0	99	1							
Distilling	750,000	25.0	16	1					80		
Total	$2,700,600	-	-	-	-				-	-	-
Ave.	$ 245,509	9.0									

Table 17

ENERGY INTERRUPTIONS AND ITS IMPACT,
FIRMS WITH 35 to 149 EMPLOYEES

Type of Business	Average Number of Energy Int. per mo.	Elapsed Time of Outage (min)	Economic Impact: Damaged Equipment (dollars per yr)	Spoiled Food ($/yr.)	Time Lost (yr)	Other (yr)	Impact of Energy Costs on Pricing (Percent increase)
Retail Dept. Store	2.0	60	0	0	$35,000	20,000 2/	12.0
Shipping and Trading	1.5	60	0	0	0	65,000 2/	3.0
Manufacturing	2.0	150	0	0	0	5/	5.0
Hotel	1.0	60	20,000	0	0	2/	14.0
Commuter Airline	1.0	78	0	0	$1,000	4/	30.0
Retail Convenience Stores	10.0	90	20,000	2,500	0	3/	4.0
Retail Dept. Store	1.5	45	8,000	0	0	3/	2.5
Distilling	2.5	270	15,000	0	0	5/	7.6
Private School	3.0	45	11,000	500	0	0	3.0
Soft Drink Bottler	4.5	60	114,000	13,500	$4,000	28,000 2/	16.0
Hotel	5.0	180	1,500	0	650 1/	0	10.0
Ave.	3.1	100	28,500 6/	5,666 6/	-	-	10.1

1/ man hours per year.

2/ cost of standby generator, where blank, cost is not known.

3/ loss of customers, dollar amount not known.

4/ when electricity is off airline cannot pump fuel.

5/ major effect on quality of product, dollar amount not known.

6/ for those reporting.

Figure 4: Characteristics of Firms, Selection of Types of Energy and Interviewee's Knowledge of USVI's Energy Plans, Policies and Assessment Report, Firms With 35 to 149 Employees

Type of Business	Were Energy Needs a Factor in Selecting USVI	Reason for Selecting Energy Used	Other Alternatives Considered	Types of Asst. Received from VI Govt.	Interviewees Knowledge of: VI Energy Policy	VI Energy Conservation Plan	Territorial Energy Assessment Reports
Hotel	Yes	Available & convenient	Solar	None	None	None	None
Private School	No	No alternatives	Diesel	Temperature Settings	Yes	None	Yes
Soft Drink Bottler	No	Appropriate	None	None	None	None	None
Retail Dept. Store	Yes	No alternative	Diesel	None	None	None	None
Shipping & Trading	No	Convenience & costs	Diesel	None	None	None	Yes
Hotel	No	Convenience & costs	Solar	None	None	None	None
Retail Convenience Stores	No	No alternative	Diesel	Energy audit	None	None	None
Commuter Airline	Yes	Fuel available	None	None	None	None	None
Manufacturing	No	Fits needs	None	None	None	None	None
Distilling	Yes	Essential to industry	Yes	None	None	None	None

The same survey questionnaire and interview was used. Firms in the 11 to 34 group have operated businesses in the USVI for an average of 27 years in contrast to those with 10 or less employees that average 10 years. No doubt the reason for this is the relative instability of small family operated businesses.

It is significant that a substantial number of the smaller firms were established by residents that have lived in the Virgin Islands for a number of years. The longevity of the larger firms (11 to 34 employees) is three times that of the small firms, 16 years as compared to 5 years. There is little difference in the data obtained from St. Thomas firms when compared to St. Croix firms. See tables 18 and 19 for the two groups of firms.

The eight firms with a range of employees, 11-34 had energy costs for the most recent years of $162,960, an average of $23,280 per firm. All firms used electricity but three of the eight used only electricity for their energy supply. Sixty four percent of the energy costs were for electricity. Four firms also used diesel and four firms used propane gas for energy generation. One company paid 41 percent of its energy costs for gasoline purchases (trucks). Tables 20 and 21 summarizes the data for these two groups of firms.

The 14 smaller firms as a group with 10 or less employees had annual energy costs of $130,016 averaging $10,001 per firm. See Table 21. Six of the smaller firms used only electricity, two used diesel and six used propane gas. Seventy-eight percent of the cost of energy was for electricity, a higher percentage than the 64% electricity cost the firms with 11 to 34 employees. Total energy

Table 18

CHARACTERISTICS OF FIRMS IN SAMPLE WITH
11 to 34 EMPLOYEES

Type of Business	Position of Person Interviewed	No. of Years in USVI	Reason for Selecting USVI	Number of Employees	Island
1. Insurance	President	12	Economic need	17	St. Thomas
2. Manufacturing	President	63	Six generation family business	14	St. Thomas
3. Banking	Manager	17	To service refinery	21	St. Thomas
4. Insurance	President	44	Resident	13	St. Croix
5. Retail Jewelry	President	10	Climate & environment	20	St. Croix
6. Well Drilling	Supervisor	45	Resident	18	St. Croix
7. Bakery	Manager	12	Retired to USVI	15	St. Croix
8. Construction	V.P.	14	Business opportunity	11	St. Croix
Total		217		129	
Ave.		27		16	

Table 19

CHARACTERISTICS OF FIRMS IN SAMPLE WITH
10 OR LESS EMPLOYEES

Type of Business	Position of Person Interviewed	No. of Years in USVI	Reason for Selecting USVI	Number of Employees	Island
Paper Products	Manager	10	Resident	5	St. Thomas
Gift Shop	Owner	15	Resident	6	St. Thomas
Water Delivery	Owner	15	Climate	6	St. Thomas
Cabinet Maker	Owner	15	Resident	2	St. Thomas
Retail Sales	Secretary	8	Business oppor.	5	St. Thomas
Printing	Owner	2	Resident	2	St. Thomas
Manufacturing	Sec.-Treas.	5	Tax incentive	10	St. Croix
Medical Services	Owner	17	Needed service	4	St. Croix
Egg production	Owner	10	Business need	3	St. Croix
Apartments	Asst. Mgr.	9	Resident	4	St. Croix
Cleaning Service	Owner	11	Resident	4	St. Croix
Radio Station	Manager	7	Resident	6	St. Croix
Medical Service	Adm. Dir.	7	Federal Grant	7	St. Croix
Hotel and apartments	Manager	12	Viable business	10	St. Croix
Total		143		74	
Ave.		10		5	

Table 20

CHARACTERISTICS OF ENERGY USE, FIRMS WITH 11 TO 34 EMPLOYEES

Type of Business	Annual Cost of Energy($)	Energy Costs As Percent of Operating Costs	Percent of Energy Used								
			Electricity	Diesel	Gas	Solar	Coal	Bunker Oil	Fuel Oil	Gasoline	Jet Fuel
Insurance	9,000	1	100								
Manufacturing	25,000	25	100								
Banking	30,000	5	95		5						
Insurance	9,600	5	100								
Retail Jewelry	N/A[1/]	N/A[1/]	99		1						
Well Drilling	51,000	13	40	35	25						
Bakery	32,400	5	34	33	33						
Construction	4,960	4	44	15						41	
Total	162,960	58	512	83	64					41	
Ave.	23,280	8	64	28	16					41	

[1/] Not available or owner did not provide data.

Table 21

CHARACTERISTICS OF ENERGY USE, FIRMS WITH 10 OR LESS EMPLOYEES

Type of Business	Annual Cost of Energy($)	Energy Costs As Percent of Operating Costs	Percent of Energy Used								
			Electricity	Diesel	Gas	Solar	Coal	Bunker Oil	Fuel Oil	Gasoline	Jet Fuel
Paper Products	6,000	3	100								
Gift Shop	8,400	5	100								
Water Delivery	12,000	N/A	100								
Cabinet Maker	N/A	N/A	98	2							
Retail Sales	4,800	5	100								
Printing	1,920	N/A	100								
Manufacturing	12,500	9	60		40						
Medical Service	12,000	10	99	1							
Egg Production	6,000	6	50		50						
Apartments	15,456	6	7		93						
Cleaning Service	3,840	2	6		94						
Radio Station	12,000	10	95		5						
Medical Services	2,100	1	100								
Hotel/Apartments	31,000	10	77		23						
Total	130,016	67	1,092	3	305						
Ave.	10,001	6	78	2	50						

Figure 5: Characteristics of Firms, Selection of Types of Energy and Interviewee's Knowledge of USVI's Energy Plans, Policies and Assessment Report, Firms With 11 to 34 Employees

Type of Business	Were Energy Needs a Factor in Selecting USVI	Other Alternatives Considered	Types of Asst. Received from VI Govt.	Interviewees Knowledge of: VI Energy Policy	VI Energy Conservation Plan	Territorial Energy Assessment Reports
Insurance	No	Yes[1/]	None	Yes	None	None
Manufacturing	No	Diesel, solar	None	None	None	None
Banking	No	None	Energy audit	None	None	None
Insurance	No	None	None	None	None	None
Retail Jewelry	No	None	None	None	None	None
Well Drilling	No	Diesel, wind	None	None	None	None
Bakery	No	Propane	None	None	None	None
Construction	No	None	None	None	None	Yes

[1/] Various alternatives considered but proved to be too costly.

Figure 6: Characteristics of Firms, Selection of Types of Energy and Interviewee's Knowledge of USVI's Energy Plans, Policies and Assessment Report, Firms with 10 or Less Employees

Type of Business	Were Energy Needs a Factor in Selecting USVI	Other Alternatives Considered	Types of Asst. Received from VI Govt.	Interviewees Knowledge of: VI Energy Policy	VI Energy Conservation Plan	Territorial Energy Assessment Reports
Paper Products	No	None	None	None	None	None
Gift Shop	No	None	None	None	None	None
Water Delivery	No	Diesel, gas	None	None	None	None
Cabinet Maker	No	None	None	Yes	None	None
Retail Sales	No	None	None	None	None	None
Printing	No	None	None	None	None	None
Manufacturing	No	Solar and diesel	None	None	Yes	None
Medical Services	No	None	Energy audit	None	None	Yes
Egg Production	No	None	None	None	None	None
Apartments	No	None	None	None	None	None
Cleaning Services	No	None	None	None	None	None
Radio Station	No	None	None	Yes	None	Yes
Medical Services	No	None	None	None	None	None
Hotel & apartments	No	None	None	None	Yes	None

costs as a percent of annual operating costs average eight percent for the 11 to 34 group firms and six percent for those with 10 or less employees. Figures 5 and 6 summarize the characteristics of firms in the selection of energy, the assistance received from the USVI and their knowledge of the USVI energy policies and programs. The annual cost of equipment damage from low voltage, surges or outages was about the same for the two groups of firms, $26,200 for the eight larger firms and $23,803 for the 14 smaller firms. Two of the eight firms reported equipment damage, four of the smaller 14 firms.

The average number of energy interruptions per month and the average elapsed time of the outages was almost identical for each group. Please note the comparisons in Tables 22 and 23.

Evaluation of USVI Energy Policies

We asked each company representative to evaluate the existing energy policies of the Virgin Islands Government. The narrative answers were condensed and are shown in Table 24. Eighteen of the respondents did not want to comment or were not knowledgeable enough on the subject to make a comment. Although very difficult to analyze or predict with certainty, some inferred that they did not know of any VI energy policy. Eight stated that the VI Government did not have a policy to evaluate.

Representatives of the larger firms were more knowledgeable and aggressive in their evaluation of the energy policies of the USVI. While only 4 of the 14 representatives of companies with

Table 22

ENERGY INTERRUPTIONS AND ITS IMPACT,
FIRMS WITH 11 TO 34 EMPLOYEES

	Energy Interruption Impact				Energy Interup. Per Mo.	Average Elapsed Time (Min)	Impact of Energy Costs on Pricing (increase) (percent)
	Damaged Equipment	Spoiled Food	Time Lost	Other			
Insurance	0	0	0	1/	3	15	0
Manufacturing	$25,000	0	$35,000	$1,500	7	3	3/
Banking	0	0	0	2/	2	120	5
Insurance	0	0	0	Comfort	2	60	0
Retail Jewelry	0	0	0	2/	N/A	N/A	2/
Well Drilling	1,200	0	250 4/	0	2	150	3/
Bakery	0	0	624 4/	42,000 2/	4	60	5/
Construction	0	0	200 4/	0	2	90	N/A
Total	$26,200	0	-		22	498	
Ave.	$13,100				3	71	

1/ Cost of surge protectors, cost not known.

2/ Cost of back-up equipment

3/ Amount of increase equals amount of damaged equipment, cost of back-up equipment and extra labor cost in "time lost" column.

4/ Man hours lost per year.

Table 23

ENERGY INTERRUPTIONS AND ITS IMPACT,
FIRMS WITH 10 OR LESS EMPLOYEES

	Energy Interruption Impact				Energy Interup. Per Mo.	Average Elapsed Time (Min)	Impact of Energy Costs on Pricing (increase) (percent)
	Damaged Equipment	Spoiled Food	Time Lost	Other			
Paper Products	0	0	0	1/			3
Gift Shop	2/	0	0	3/	1	60	5
Water Delivery	4/	0	N/A	5/	1	35	N/A
Cabinet Maker	6/	0	0	0	N/A	N/A	N/A
Retail Sales	0	0	N/A	Safety of customers	1	90	5
Printing	0	0	N/A	Ruined print	1	60	N/A
Manufacturing	0	0	50 (hrs/yr)	Overtime	16	15	9
Medical Services	517 (hrs/yr)	0	$4,800	0	1	90	10
Egg Production	0	0	$2,100	0	1	150	6
Apartments	$4,500	0	0	Inconvenience	1	35	6
Cleaning Services	0	0	416 (hrs/yr)	0	2	90	2
Radio Station	$14,286	0	200 (")	0	1	120	10
Medical Services	0	0	576 (")	0	1	90	1
Hotel & apartments	$ 4,500	0	40 (")	0	5	90	10
Total	-	-	-	-	32	905	67
Ave.	-	-	-	-	2.4	69	6.0

1/lost use of warehouse; 2/ 2 compressors, value not given; 3/ customers leave; 4/ damaged pumps, value not given; 5/ can't pump or deliver water; 6/ damaged saw, compressor, value not given.

10 or less employees had comments on energy policies, twenty two of the 30 representatives of firms with 11 or more employees gave their evaluation.

Table 24

EVALUATION OF USVI ENERGY POLICIES BY REPRESENTATIVES OF BUSINESS FIRMS IN THE STUDY

Comment	Business firms by employee category			
	Under 10	11-34	35-149	150 & over
	number			
No comment on policy	10	5	2	1
No policy to evaluate		1	4	3
Energy supply unreliable or too expensive			2	3
Miscellaneous	4	2	3	4
Total	14	8	11	11

The first reaction of many of those interviewed appeared to be one of frustration and helplessness. The theme of their reactions reflected their feeling that the VI Government did not know of or did not understand the economic and social impact of power outages, decreased voltage or surges on the operations of their businesses. Although each interviewee was given assurances that all responses would be kept confidential, 18 of the 44 interviewed did not wish to express an opinion or comment. Eight did not feel that the VI Government had a definite energy policy that they could evaluate.

In the miscellaneous category the comments were wide ranging and covered all aspects of power generation, distribution and use.

Examples of comments:

-WAPA should be sold to private enterprise
-WAPA should not have sold the St. Croix plant
-WAPA and VI Government deal only with crisis
-No direction by VI Government on energy policies
-Lack of understanding by VI Government of problems
-Electricity is expensive and unreliable
-Lack of proper energy legislation
-VI Government does not want suggestions
-Assistance given by VI Government not thorough

PART VIII

ANALYSIS OF DATA OBTAINED FROM VIRGIN ISLANDS AGENCY REPRESENTATIVES

In order to obtain as much input as possible, we interviewed senior managerial representatives of seven Virgin Islands government agencies. Interviews were successfully conducted with 7 agencies. The agency, position of representative interviewed and the representative's understanding of the agency's responsibility for energy policies is shown in figure 7. We were not successful in our efforts to obtain interviews with the commissioners or their representatives in the Departments of Health or Education.

Figure 7: Interviews With VI Government Agencies

Agency	Position of Person Interviewed	Agency's Responsibility for Energy Policies[1/]
1. Dept. of Labor	Asst. Comm.	Cabinet functions, train other agency employees on energy use.
2. Dept. of Conservation and Cultural Affairs	Dir., Adm.	None
3. Department of Commerce	Staff Members	Task force members, provide data
4. Office of Energy	Director	Established policy
5. Public Safety	Deputy Comm.	None
6. Department of Housing	Asst. Comm.	Housing Codes
7. Office of Planning	Director	Energy plans for zoning

[1/] As expressed by person interviewed.

In our interviews we asked each agency to respond to what we considered eleven significant questions. The questions were (1) your agency's responsibility as it relates to energy, (2) assistance the agency gives to VI Government relating to energy plans, policies or laws, (3) the agency's coordination of energy policies with other VI Government agencies, (4) assistance the agency has received or is receiving from other VI Government agencies, (5) the assistance the agency gives to other VI agencies, (6) the agency representative's evaluation of the VI and U.S. Government's policies on energy, (7) the number of energy interruptions per month, (8) the impact of energy interruptions, (9) the elapsed time of energy interruptions, (10) the impact of energy costs on the operation of the agency, and (11) the agency representative's recommendations for a solution to the Virgin Islands' energy needs and problems.

Agencies other than the office of Energy or the Office of Planning have very little knowledge of the energy policies of the VI Government. The Office of Energy, with a major responsibility for energy, has the most active role. It has assisted in or prepared most of the energy plans, including the territorial assessment plan. While the office provides assistance and generally is not the recipient of assistance it appears that the VI Legislature has provided limited support and assistance to that office. Two of the agencies indicated that they did not receive, give or coordinate assistance relating to energy. The Department of Housing stated that they receive assistance from the Office

of Energy on new construction and the Department of Conservation and Cultural Affairs received advice on the use of tinted glass as a means of energy conservation in buildings. One agency indicated they had received an energy audit from the Office of Energy. Five of seven of the agencies do not provide any assistance to other VI agencies.

In their evaluation of VI energy policies one agency representative stated that the local government did not have an energy policy, direction or effort. Another stated that more basic research is needed in the use of solar energy. Two agency representatives said that they were not knowledgeable enough to evaluate the VI Energy Policy. One agency representative felt that the VI Legislature supported an energy policy, another felt that the legislature was anti-energy conservation.

The Director of the Office of Energy has received substantial support from Federal agencies such as the U.S. Department of Housing, Health and Human Services and Agriculture. The Energy Office Director feels that he has a good working relationship with the College of the Virgin Islands and the local Community Action Agency.

Energy interruptions and their impact do not affect agencies to the extent that businesses are disrupted. There is an average of 1.5 outages per month and the average elapsed time is about 55 minutes. Some agencies shut down offices when electricity is off because of the loss of the use of equipment such as computers, calculators and typewriters. Office shutdowns means lost labor (time) that must be made up at a later date. Two agencies reported

damaged equipment from energy interruptions. The Department of public safety is vitally affected because of the loss of security that lights, telephones and burglar alarms provide businesses and citizens. Police equipment must respond to alarms caused by electricity interruptions that pulls patrols away from priority police work.

Agency representatives were candid and offered constructive suggestions on possible solutions to the USVI's energy problems. The Director, Office of Energy thinks that the local and Federal Governments should use the islands as a showcase in the use of alternative energy, that the VI Government should properly finance WAPA and provide it with proper technical assistance in electric generation. Another agency suggested that the VI Government should establish an energy policy that would give the Office of Energy Credibility and support of the Legislature. One recommended that WAPA be sold to private enterprise while another felt that a WAPA type approach is the only viable means of providing energy and the local government must make it work efficiently.

PART IX

Interviews With Virgin Islands Organizations On Energy Use, Needs and Policies

We interviewed the heads of five organizations to obtain their views on energy use, needs and policies. The names of the organizations and the positions of the people we interviewed are shown in Figure 8.

Figure 8: Interviews With Organization Representatives

Name of Organization	Position of Person Interviewed
1. St. Thomas-St. Johns Chamber of Commerce	Executive Director
2. Virgin Islands Charter Yacht League[1/]	Executive Director
3. Virgin Islands Retailers Assoc.	Executive Director
4. Virgin Islands Hotel Assoc.	Executive Director
5. Virgin Islands Taxi Assoc.	President

[1/] Survey form was completed by Director and returned. All others were personal interviews.

The interviews included questions on their organizations' role in establishing energy policies, studies, coordination with VI and federal agencies, the assistance they give and receive from VI agencies, the impact of energy costs on their members and their evaluation of the VI energy policies and their recommendations for future energy policies.

Two of the organizations stated they performed a role in establishing energy policies. One organization identifies, supports and publicizes ways for commercial users to reduce energy costs. That organization also lobbies the legislature in support of energy policies. The other organization lobbies the legislature on energy issues. The same two organizations coordinated their work with VI agencies. Three organizations indicated that they did not have a role in establishing energy policies nor did they coordinate or receive assistance from the VI Government. Three of the five organizations gave assistance to the VI Government by distributing

energy conservation information, providing energy cost estimates, conducting seminars and participating on various committees that have a responsibility for energy policies.

Organizations' Evaluation of VI Energy Policies

One of the leading organizations that has an active role in energy issues takes the position that the VI Government presently has adequate policies but they do not implement them. The assistance they give according to that organization is too late and ineffective. Two of the organizations stated there was not any policy to evaluate. One organization representative stated that VI agencies lack a devotion to energy needs or policies and the fifth organization commented that the VI government agencies did not provide any assistance to their organization members.

Organizations' Recommendations on Energy Needs and Future Policies

Each of the five organizations made recommendations to the VI Government on energy needs and future policies. They are:

1. Provide effective management and responsibility with flexibility in key positions.
2. Accountability
3. Motivate the public on energy issues.
4. Re-evaluate WAPA and provide better management. Too many high salaried employees.
5. Sell WAPA and replace equipment.
6. More federal funding for WAPA.
7. Provide hotel owners with assistance on energy conservation.

PART X

ANALYSIS OF ENERGY USE AND COSTS FOR FAMILY RESIDENCES

In order to extend our questionnaire sample to all major segments of the Virgin Islands socio-economic groups, we interviewed 31 home owners or renters. Our sample included 20 residents of St. Thomas and 11 on St. Croix. Most respondents were homeowners, 12 on St. Thomas and 8 on St. Croix. There were 11 renters, 8 on St. Thomas and 3 on St. Croix. See Table 25 for a summary of data collected from 31 residents.

The rooms per homes were about the same on both islands, 6.3 rooms on St. Thomas and 6.0 on St. Croix. Electricity is by far the most consumed energy. Twelve of the 31 homes used electricity for all of their needs. Seventeen homes utilized propane gas for cooking. All households except one used electricity for domestic hot water. That one homeowner has a gas hot water heater. Four residents do not use any hot water because of the cost, although they have an electric heater.Electricity accounts for 92 percent of the energy used on St. Thomas and 87 percent on St. Croix. The average for the two islands is 90 percent. Seventeen of the 31 residents use gas for cooking purposes. Gas accounts for 16.5 percent of the energy use for the 17 residents but only 8 percent of the total used for the 31 residents in the sample.

The average monthly energy bill for electricity and gas for the 31 sampled is $107.06. The average cost is higher on St. Thomas, $114.95 and $92.72 on St. Croix. The difference can be attributed

to less energy consumption on St. Croix since rates are the same on both islands.

Four of the 31 residences have air conditioning but only one respondent stated that they used it on a regular basis and then only during the summer months.

It is significant that only one resident had solar energy, and that represented only 10 percent of that household's energy consumption. Another significant point is that all households except one, use electricity for heating hot water whereas 17 use gas for cooking purposes. Data developed in the Virgin Islands shows that approximately 35 percent of household energy costs can be attributed to heating hot water.

Measures Residents Have Taken to Reduce Energy Costs

Fourteen of the 31 residents reported that they had not taken any special measures to reduce energy costs. Measures taken by the other 17 residents in order of their frequency are listed below:

-Intermittent use of hot water heater	7
-Do not use air conditioning	3
-Timers on water heater	2[1/]
-Shower or wash with cold water	1
-Use of ceiling fans	1
-Solar tank for hot water supplement	1
-Low flush toilet	1
-Low flow shower nozzle	1

[1/] Timers are affected by power outages.

Table 25

Characteristics of Private Residences

Location of Home	Own or Rent	Size of Residence (rooms)	Percentage of energy used: Electricity	Propane Gas	Solar	Kerosene	Total Monthly Cost($)	Does Residence Have AC	Energy used for hot water: Electricity	Gas	Energy used for cooking: Electricity	Gas
-St. Thomas-												
Water Island	Own	6	100				110	No	x		x	
Estate Pearl	Own	6	90	10			165	No	x			x
Estate Elizabeth	Rent	7	100				87	No	x		x	
East End	Rent	7	100				65	No	x		x	
Northside	Rent	6	80	20			77	No	x			x
College of VI	Rent	6	100				165	No	x		x	
Watergate Villas	Rent	7	100				77	Yes	x		x	
Not given	Rent	4	100				125	No	x		x	
Hospital	Own	8	88	12			97	No	x			x
Est. Frydenhoj	Own	8	81	19			160	No	x			x
Est. Frydenhoj	Own	12	95	5			154	No		x		x
Estate Pearl	Own	6	88	10		3	146	No	x			x
Bolongo Bay	Own	6	100				186	No	x		x	
Water Island	Own	5	100				125	Yes	x		x	
Estate Thomas	Own	9	86	14			105	No	x			x
Unknown	Rent	6	100				115	No	x		x	
Char. Amalie	Own	3	75	25			60	No	x			x
Char. Amalie	Rent	5	100				110	No	x		x	
Contant	Own	2	75	25			60	No	x			x
Sapphire	Own	7	90	10			110	No	x			x
Ave[1]		6.3	92.4	15.0		3	$149.95	2 yes, 18 no				
-St. Croix-												
Green Cay	Own	6	94	6			64	No	x			x
Cotton Grove	Own	5	90		10		165	No	2/		x	
Orange Grove	Rent	4	100				92	Yes	x		x	
Estate Bon Be Ju	Own	6	100				110	Yes	x		x	
Anna's Hope	Own	6	84	16			120	No	x			x
La Grande Princess	Own	10	90				100	No	x			x
Ralph De Chabert	Rent	5	86	14			104	No	2/			x
Catherine's Rest	Own	6	78	22			64	No	x			x
Stony Ground	Rent	6	78	22			64	No	x			x
Estate Welcome	Own	6	81	19			73	No	2/			x
La Grande Princess	Own	6	78	22			64	No	2/			x
Ave.		6.0	87.2	17.28			$92.72					

1/ Of those responding; 2/ does not use hot water heater because of cost.

Residents' Recommendations on Energy Policies and Problems

Residents expressed a number of concerns and frustrations when asked what recommendations they wished to offer. The most frequent complaints centered on energy interruptions and its impact on family life, the damage to household electric equipment by energy outages, low voltages, power surges, and the substantial portion of the family income that must be used to pay energy costs.

Much of the frustration is directed at WAPA, no doubt because WAPA is the most visible entity of the local government. Although WAPA is a quasi-government agency the local resident perceives it as the government. When asked for their specific recommendations on the Virgin Islands energy problems and the future policies that the Virgin Islands Government should follow their responses ranged from the sale of the local power generation plant to limiting the size of automobiles. A tally of the responses are shown in Figure 9.

Figure 9: Recommendations of 31 Residents on Virgin Islands Energy Problems and Suggested Policies

Comment	No. of Residents
1. Sell WAPA	8
2. Better Management at WAPA	5
3. No recommendations	3
4. Re-equip WAPA	3
5. More even flow of electricity	2
6. More use of solar energy	2
7. Develop a meaningful long range plan	2
8. Limit size of automobiles	1
9. More office design of buildings	1
10. Frequent checks of accuracy of electric meters	1
11. Evaluate WAPA's performance	1
12. Require VI Government to acquire and resell wind generators at a discount price	1
13. Maintenance training program for WAPA employees	1
Total	31

All respondents are concerned about the population growth, present and future use of energy and the expense and frustration of power outages. Power costs don't appear to be as great a factor as the problems associated with outages damaged equipment and the impact on family life.

PART XI

THE POTENTIAL USE OF RENEWABLE ENERGY RESOURCES IN THE US VIRGIN ISLANDS

Some preliminary investigation has been done on alternative energy sources for the Virgin Islands. The Territorial Energy Assessment reports, perhaps optimistically, that as much as 80% of the territory's energy needs might be supplied with indigenous renewable energy by 2005. Such an achievement could result in major savings from reduced oil imports. The report notes: "Over the next twenty-five years, the use of renewable could save the Territory between $50 million and $120 million, depending on the price of oil.[55] It is believed that solar hot water heaters are most likely to be able to penetrate the territorial market and have the most immediate impact on reducing nonrenewable energy use. According to the Water and Power Plan, solar water heaters alone may be able to reduce energy consumption by 10 to 20%.[56] If electricity accounts for most of the energy use on the Islands, 65%, hot water heating is responsible for the largest share of that electricity, 35%. Along with solar hot water heating technology, the Territorial Energy Assessment argues that improved appliance and building efficiency and the use of heat pumps could result in a 25% reduction in electric use.

In addition to solar hot water resources, other renewable and traditional energies have been considered, including some still in the experimental stage. Perhaps the two most experimental technologies are Ocean Thermal Energy Conservation (OTEC) and Solar Thermal Energy Conversion (STEC), both of which require high capital intensive investments to develop. OTEC produces power through energy "created by the temperature difference between sun warmed surface water and cold deep ocean water to produce electricity.[57] Significantly, OTEC is not expected to cause any disruption of marine life, although, it does cause bio-fouling which would necessitate costly expenditures to correct. The Territorial Energy Assessment argues that the Virgin Islands, especially St. Croix, would make a good place to experiment because the ocean shelf is near its shoreline and there are constant warm outdoor temperatures. Moreover, OTEC is very cheap to run, with operating costs estimated to be 5 mills/kwh, or, about 0.5¢/kwh. However, there are two serious problems with OTEC: capital costs, estimated at $8000 per kilowatt of capacity, and, extremely low thermal efficiency, approximately 3%. Further, the only real experimentation has been done with a small mini-OTEC facility in Hawaii.

STEC is something of a combination between OTEC and solar energy. It "uses mirrors, lenses, and other focusing devices to concentrate solar energy to produce high heat which can then be used to produce industrial process steam."[58] Like OTEC, STEC is expensive to develop: $3000/kw. Thermal efficiency is highly variable, and is dependent upon the type of (steam) generators and solar receivers used. Further, it requires a good amount of land. Most important, though, is that no current commercial production of STEC components exists.

Several other renewable technologies also have been reviewed as potential sources for the Virgin Islands, including photovoltaic cells, solar ponds, biomass and bagasse conversion, wind power, and hydro-electric power. There has been much more research on these techniques and their utility and capacity have been proven in other locations. Photovoltaics "use solid-state semi-conductors which convert solar radiation directly into electricity.[59] Generally, it is considered a reliable source of energy, particularly for sunny areas like the Islands. Thermal efficiency is estimated to be approximately 10-14% and is expected to improve in the future. The Assessment reports that there are numerous obstacles to its development, not the least of which is its high cost, which might be as high as $18,000/kw. By 2005, though, research might have reduced that cost to $2600. Further, photovoltaics require land use, another scarce resource in the Islands, and may produce toxic waste because of the chemicals used in their manufacture.

Solar ponds also might have potential because they are cheap to operate, 8-9¢/kwh. This system works as a "body of still water that absorbs solar radiation and stores it as thermal energy."[60] Again, though, there are problems in its development, especially its requirement of land. Biomass energy comes from burning a variety of organic products, including wastes, agricultural residues, or even crops grown specifically for their high energy content.[61] It is estimated that this technology would cost approximately $1500/kw to produce. Conversion efficiency and the particular process will be determined by the specific biomass used. Bagasse is a similar process, the burning of a "fibrous sugarcane residue." Two thousand acres of bagasse material could produce as much as 10% of Territorial energy needs by 2005. The one difficulty stems from its requirement of land mass.

Wind power may have enormous potential in the islands. It has the advantage of being non-polluting, and of permitting the generation capacity for more power to be added in relatively easy manner and in a quick time of two to three years, unlike adding capacity to more traditional oil-fired generation units which may take eight to ten years. As with the other sources mentioned, wind power also has problems. Its source "cannot be controlled or matched to local requirements." Also, it is costly to develop right now, $2500/kw, although it is believed that by 2005 this cost might drop to $700/kw. The key problem is that there has been little done in the way of specific site investigations and experimentation to determine its efficiency and viability. The same difficulty is true for hydro-electric power. The Assessment provides little information on this power source, saying only that old plants on St. Thomas and St. Croix are "poorly developed dam sites whose potential vary with seasonal rainfall. There are no rivers or large waterfalls for exploitation."[63] In addition, water is a resource which itself is very scarce.

Serious difficulties also accompany the use of coal. Coal has the advantage of being abundant in the United States mainland, and, hence, there would be an uninterrupted supply. However, coal prices are volatile. Furthermore, coal plant development is highly capital intensive. If the Virgin Islands use coal, then, it simply would replace its dependence on source material from one set of countries to another, and would not gain appreciabely in its total control over resources or technological self-reliance. As the Assessment observes, "the Virgin Islands currently has no infrastructure for coal usage."[67] It should be noted that despite these problems, the Martin Marietta plant has started construction of a 15 Mw coal generator in St. Croix.

Table 26

ALTERNATE ENERGY TECHNOLOGIES

Technology	When Commercialization Expected in Virgin Islands	Suitable for Base, Intermediate or Peak Load	Capital Cost/KW 1980 (1980 $)	Assumed Maximum Resources Potential in 2005
OTEC	Mid term	Base	8,000	10 MW for St. Croix Grid
Wind	Near term	Intermediate	2,500	5 MW for each of the two Grids
Biomass	Near term	Peak	1,500	2 MW for St. Croix Grid
Resource Recovery	Mid term	Intermediate	1,200	5 MW each for St. Thomas/St. John - St. Croix Grids
STEC	Mid term	Intermediate	3,000	5 MW for each Grid
Photovoltaics	Long term	Intermediate	18,000	6 MW for each Grid
Hydroelectric	Near term	Peak	800	2 MW for each Grid
Pumped Storage	Mid term	Peak	1,000	4 MW potential for each Grid
Submarine High Voltage DC Transmission Cable	Near term	Not Applicable	800	No theoretical limit; to be used to transmit power from island to island

[a]Near term, present to 1985; mid term 1985-1995; long term 1995-2005 or later.

[b]Baseload power sources run 24 hours a day, intermediate load, 17 hours a day, and peak load 2 to 3 hours. Wind, hydroelectric power, biomass, and its subset municipal solid waste, can power baseload facilities only when supplies are uninterrupted by seasonal or daily variations.

[c]STEC - High Temperature Solar Systems
OTEC - Ocean Thermal Systems

Source: Territorial Energy Assessment, 1982, p. 63.

What are the conclusions in the Water and Power Plan and the Territorial Energy Assessment about future energy resources in the Virgin Islands? The Water and Power Plan suggested the following:

- a dire need for water management activities
- a need for the "rehabilitation and replacement" of WAPA electrical equipment
- alternative energy and more energy efficient methods "should play a major role in reducing electrical consumption"

- a "Comprehensive Energy Management Plan" is essential, and should be drafted and supervised by the Department of Energy

- high electric rates make alternative energy technologies feasible

- new power plants are not recommended because peak load demand levelled off in recent years

- other water desalination processes, such as reverse osmosis, should be explored because of the cost and energy consumption involved in oil-fired desalination

- solar hot water heating is a proven and economical technology that could be used effectively in the Virgin Islands

- solar salt ponds should be a low priority because of the land they require

- coal burning plants should be a low priority[65]

The Territorial Energy Assessment has outlined, perhaps much too briefly, what the "energy program" of the Virgin Islands should be right now.[66] It includes the following points:

- "Implement system repair" of WAPA electric facilities

- "Perform long range generation planning study"

- "Implement a water supply system overhaul"

- "Study the groundwater potential in St. Croix" as a possible source of potable water

- "Establish a program of data collection on petroleum product use," with supplemental information on petroleum imports, exports, and territorial production and distribution

- "Determine the feasibility of coal use."

- "Expand the evaluation of the renewable resource data base," with special reference to field data collection

- "Establish a renewable resource technology data base."

- "Conduct a study on the integration of renewable resource technologies into the WAPA system."

- Develop and "implement pilot scale demonstrations" for renewable resources.

- "Evaluate institutional structures influencing renewable resources."
- revise and update the Islands' energy conservation plan
- "Develop an energy planning system."
- "Conduct updated energy planning effort."[67]

PART XII

THE DEVELOPMENT AND MANAGEMENT OF ENERGY RESOURCES FOR THE FUTURE IN THE USVI

The recommendations of both reports provide important guidelines for energy resource analysis in the Virgin Islands. How these data collection programs will be supported and who will provide the financing are questions of immediate importance. They also are questions of political concern, and debate among and between Federal and Territorial authorities and the private sector. The economics and politics of energy development will affect the future of economic activity as much if not more so than technological achievements.

The availability and price of energy resources directly affects economic activity. Nothing demonstrated this fact so clearly as the interruption in oil supply during the embargo of 1973-4, and subsequent and continuous rising oil prices. In an effort to understand this impact more fully, and to analyze what measures may be taken to prevent economic decline if oil supplies again were interrupted, the United States Senate Committee on Energy and Resources comissioned a study entitled The Economic Impact of Oil Reduction. Although it is specifically about the U.S., its findings pertain to other oil importing countries. The Senate report noted that: Reduced oil supply and increased oil prices meant lower demand for production, decreased ability to produce, lower GNP, and less real family income and wealth.[68]

Without question, the energy crisis raised an issue with which only a few oil importing countries have dealt effectively: how to sustain and expand economic activities and wealth while cutting back on energy usage. We have been forced to examine more carefully the relationship between energy consumption

and GNP. Some economists think that developed countries in their earlier stages of economic expansion had a ratio greater than one. As we have shifted our consumption patterns toward greater conservation and increased energy efficient machines, that ratio has decreased and may continue to decrease in the future, so that it will be significantly below one. Developing countries, though, may have difficulty in maintaining an energy coefficient below one. In other words, their use of energy will be great in comparison to their ability to increase their economic wealth.

Closely related is another form of energy coefficient, energy elasticity. Essentially, energy elasticity tells us how much a consumer is willing to pay for the energy component of a product before he changes his purchasing behavior. The more important a good is to a person and the higher price he is willing to pay for it, the more inelastic that good is considered. The higher the elasticity, the easier it will be for people to moderate their demand for a good without decreasing economic activity.[69]

In order to attain a high elasticity in energy demand and a low energy coefficient ratio, countries must have, or develop, a comprehensive program for energy demand management and conservation, as energy specialist Mohan Munasinghe suggests.[70] According to Munasinghe, the components of demand management include pricing policy, education, and technical development. Each of these is critical, and they will affect the level and quality of conservation. The strategies and policies constructured for these will say much about the kind of society envisioned by Territorial leadership and the degree of economic self-reliance that result for the Islands. How pricing and education are carried out will help to determine who will get hurt, who will profit, how income will be distributed (or redistributed), and what inequalities in wealth

and energy use will be sustained, created, or reproduced in society. Equally important is the manner in which these issues are resolved and the planning vehicles used. It will signal the kind of decision-making process that will operate. Indeed, it will help determine whether "development" or growth takes place. Critical discussion of the full range of implications of these issues is beyond the scope of this research, but, should be included in future studies on the subject of energy and economic development.

The pricing aspect of demand management is critical, especially in an area, like the Virgin Islands, where energy prices per kilowatt hour do not cover costs. That fact helps to explain some of the inefficiencies in WAPA. Yet, to allow prices to rise beyond their already high rate could cripple economic activity in the Islands and destroy possibilities for development. This issue is of special concern in a declining economy. There are at least three aspects to pricing: one is purely economic, another is political, and the third is cultural.

Economists often see price as an indication of people's tastes, desires, predispositions, and demands. Shifts in price may signal shifts in purchasing behavior, depending, as noted above, on product elasticity. When possible, the tendency will be to shift away from consumption of products and services that are energy intensive. The degree of this change will depend on how much of the cost of a good or service is comprised by energy. As the Committee on Nuclear and Alternative Energy Systems of the National Research Council report, "Consumers will shift away from goods and services that are energy intensive in their production or supply, toward others that serve similar purposes with less energy. The extent of these substitutions will in general be larger the higher the component of energy cost in the price of the good or service."[71]

However, conservation itself will not permit increased economic activity. Rather, only substitution with another energy source will provide that possibility. LeBell notes: "If technological improvements in energy efficiency can be achieved simultaneously with increasing energy prices, it may be possible to maintain output and consumption at their previous levels..."[72]

These transformations in consumption behavior are the result of purely economic calculations by people. However, such decisions rarely are made on cost-benefit evaluations alone. Rather, political and cultural circumstances always enter into consumption decisions. In one sense, the formulation of pricing to change demand and consumption is an explicitly political question that deserves and must engage the entire community in debate, for it might have the impact of "conditioning," a fact with which economists will agree, although they may ignore the political implications of the practice. As Marcelo Alonso and Phactuel Rego of the Organization of American States contend in their article, "Energy Strategies and Economic Growth for Oil Developing Countries":

> An energy demand reorientation is not a purely technical problem; it also has a political component, inasmuch as it requires the establishment of social and economic policies that will eventually produce the desired changes in demand patterns. ...It is essentially an effort to condition and guide energy consumption patterns, assuming a suitable supply by conditioning the technical, economic, and social variables that will influence energy demand.[73]

At the same time, there are other economic and political factors that will effect pricing in the Islands over which there is no control. Once again, we return to the nexus of three exogenous markets in which the Territory is caught. World events, prices, and politics will affect the ability of the Territory to determine its own pricing. Technological advancement and expertise, which also are affected by a variety of factors, will impact on the pricing of energy in the Islands. The difficulties become ever more complicated.

Still one more factor must be mentioned. As representatives from the U.S. insular territories reminded everybody this past May, the islands are not synonymous with underdeveloped countries. Yet, the Islands still suffer from some similar aspects of underdevelopment that other oil importing developing countries face. In large part, these problems are exacerbated because of the legacy of territorial status. Bryan Thompson of the Organization of American States explained the problem well at the May conference. He talked about the serious difficulty of "colonial trauma": powers, like the United States, seem to have abandoned their territorial possessions without capital resources and administrative capacity. They are "governments with very little money, with a lot of very poor people going after it..." Hence, the marketplace alone, which frequently is where prices are worked out, is not sufficient to guide pricing.[74]

Throughout this discussion runs the crucial question of control: who controls (or at least participates) in the decision-making processes that will determine energy demand management and the policy tools used to effect it? Control comes through participation in the process of determining social, technological, and research priorities, and it comes through knowledge. Once displaced from public discourse about energy use and resources, technologies that are inappropriate and pricing mechanisms that make energy unaffordable may emerge. One of the world's foremost energy experts, Arjun Makhijan, understands this and explains the issue in his article, "Economics and Sociology of Alternative Energy Sources." Although it is about energy use in India, which has very different problems than the Virgin Islands, its implications are of enormous consequence, and should concern all nations and areas struggling with energy self-reliance. He observes:

> Many crucial techniques are being ignored, possibly because the technological orientation of the research so far has taken its cues from the wealthy countries, and because social considerations, particularly at the local level, are not yet a systematic part of the process of deciding what techniques should or should not be developed. Appropriate priorities for research can scarcely be developed unless the desires of the people are systematically taken into account.
>
> ...What is crucial is how we mechanize, who controls the process, how it can be made consistent with meaningful and productive work for all with a just distribution of goods, and with increasing human creativity cooperation, and freedom.[75]

The other area from which control is derived is knowledge. In this case, it is knowledge (technical, political and economic) of alternative energy production and use. James Masker, of the National Center for Appropriate Technology, in his presentation at the May, 1983 conference, provided a very useful term for such knowledge: "renewable energy literacy." His argument fits well in the scheme of development suggested throughout this review. Essentially, Masker believes that along with technological experimentation and application, there must be a program of education. Islanders must learn about the "basic principles of designing and sizing considerations, installation, maintenance, repair, troubleshooting" of renewable energy resources. This will provide energy self-reliance. Otherwise, if renewable energy literacy is not integrated "into technology transfer programs, the dependence on expensive imported oil is going to be replaced with an equal dependence on skilled labor and expertise from outside the Pacific and insular areas."[76]

The Conference on Energy Planning in the U.S. Insular Areas, held May 12-13, 1983, may turn out to have been a very important step in the energy self-reliance of the Caribbean Region. Bringing together Federal and Territorial officials, as well as businessmen in the energy industry, the Conference permitted discussion of a wide range of issues and viewpoints. Fortunately, it seems that

most participants were willing to air their views openly, without concealing criticisms and expressions of problems. It is in this type of forum that the momentum for discussions about how to meet the difficulties might emerge.

Energy and other related industry consultants offered several observations about what the private sector would look for in order to undertake alternative energy resource development. One private sector representative indicated there were at least four considerations for such action: the definition of a market for the renewable resources; the production and distribution mechanisms; the kind and amount of Federal and Territorial Assistance to private companies; and, the nature of competition with foreign countries for such production and distribution.[77] Dr. Fred Blum of the Merrill, Lynch Alternative Energy Financing Group, elaborated on these factors. He included the importance of a good rate of return that was commensurate with the risk of alternative energy development. Also, there should be a fair degree of security on some level of return. Tax incentives, he argued, were very important to induce research, exploration, and development by the private sector. Regulations were a particular concern for these companies, as was the security of the market from outside intervention.[78] Tom McCord of SETS, Inc., made some helpful comments about governmental structure that could assist businessmen in energy development projects. McCord noted that businesses oftentimes had difficulty dealing with the Islands because there were no consistent Federal and Territorial policies regarding energy. In addition, there was further hindrance because there seemed to be no one Federal agency responsible for energy policy for the Islands. His thoughts were phrased well when he said: "We don't want rigidity. What we do want is stability and a logically evolving policy that allows us time to go through the various phases necessary to develop alternative energy items."[79]

One concern that was shared by both the private sector and the Territorial representatives emphasized that tax credit programs, such as the Public Utilities Regulatory Policies Act (PURPA - that gives tax credits for building cogeneration facilities and provides regulations regarding the purchase of excess power by public utilities according to their "full avoided costs"), the accelerated depreciation tax credit, and various alternative renewable energy tax credits, must be made to apply to the Islands in the same way they do to U.S. states. There is a need for what the representative from Guam termed "innovative financing assistance." In one workshop Islanders argued that "financing was a political issue. They felt it would be more productive to find ways to 'tap into' existing U.S. financial systems or to increase the flexibility in the regulations of internal funding programs such as AID or OAS to allow U.S. territories to participate.[80] There also seemed to be agreement on the need for continuous and consistent Federal policies toward the Islands, and the need to coordinate more effectively which Federal agency will be responsible for energy development in all U.S. insular areas.

A crucial territorial concern was the need for Federal assistance to insure adequate energy needs assessments are done, to undertake site specific analysis of renewable resources, and to fund demonstration projects. Significantly, one workshop group argued that demonstration projects should be test projects which permit the energy generated to be used immediately by Islanders. Another prime concern of Islanders was the importance of making credit and expertise available to train Island residents in the use of renewable resources. If such provisions are not made, the feeling was that the same difficulties which have beset territorial utilities now will hamper and reduce the effectiveness of any new technology that is developed there. As one workshop

noted: "Any program should be aimed at building an infrastructure of personnel capable of building, installing, and maintaining equipment."[81]

Another area that was emphasized was the need for improved communication between all groups. A cooperative network to facilitate information and data exchange, technology transfer, and market strategies, was suggested. One group proposed that each territory appoint an ombudsman to clarify and explain special regulations and tax structures to energy companies interested in working in that territory. There also was a feeling that more energy capacity was not needed as much as an improvement (and perhaps transformation) of existing capacity. In order for more Federal assistance and fulfillment of the potential of the Territorial Energy Assessment, such support must emerge. Otherwise, the financial, economic, and political difficulties suggested throughout this study may never be resolved. CDBGs and UDAGs will be insufficient for this purpose, and it is unclear that for U.S. Caribbean possessions the administration's Caribbean Basin Initiative will supply the financial answers.

In this study we have endeavored to identify and document data that can be used by the Virgin Islands Government, organizations, business firms and individuals in the development of strategies to combat the negative effects of high energy use and high energy cost to the citizens of the United States Virgin Islands.

In developing strategies for future energy development and use the Virgin Islands Government should pay particular attention to the perceptions of the populace as revealed in this study and also to the suggestions and recommendations by respondents in this study.

This study reveals that the mitigation strategies should include the following:

1. A comprehensive public information program to educate the populace as to the nature and causes of our energy problems, and also to educate the populace in energy use and conservation. The program should be delivered in such a manner as to convey both the understanding by the Government of the energy problems of all segments of the Virgin Islands society, and also the Government's willingness to make every effort to resolve these problems.

2. In this regard the Government must demonstrate flexibility, a cooperative attitude, and a willingness to take into consideration comments and suggestions made by energy users.

3. In the short run immediate steps should be taken to upgrade management, production and distribution capabilities of WAPA. As one organization director stated during his interview, "We must make WAPA work, it is the only thing we have."

4. In the long run alternative energy resources should be developed and utilized beginning with the expanded utilization of solar energy for heating domestic hot water. In the development of further alternate resources assistance should be sought from the Federal Government in the funding of research and demonstration projects to emperically determine local practicality and cost effectiveness.

FOOTNOTES TO TEXT

[1]Albert Shapero, "The Role of Entrepreneurship in Economic Development at the Less-Than-National Level," in Robert Friedman and William Schweke, eds., Expanding the Opportunity to Produce: Revitalizing the American Economy Through New Enterprise Development. (Washington, D.C.: The Corporation for Enterprise Development, 1981).

[2]See Richard W. Miller, The Economy of the Virgin Islands, June 20, 1979, Office of Territorial Affairs, Department of the Interior, p. 1.

[3]Miller. Bruce Sever also was helpful in discussing this point with me.

[4]Miller, p. 15.

[5]Economic Development Policy Guidelines, Volume II, Background Narrative, Prepared by the Economic Policy Council, January, 1979, pp. 57 and 124-5. Cited as EDPG hereafter.

[6]Miller, p. 31.

[7]EDPG, p. 12.

[8]James Pobicki, "U.S. Virgin Islands Economy -- A Review of the 1970s and Outlook for the 1980s," in Annual Economic Review, 1980, Office of Policy, Planning and Research, U.S.V.I. Department of Commerce, p. 3.

[9]Miller, p. 5. See also EDPG, p. 12.

[10]Miller, p. 5., and Table VI, p. 52.

[11]Ibid. See Table V, p. 52.

[12]Pobicki, p. 3.

[13]Miller, Table I., p. 49.

[14]Miller, pp. 2 and 21-22.

[15]Ibid, pp. 27-29.

[16]Ibid, pp. 29-31.

[17]Miller, Chart VIII, p. 54, and the Annual Economic Review, 1977, p. 18.

[18]Annual Economic Review, 1977, U.S. Virgin Islands Growth Statistics, pp. 14-15.

[19]Ibid. See also Territorial Energy Assessment, Final Report, December, 1982, Department of Energy, p. 155.

[20]Ibid.

[21]Miller, pp. 7-8.

[22]Ibid, p. 6.

[23]William Newbold, Jr., and Edward Rozynski, "Tourism in the Virgin Islands: 1980 Status Report," in Annual Economic Review, 1980, p. 19.

[24]EDPG, p. 103.

[25]Ibid, pp. 47-49.

[26]Pobicki, p. 16.

[27]Ibid, pp. 5-6.

[28]U.S. Virgin Islands Growth Statistics, 1981.

[29]EDPG, p. 163.

[30]Ibid, pp. 166-167.

[31]Economic Development Administration, Annual Report, 1982, pp. 4-7, 12-15, and 222.

[32]Miller, pp. 18-21.

[33]Frank R. Price, Water and Power Plan, April 1981, U.S. Virgin Islands Office of Energy, p. 22.

[34]Quarterly Statistical Review, Statistics Department of the Edison Electric Institute, V. 50, No. 4, March 22, 1983, p. 2.

[35]Water and Power Plan, p. 33, and Territorial Energy Assessment, p. 173.

[36]Water and Power Plan, p. 36.

[37]Territorial Energy Assessment, p. 60.

[38]Ibid., p. 72.

[39]Ibid., p. 72.

[40]Ibid., pp. 168-9.

[41]Ibid., p. 158.

[42]Ibid., p. 159.

[43]Ibid., p. 160.

[44]Water and Power Plan, p. 28.

[45]Miller, p. 17.

[46]EDPG, pp. 63-4.

[47]See Proceedings, Conference on Energy Planning in the U.S. Insular Areas, May 12-13, 1983. Publication forthcoming.

[48]Territorial Energy Assessment, pp. 156-8. Some of this material (projections for 1990) was prepared by James Pobicki and appeared in the 1980 article cited above.

[49]Ibid.

[50]Ibid., p. 169.

[51]Ibid., p. 162.

[52]Ibid.

[53]James Bridger Robinson, "Bottom-up Methods and Low-Down Results: Changes in the Estimation of Future Energy Demands," in Energy, Vo. 7, No. 7, July, 1982, p. 627.

[54]Ibid.

[55]Territorial Energy Assessment, p. 60.

[56]Water and Power Plan, p. 8.

[57]Territorial Energy Assessment, p. 64.

[58]Ibid., p. 65.

[59]Ibid., p. 66.

[60]Ibid., p. 67.

[61]Ibid., p. 64.

[62]Ibid., p. 65.

[63]Ibid., p. 66.

[64]Ibid., p. 173.

[65]Water and Power Plan, pp. 4-6.

[66]Territorial Energy Assessment, p. 186.

[67]Ibid., pp. 86-200.

[68]Committee on Energy and Natural Resources, United States Senate, The Economic Impact of Oil Import Reduction, December, 1978, p. 5.

[69]National Academy of Science, National Research Council, Energy in Transition, 1985-2020 (San Francisco: W. H. Freeman and Co., 1980), p.

[70]Mohan Munasinghe, "Third World Energy Policies -- Demand Management and Conservation," in Energy Policy, March, 1983.

[71]Energy in Transition, p. 103.

[72]Phillip LeBel, Energy, Economics and Technology (Baltimore: The Johns Hopkins University Press, 1981), p. 43.

[73]Marcelo Alonso and Phactuel Rego, "Energy Strategies and Economic Growth for Oil Importing Developing Countries," in Behram N. Kursungolu, Jean Couture, Andrew C. Millanyi, Arnold Perlmutter, and Linda Scott, Energy for Developed and Developing Countries (Lexington, MA: D. C. Heath/Lexington Books, 1983), p. 179.

[74]B. Thompson, Proceedings, Conference on Energy Planning in the U.S. Insular Areas, May 12-13, 1983, unpublished volumes, p. 127.

[75]Arjun Makhijani, "Economics and Sociology of Alternative Energy Sources," PACIFIC, Vol. 32, June, 1981, p. 55 (first quotation) and p. 35 (second quotation).

[76]Conference Proceedings, p. 100.

[77]Ibid.

[78]Ibid., p. 116.

[79]Ibid., p. 191.

[80]Ibid., pp. 152-153.

[81]Peter Johnson and Dale Brown, Notes/Summary on Workshop on "Energy Development and Technology Applicable to Island Municipal Centers," held during the Conference on Energy Planning in the U.S. Insular Areas, MIMEO, p. 10.

[82]Conference Proceedings, see pp. 160-166.

Bibliography

Alonso, Marcelo and Phactuel Rego, "Energy Strategies and Economic Growth for Oil Importing Developing Countries," in Behram N. Kursungolu, Jean Couture, Andrew C. Millanyi, Arnold Perlmutter, and Linda Scott, Energy for Developed and Developing Countries. Lexington, Massachusetts. D.C. Heath/Lexington Book. 1983.

Annual Economic Review, 1977 and 1980.
The 1980 issue was especially helpful. It includes the important article by James Pobicki, "U.S. Virgin Islands Economy -- A Review of the 970s and Outlook for the 1980s." Also there are articles on tourism, employment opportunities in small businesses, the St. Croix west end business survey (there has been much unemployment in St. Croix), and statistics on air and cruise ship arrivals. In addition, there are the 1980 U.S. Virgin Islands Growth Statistics. The 1977 edition is useful because it contains 1960 statistical data in the Growth Statistics chart, as well as information on agricultural imports.

Committee on Energy and Natural Resources, United States Senate, The Economic Impact of Oil Import Reduction. December, 1978.
U.S. Senate Committee commissioned this report to estimate what harm was done by oil supply interruptions during the oil embargo of 1973-4. The report also focuses on examining how different measures, such as price controls, affect oil consumption in an effort to devise strategies to reduce oil use in the U.S.

Conference on Energy Planning in the U.S. Insular Areas, May 12-13, 1983. Sponsored by the Congressional Research Service. Proceeding whose publication is forthcoming.

This is the most up-to-date material on energy research and development for all U.S. territorial possessions. It brought together representatives from the U.S. insular areas, business, and the Federal government.

Economic Development Administration, 1982 Annual Report, U.S. Department of Commerce.

Economic Development Policy Guidelines, Volume II, Background Narrative, by the Economic Policy Council, January, 1979.

Excellent analysis of planning capacity, industrial incentive programs, and economic structure of the Virgin Islands.

Eden, Richard, Michael Posner, Richard Bending, Edmunc Couch, and Joe Stanislaw, Energy Economics, Growth, Resources and Policies. Cambridge. Cambridge University Press. 1981.

Foster, John, Erain Friedmann, James W. Howe, Francisco R. Parra and David Pollock, Energy for Development: An International Challenge. New York. Prager. 1981. This book contains several nice essays on oil importing developed and developing countries, and oil exporting developing countries. It contains a nice piece on a "framework" for developing countries.

Johnson, Peter, and Dale Brown, Notes/Summary on Workshop at Conference on Energy Planning in the U.S. Insular Areas, May 12-13, 1983. Workshop entitled: "Energy Development and Technology Applicable to Island Municipal Centers." Mimeo.

LeBel, Phillip, Energy, Economics and Technology. Baltimore. The Johns Hopkins University Press. 1981. Very helpful for focusing on the energy crisis in the U.S., and on the relationship between energy and economic growth, especially from an "economic" standpoint.

Makhijani, Arjun, "Economics and Sociology of Alternative Energy Sources," PACIFIC, V. 32, June, 1981, pp. 34-55. Perhaps the best piece read for this project on the subject of energy, economics, and development in underdeveloped areas. It explores the use of alternative energy resources (such as biomass and fuelwood) in India. The essay does an excellent job discussing the implications of participating in the decision-making process of determining which type of appropriate technologies to use and for what purposes. It emphasizes the importance of people's control in order to increase the possibilities for a more creative and humane life experience.

Miller, Richard W., The Economy of the Virgin Islands, June 20, 1979, Department of Insular Affairs, Department of the Interior. Very good piece that provides an overview of the economy of the Territory. It focuses on different industries, population growth, migration problems, tourism, utilities, and industrial incentive and tax programs.

Munasinghe, Mohan, "Third World Energy Policies -- Demand Management and Conservation," in Energy Policy, March, 1983.

National Academy of Sciences, National Research Council, Energy in Transition, 1985-2020, Final Report of the Committee on Nuclear and Alternative Energy Systems. San Francisco. W. H. Freeman and Co. 1980.

James Pobicki, "U.S. Virgin Islands Economy -- A Review of the 1970s and Outlook for the 1980s," in the Annual Economic Review, 1980. Office of Policy, Planning and Research, Department of Commerce. One of the best single pieces on the economy of the Virgin Islands. Discusses changes in population, development of employment structure in the Islands, and suggests some possible trends in the future. Breaks down employment by sector in most detailed way of any materials.

Price, Frank R., Water and Power Plan, April, 1981, Office of Energy. U.S. Virgin Islands. Next to the 1982 Territorial Energy Assessment, this is the most recent and comprehensive material on energy resources (electricity) and water resources on the Islands. Also provides very good coverage of research and experimentation of alternative energy sources and water desalination processes.

Quarterly Statistical Report. Statistics Department of the Edison Electric Institute, Vol. 50, No. 4, March 22, 1983. Source of the most recent average consumer price of electricity in the United States.

Robinson, James Bridger, "Bottom-up Methods and Low-Down Results: Changes in the Estimation of Future Energy Demands," in Energy, Vol. 7, No. 7, July, 1982, pp. 627-635. Contains important materials on changes in predicting future energy needs. It examines the "bottom-up" method as opposed to the "top-down" method. Also, it advocates the use of "back-casting" instead of "forecasting."

Smil, Vaclav and William E. Knowland, "Energy in the Developing World," in Vaclav Smil and William E. Knowland, eds., Energy in the Developing World. New York. Oxford University Press. 1980.

Territorial Energy Assessment, Final Report, December, 1982. Department of Energy. Most recent published study on energy use and possible resources in U.S. Pacific territories and the Caribbean (primarily Puerto Rico and the Virgin Islands). Much of all the earlier works on energy and economics about the Virgin Islands has been used to put this report together.

Uri, Noel D., "Energy as a Determinant of Investment," in Energy, Vol. 6, January, 1981, pp. 1-8. Examines importance of energy as a determinant of financial investment in certain selected industries.

U.S. Virgin Islands Census, 1980.

U.S. Virgin Islands Growth Statistics, 1981. U.S. Virgin Islands Office of Policy, Planning and Research, U.S.V.I. Department of Commerce.

U.S. Virgin Islands Labor Market Review. January-November, 1982.

U.S. Virgin Islands Labor Market Review, 1982. U.S. Virgin Islands Department of Labor, Bureau of Labor Statistics, reported July 1982 for the year 1981. Gives statistical information on employment by sector; contains labor force totals, annual gross average earnings, hours and earnings for selected industries, and the 100 largest employers in the Virgin Islands.

PRIVATE BUSINESSES
NARRATIVE QUESTIONAIRE

VIRGIN ISLANDS COSTAL ENERGY
IMPACT PLANNING STUDY

1. NAME OF COMPANY_____

2. NAME OF PERSON INTERVIEWED_____

POSITION WITH COMPANY_____ _____

3. WHAT TYPE OF BUSINESS OR SERVICE DOES YOUR COMPANY OPERATE?_____

_____

_____

4. HOW LONG HAS YOUR COMPANY CONDUCTED BUSINESS IN THE U.S. VIRGIN ISLANDS?_____

5. WHY DID YOU SELECT THE VIRGIN ISLANDS?_____

_____

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6. WERE ENERGY NEEDS A FACTOR CONSIDERED IN THE SELECTION OF THE U.S. VIRGIN ISLANDS?_____

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_____

7. HOW MANY EMPLOYEES ARE IN YOUR COMPANY?_____

8. WHAT TYPES OF ENERGY ARE USED IN THE OPERATION OF YOUR BUSINESS?

_____

_____

9. WHAT PERCENT OF EACH TYPE OF ENERGY DO YOU USE?_____

_____

_____

NARRATIVE QUESTIONAIRE
PAGE 2

10. TOTAL YEARLY COST OF ENERGY?_____

11. WHAT PERCENT OF YOUR TOTAL BUSINESS OPERATING COSTS ARE ENERGY COSTS?

_____ _____ _____

12. WHY DID YOU SELECT THE TYPES OF ENERGY YOU USE?_____

_____

_____

_____

13. DID YOU CONSIDER ALTERNATIVE FORMS OF ENERGY?_____

_____

14. DID YOU RECEIVE ANY SUGGESTIONS, DIRECTIONS OR GUIDANCE IN THE SELECTION OR COST OF ENERGY FROM AN AGENCY OR AGENCIES OF THE VIRGIN ISLANDS GOVERNMENT? IF YES, WHAT AGENCIES?_____

_____

15. WHAT WAS THE NATURE OF THE ASSISTANCE YOU RECEIVED?_____

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_____

_____

16. WHAT KNOWLEDGE DO YOU HAVE OF THE FOLLOWING:

A) ENERGY POLICIES OF THE U.S. VIRGIN ISLANDS_____

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NARRATIVE QUESTIONAIRE
PAGE 3

B) THE TERRITORY'S PLANS FOR FUTURE ENERGY NEEDS_____

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_____

_____

C) THE TERRITORY'S ENERGY ASSESSMENT REPORT_____

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17. DO YOU PLAN TO EXPAND YOUR BUSINESS OPERATIONS IN THE U.S. VIRGIN ISLANDS? IF SO, EXPLAIN_____

_____

_____

18. IF THE ANSWER TO QUESTION 17 WAS YES, HOW MUCH CONSIDERATION WAS GIVEN TO ENERGY COSTS, NEEDS AND ENERGY TYPES?_____

_____

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_____

19. WHAT ARE YOUR THOUGHTS ON THE ISLANDS ENERGY NEEDS AND YOUR EVALUATION OF THE POLICIES AND ASSISTANCE GIVEN BY THE VIRGIN ISLANDS GOVERNMENT?

_____

_____

AND THE FEDERAL GOVERNMENT_____

_____

_____

NARRATIVE QUESTIONAIRE
PAGE 4

20. WHAT ARE YOUR RECOMMENDATIONS FOR A PROPER SOLUTION TO THE ISLANDS' ENERGY PROBLEMS? _____

_____

_____

_____

21. WHAT IMPACT DOES THE COST OF ENERGY HAVE ON THE PRICING OF YOUR GOODS OR SERVICE? _____

_____

_____

22. WHAT IMPACT DOES ENERGY INTERRUPTIONS HAVE ON YOUR BUSINESS?

DAMAGED EQUIPMENT _____

SPOILED FOOD _____

TIME LOST _____

OTHER _____

23. HOW MANY ENERGY INTERRUPTIONS DOES YOUR BUSINESS HAVE EACH MONTH?

_____

_____

24. WHAT IS THE AVERAGE ELAPSED TIME OF THE OUTAGE? _____

_____

VIRGIN ISLANDS ORGANIZATION QUESTIONAIRE

VIRGIN ISLANDS COASTAL ENERGY IMPACT PLANNING STUDY

1. NAME OF ORGANIZATION _____

2. NAME OF PERSON INTERVIEWED _____

3. POSITION _____

4. WHAT ROLE, IF ANY, DOES YOUR ORGANIZATION HAVE IN ESTABLISHING ENERGY POLICIES IN THE U.S. VIRGIN ISLANDS? _____

5. HAS YOUR ORGANIZATION PARTICIPATED IN ANY ENERGY STUDIES OR ASSISTED IN THE PREPARATION OF ANY TERRITORIAL LAWS RELATING TO ENERGY PLANNING OR ENERGY NEEDS? DESCRIBE _____

6. DESCRIBE THE WORKING RELATIONSHIPS AND COORDINATION EXPERIENCE, IF ANY, WITH VIRGIN ISLANDS OR FEDERAL AGENCIES THAT DEAL WITH ENERGY NEEDS.

V.I. COASTAL ENERGY QUESTIONAIRE
PAGE 2

7. DESCRIBE THE SUPPORT AND ASSISTANCE, IF ANY, YOUR ORGANIZATION HAS RECEIVED OR RECEIVES REGARDING ENERGY NEEDS OR PROBLEMS FROM VIRGIN ISLANDS AGENCIES INCLUDING THE GOVERNOR'S OFFICE AND FROM FEDERAL AGENCIES.

8. WHAT ASSISTANCE, IF ANY, DOES YOUR ORGANIZATION PROVIDE PRIVATE COMPANIES, ORGANIZATIONS AND VIRGIN ISLANDS AGENCIES TO HELP THEM WITH THEIR PLANNING FOR ENERGY NEEDS?

9. WHAT IS YOUR EVALUATION OF THE POLICIES OF THE VIRGIN ISLANDS AND THE ASSISTANCE OF VIRGIN ISLANDS AND FEDERAL GOVERNMENTS REGARDING ENERGY?

10. WHAT ARE YOUR RECOMMENDATIONS ON THE ISLANDS' ENERGY NEEDS AND POLICIES?

V.I. COASTAL ENERGY QUESTIONAIRE
PAGE 3

11. WHAT IMPACT DOES POWER INTERRUPTIONS HAVE ON YOUR ORGANIZATION?

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_____

12. HOW MANY ENERGY INTERRUPTIONS DOES YOUR ORGANIZATION HAVE EACH MONTH?

_____

13. WHAT IS THE AVERAGE ELAPSED TIME OF THE OUTAGE?_____

_____

14. WHAT IS THE IMPACT OF ENERGY COSTS ON YOUR ORGANIZATION?_____

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_____

15. WHAT ARE YOUR RECOMMENDATIONS FOR A PROPER SOLUTION TO THE ISLANDS' ENERGY PROBLEMS?_____

_____

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_____

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_____

RESIDENCE QUESTIONAIRE

VIRGIN ISLANDS COASTAL ENERGY IMPACT PLANNING STUDY

1. NAME OF PERSON INTERVIEWED_____

2. ADDRESS_____ _____

3. DO YOU OWN OR RENT_____

4. SIZE OF HOME OR APARTMENT (NUMBER OF ROOMS)_____

5. WHAT TYPES OF ENERGY DO YOU USE:

   A) ELECTRIC_____ % OF ENERGY USED_____ MONTHLY COST_____

   B) GAS_____ % OF ENERGY USED_____ MONTHLY COST_____

   C) KEROSENE_____ % OF ENERGY USED_____ MONTHLY COST_____

   D) SOLAR_____ % OF ENERGY USED_____ MONTHLY COST_____

   E) WIND_____ % OF ENERGY USED_____ MONTHLY COST_____

   F) OTHER_____ % OF ENERGY USED_____ MONTHLY COST_____

6. DOES YOUR HOME HAVE AIR CONDITIONING? YES_____ NO_____ IF YES, HOW OFTEN DO YOU USE YOUR AIR CONDITIONER?_____

   _____

7. WHAT TYPE OF ENERGY DO YOU USE FOR: DOMESTIC HOT WATER_____

   _____ FOR COOKING_____

8. DO YOU PLAN TO INSTALL ANY ALTERNATIVE ENERGY GENERATORS SUCH AS SOLAR OR WIND? YES_____ NO_____ IF YES, WHAT TYPE_____

   _____ _____

RESIDENCE QUESTIONAIRE
PAGE 2

9. WHAT ARE YOUR RECOMMENDATIONS FOR A PROPER SOLUTION TO THE ISLANDS' ENERGY PROBLEMS? _____

_____

_____

_____

10. WHAT IMPACT DOES THE COST OF ENERGY HAVE ON YOUR STANDARD OF LIVING?

_____

_____

_____

11. WHAT IMPACT DOES ENERGY INTERRUPTIONS HAVE ON YOUR FAMILY LIFE?

_____

_____

_____

12. WHAT MEASURES HAVE YOU TAKEN TO REDUCE YOUR ENERGY COST? (WATER JACKETS - TIMERS, ETC.) _____

_____

_____

_____

VIRGIN ISLANDS AGENCY QUESTIONAIRE

VIRGIN ISLANDS COASTAL ENERGY IMPACT PLANNING STUDY

1. NAME OF AGENCY _____

2. NAME OF PERSON INTERVIEWED _____

3. POSITION _____

4. WHAT RESPONSIBILITIES DOES YOUR AGENCY HAVE IN ESTABLISHING ENERGY POLICIES? _____

5. HAS YOUR AGENCY PARTICIPATED IN ANY ENERGY STUDIES OR ASSISTED IN THE PREPARATION OF ANY TERRITORIAL LAWS RELATING TO ENERGY PLANNING OR ENERGY NEEDS? DESCRIBE _____

6. DESCRIBE THE WORKING RELATIONSHIPS AND COORDINATION EXPERIENCE, IF ANY, WITH OTHER VIRGIN ISLANDS OR FEDERAL AGENCIES THAT DEAL WITH ENERGY NEEDS. _____

V.I. COASTAL ENERGY QUESIONAIRE
PAGE 2

7. DESCRIBE THE SUPPORT AND ASSISTANCE, IF ANY, YOUR AGENCY HAS RECEIVED OR RECEIVES REGARDING ENERGY NEEDS OR PROBLEMS FROM OTHER VIRGIN ISLANDS AGENCIES INCLUDING THE GOVERNOR'S OFFICE AND FROM FEDERAL AGENCIES. _____

8. WHAT ASSISTANCE, IF ANY, DOES YOUR AGENCY PROVIDE PRIVATE COMPANIES, ORGANIZATIONS AND OTHER VIRGIN ISLANDS AGENCIES TO HELP THEM WITH THEIR PLANNING FOR ENERGY NEEDS? _____

9. WHAT IS YOUR EVALUATION OF THE POLICIES OF THE VIRGIN ISLANDS AND THE ASSISTANCE OF VIRGIN ISLANDS AND FEDERAL GOVERNMENTS REGARDING ENERGY? _____

10. WHAT ARE YOUR RECOMMENDATIONS ON THE ISLANDS' ENERGY NEEDS AND POLICIES? _____

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