Report No. 5103-STV

St. Vincent and the Grenadines: Issues and Options in the Energy Sector

September 1984

Report of the Joint UNDP/World Bank Energy Sector Assessment Program

Report No. 5103-STV

JOINT UNDP/WORLD BANK ENERGY SECTOR ASSESSMENT PROGRAM
REPORTS ALREADY ISSUED

Country	Date	Number
Indonesia	November 1981	3543-IND
Mauritius	December 1981	3510-MAS
Kenya	May 1982	3800-KE
Sri Lanka	May 1982	3792-CE
Zimbabwe	June 1982	3765-ZIM
Haiti	June 1982	3672-HA
Papua New Guinea	June 1982	3882-PNG
Burundi	June 1982	3778-BU
Rwanda	June 1982	3779-RW
Malawi	August 1982	3903-MAL
Bangladesh	October 1982	3873-BD
Zambia	January 1983	4110-ZA
Turkey	February 1983	3877-TU
Bolivia	April 1983	4213-BO
Fiji	June 1983	4462-FIJ
Solomon Islands	June 1983	4404-SOL
Senegal	July 1983	4182-SE
Sudan	July 1983	4511-SU
Uganda	July 1983	4453-UG
Nigeria	August 1983	4440-UNI
Nepal	August 1983	4474-NEP
Gambia	November 1983	4743-GM
Peru	January 1984	4677-PE
Costa Rica	January 1984	4655-CR
Lesotho	January 1984	4676-LSO
Seychelles	January 1984	4693-SEY
Niger	March 1984	4642-NIR
Portugal	April 1984	4824-PO
Morocco	March 1984	4157-MOR
Ethiopia	July 1984	4741-ET
Botswana	August 1984	4998-BT
Cape Verde	August 1984	5073-CV
Guinea-Bissau	August 1984	5083-GUB
St. Vincent and The Grenadines	September 1984	5103-STV

FOR OFFICIAL USE ONLY

Report No. 5103-STV

ST. VINCENT AND THE GRENADINES

ISSUES AND OPTIONS IN THE ENERGY SECTOR

SEPTEMBER 1984

This is one of a series of reports of the Joint UNDP/World Bank Energy Sector Assessment Program. Finance for this work has been provided, in part, by the UNDP Energy Account, and the work has been carried out by the World Bank.

ABSTRACT

St. Vincent is a small, open island economy with a limited market size and a large volume of external trade. Its future growth prospects depend on productive investments in agriculture, light industries and tourism, from which the economy is expected to show real growth of about 5% a year. Outstanding petroleum issues concern the country's complete dependence on imports, and high freight costs. Major power sector issues include high losses, the development of indigenous hydropower resources, power tariffs, and institutional arrangements. These issues are discussed at both a country and regional level with the resulting priority recommendations: (a) a study to determine a regional strategy to lower petroleum supply and transportation costs; (b) develop a petroleum pricing policy; (c) establish a forestry program to meet fuelwood shortages; and (d) implement a fuel substitution program in copra drying and tobacco curing operations. The Government already has agreed to implement the recommendations of the power loss reduction study.

ABBREVIATIONS AND ACRONYMS

Ag	American gallon
bbl	barrel
CAESP	Caribbean Alternative Energy Systems Project
CCS	Caribbean Community (CARICOM) Secretariat
CDB	Caribbean Development Bank
CDC	Commonwealth Development Corporation
CIDA	Canadian International Development Agency
c.i.f.	cost, insurance and freight
ECOs	Energy Conservation Opportunities
f.o.b.	free on board
GATE	German Appropriate Technology Exchange
GDP	Gross Domestic Product
GWh	gigawatt hour
ha	hectares
H-T	high tension
IBRD	International Bank for Reconstruction and Development
Ig	Imperial gallon
kcal	kilocalorie
kg	kilogram
kgoe	kilograms of oil eqivalent
kW	kilowatt
kWh	kilowatt hour
LPG	Liquefied Petroleum Gas
L-T	low tension
m^3	cubic meter
MCW	Ministry of Communications and Works
MTIA	Ministry of Trade, Industry and Agriculture
mpg	miles per gallon
MW	megawatt
MVA	megavolt ampere
OAS	Organization of Amercian States
OECS	Organization of the Eastern Caribbean States
p.a.	per annum
REAP	Regional Energy Action Plan (Caribbean)
SPC	safe plant capacity
T&D	Transmission and Distribution
T&T	Trinidad and Tobago
toe	tonne of oil equivalent
TORs	Terms of Reference
USAID	United States Agency for International Development
VINLEC	St. Vincent Electricity Services

CURRENCY EQUIVALENTS

Currency units	=	Eastern Caribbean dollar (EC$)
EC$1.00 = 100 cents	=	US$0.37
US$1.00	=	EC$2.70

ENERGY CONVERSION FACTORS

Fuel	toe per Physical Unit a/
Petroleum Products (tonnes) b/	
LPG	1.08
Gasoline	1.05
Kerosene/Jet Fuel	1.03
Diesel Oil (LDO)	1.02
Electricity	3,142 Btu/kWh c/
Biomass Fuels (tonnes)	
Charcoal	0.69
Firewood	0.33-0.35
Groundnut Husk/Shell	0.37

a/ 1 toe = 10 million kcal
= 6.61 boe
= 39.68 million Btu

b/ LPG = 1,730 liters/tonne
Gasoline = 1,357 liters/tonne
Kerosene/Jet Fuel = 1,229 liters/tonne
Diesel (LDO) = 1,187 liters/tonne

c/ Converted at end use thermal efficiency of 3,412 Btu/kWh.

This report is based on the findings of an energy sector assessment mission comprising Messrs. Zia Mian (Mission Chief), Trevor Byer (Power Sector - CDB), Ernesto Terrado (Biomass and Renewables), Sveinn Einarsson (Geothermal Specialist-UNDTCD), Robbert van Duin (Conservation Consultant) and Michael Morrison (Researcher), which visited St. Vincent between October 31 and November 14, 1983. Secretarial assistance was provided by Mr. Jagdish Lal. The report was discussed with the Government in August 1984.

TABLE OF CONTENTS

Page

ANNEXES

MAPS

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Overview

1. St. Vincent suffers from the problems faced by many small open economies: a limited domestic market and heavy reliance on external trade (1.2). Tourism and banana production dominate economic activities. As in the other LDC's of the Eastern Caribbean, there are major energy issues which also arise from the small size and openness of the economy as well as from the dependence of St. Vincent on developments in the region as a whole. 1/

2. Economic growth averaged about 7% p.a. between 1975 and 1978. The country then experienced two successive years of setbacks due to a volcanic eruption (1979) and a hurricane (1980). Economic growth fluctuated widely; in 1981 it was 12%, led by increases in agricultural and industrial production, but in 1982 it was 2.3%. Future growth prospects depend on productive investments in agriculture, light industries and tourism. 2/ In agreement with the Government, the mission has adopted a GDP growth rate of 5% p.a. through 1990 as a basis for energy demand projections. 3/

Petroleum Subsector Issues

Supplies

3. St. Vincent is totally dependent on imported petroleum products from Trinidad and Tobago, the Netherlands, Antilles and Venezuela. A small market of 370 barrels/day (BD) is shared between Shell and Texaco. The current freight cost of liquid petroleum products is estimated at US$2.93/bbl, which compares with the estimated Worldscale/AFRA freight

---

1/ The LDCs (Lesser Developed Countries) of the Eastern Caribbean include seven small island economies with populations ranging from 12,000 in Montserrat to 122,000 in St. Lucia. They all (Antigua and Barbuda, Dominica, Grenada, Montserrat, St. Kitts-Nevis, St. Lucia, and St. Vincent and the Grenadines) belong to the Organization of Eastern Caribbean States-OECS.

2/ During the green cover review in August, 1984, the mission was informed that the new Government was investigating the possibilities for constructing an international airport.

3/ Also see IBRD Report No. 4370-CRG, St. Vincent and the Grenadines Economic Situation and Medium-Term Prospects, April 1, 1983.

rate of US$0.45/bbl. The freight charged by the companies reflects the notional cost of moving small cargoes on a single destination loading/off-loading voyage basis. In the mission's view, it is possible to lower these costs by developing a regional supply, transport and storage strategy. The mission recommends a study to:

(a) establish the least-cost strategy for the supply, transport and storage of petroleum products to St. Vincent; and

(b) develop specific recommendations on a regional basis.

The terms of reference for this study are shown in Annex 1, Part A. The proposal was discussed with Esso, Shell, Texaco and Trintoc, who have indicated their willingness to provide cooperation and support. The mission recommends that independent consultants be used to do the study which is expected to cost US$120,000. The UNDP Caribbean Regional Petroleum Exploration Promotion Project has agreed to provide US$50,000 for the first phase of the study.

Petroleum Prices

4. Although the Government follows a sound policy of passing all costs to the consumer, it lacks the appropriate information and expertise to develop a petroleum pricing policy. A complex pricing structure has evolved over the years and the mission recommends that this be changed and cost elements be monitored to keep the costs within reasonable limits. A technical capability should be developed within the Energy Desk of the Central Planning Unit in the Ministry of Finance, to analyze and handle petroleum pricing matters. The mission recommends that the assistance (Annex 1, Part C) of a regional pricing/petroleum policy specialist should be used to develop this capability. The specialist started work with the OECS in July, 1984.

Power Sector Issues

Supplies

5. The St. Vincent Electricity Services Ltd. (VINLEC) is the sole supplier of commercial electric power in St. Vincent and the island of Bequia in the Grenadines. It also manages a small government-owned power station on Union Island. The system is integrated, with all generation tied into a common distribution system. Currently, thermal generation is diesel-based (62% of generation in 1982). In 1983, the safe plant capacity (SPC) was below peak demand which resulted in daily load shedding of up to 12 hours/day. VINLEC has acquired, on an emergency basis, three skid-mounted units of 600 kW each to solve this short-term problem.

6. The causes of this situation were:

(a) the breakdown of all four of the old diesel units at the Kingstown station;

(b) extensive outages on two of the three diesel units at the Cane Hall stations, which have experienced severe thermal stress and crankshaft problems; and

(c) an 18 month delay in procuring and commissioning a new 2,900 kW medium-speed diesel unit (Cane Hall No. 4).

The purchase of three new units will provide some relief until the Cane Hall No. 4 Unit is commissioned in 1984. During 1985, units one, two and three at the Cane Hall station will undergo major overhaul (50,000 hours) and rehabilitation. At that time, only two of these units would be available. It therefore will be necessary to keep all four units of the Kingstown station in service. These units are about 25 years old, fuel inefficient and can only be called on sparingly for peaking duty. However, they will provide a critical reserve for the system over the period to 1987 when the first phase of the Cumberland hydro project (Cumberland 1 and 2) should come on-stream.

Power Losses

7. VINLEC's transmission and distribution losses during 1982 amounted to about 23.3% of net generation and increased to 26.3% for the period ending March 1983 (12 months). This loss level is considered excessive for a utility whose sub-transmission and distribution systems are relatively small. Theft, obsolete sub-transmission/distribution facilities, overloaded equipment (transformers, conductors), lack of capacitor banks (required to reduce losses and to improve the system's power factor), and deficient metering equipment are the main causes of the high level of the system's losses. In 1983, CAESP financed a study to recommend measures to reduce these losses. The study has recommended an investment program of US$3.9 million (1983 prices) over the period 1985-88 to reduce non-technical and technical losses to 0.5% and 6.5% of net generation, from levels in 1982 of 10.8% and 12.5%, respectively. In 1982, technical losses represented foregone income to Vinlec of about EC$1.0 million p.a. compared to Vinlec's net income after tax of EC$859,000. The mission supports these targets and the Government has agreed with the Bank to implement the recommendations of this study during the construction of the Cumberland project. Some of the measures included in the investment program to reduce losses are:

(a) capacitor installation on the H-T system;

(b) restructuring the L-T system by overlaying it with H-T, reducing the area of coverage by each transformer, and the use of small, high-efficiency transformers;

(c) application of new standards incorporating larger conductor sizes and defining maximum lengths of L-T construction;

(d) productivity improvement measures in the Transmission and Distribution Department (T&DD); and

(e) new meter installation standards, replacement and sealing of meters and improvement of the meter testing facility.

Hydropower Resources

8. Although hydropower has played an important role, information on the hydrological characteristics of the island is poor. A rainfall and steam gauging network would be established on the important rivers during the Cumberland project. For this purpose, about US$181,000 has been provided in the Cumberland hydropower project.

9. The island's hydro potential was assessed in 1981/82, and schemes were identified 4/ with a combined installed capacity of about 15 MW and an annual average generation capability of some 80 GWh. As it is not possible to build storage reservoirs to regulate river flows, all potential projects are run-of-river and have only a few hours' storage. The investment cost for most of these schemes is excessively high. The Cumberland project has allocated US$340,000 to evaluate the feasibility of new hydroelectric schemes.

Power Tariffs and Investment Program

10. VINLEC experienced significant financial losses in 1979 and 1980. After some tariff adjustments, the situation improved in 1981 and 1982 at which point the company earned EC$859,000 (US$318,000) in net income after taxes. VINLEC continues to remain in a cash-starved position while it needs capital for the power sector investment program. The cash shortage also has affected maintenance programs. For example, on the H-T and L-T distribution systems, the lack of spare parts has led to fuses being bypassed, and improper connections are made which result in increased technical losses.

11. The company is about to embark on its largest ever expansion program over a five-year period (1984-88). This investment program is estimated at about US$21 million (1983 prices). When price and physical contingencies are accounted for this amounts to some US$30 million (current prices). Of this, VINLEC is expected to finance about 10% (US$3 million). The remainder of the financing would be provided by five agencies: CIDA, USAID, IDA, CDB and EIB.

12. Measures to reduce losses (especially non-technical ones) and to improve the efficiency of service and operations will need to be

---

4/ On the Cumberland, Buccament, Colonaire, Colonaire/Union, Yambou, Rabacca and Wallibon Rivers. In addition, expansion of the existing schemes on the Richmond and South Rivers.

supplemented by a series of annual tariff increases over the next five years, with increases of not less than the rate of inflation in each year. Such increases are essential both to improve the company's short-term cash position as well as to contribute towards financing its share of the investment program. Over and above this issue of the tariff level, the question of tariff structure needs urgent attention. A long-run marginal tariff study recently has been completed (May 1984) and will be reviewed by the Bank. As a part of the loan agreement on the Cumberland project, the Government agrees that it will approve the increases in tariffs to meet the agreed rate of return requirements.

Management Services

13. Under a 1973 agreement, the Commonwealth Development Corporation (CDC) provides VINLEC such advice as it requires on the management and operation of the company. CDC has informed the Government of its desire to sell its shares (51%) in VINLEC and to terminate the management agreement with VINLEC. The withdrawal of CDC would weaken the planning, training, technical and financial capabilities of VINLEC. The mission supports a study which has been proposed by the Regional Energy Action Plan (REAP) 5/ to determine management and other common services needed by the small island countries' utilities and establish common services arrangements.

Other Issues

Biomass

14. The country has a fuelwood supply deficit which is being met through clearings of secondary forest lands and illegal cuttings. In watershed areas, encroachment and deforestation may cause erosion in the long term and result in siltation at hydro development sites. The mission recommends the establishment of plantations of short-rotation fuelwood species in conjunction with a management program of existing forests to increase fuelwood yields. On the demand side there should be strict regulation of charcoal makers and forest tenants. Wood cutting 'permit fees' should be increased to reflect the economic costs. During the green cover review, the mission was informed that substantial developments in forestry have been made. CIDA and OAS are expected to finance forestry projects, and the Cumberland project includes US$500,000 to finance a watershed management program.

5/ The plan was prepared by the CDB/CARICOM for consideration by the Caribbean Group for Cooperation in Economic Development (CGCED).

Fuel Substitution

15. Regarding the possible substitution of petroleum fuels by biomass resources in the agro-industrial sector, adequate supplies of coconut husks and shells are available locally to replace the use of diesel and LPG in copra drying and tobacco curing. 6/ The mission's findings also confirm the potential for biogas production from arrowroot waste, or 'bittie', generated in starch recovery operations. However, any major investment in this area must await the results of the proposed demonstration plant at Wallilabou.

Geothermal

16. Geothermal manifestations outside the crater of the active Soufriere volcano are scarce or non-existent. Although the outside slopes of the volcano might have some thermal potential, the recurring volcanic eruptions inhibit development of such resources close to the volcano. The mission is uncertain about the geothermal potential and believes that no major investment in exploration should be made at this time. However, it would be useful, though not urgent, to do a reconnaissance survey.

Energy Conservation

17. Due to the small volume of energy use, old equipment, financial constraints and a major concern for secure electricity supplies (due to power outages), the establishment of a large investment program in energy conservation is not a priority issue. However, the mission recommends that the Government introduce a housekeeping and equipment maintenance program, particularly in the transport sector.

18. In summary, priority recommendations for the energy sector are to:

(a) implement a study to determine a regional strategy to lower petroleum, supply and transport costs;

(b) develop a petroleum pricing policy;

(c) implement a power loss reduction program;

(d) establish and restructure tariffs based on the results of a long-run marginal tariff study;

(e) establish a forestry program to meet fuelwood shortages; and

(f) implement fuel substitution in copra drying and tobacco curing.

6/ Tobacco is grown on the coconut plantations so there is little need to transport coconut wastes.

I. ENERGY AND THE ECONOMY

Country Situation

1.1 St. Vincent, situated in the Windward Islands of the Caribbean, has a total land area of 388 km^2, including the Grenadines, a band of nine small island dependencies (IBRD Map No. 17593). A range of volcanic mountains dominates the center of the island forcing almost all of the 113,400 inhabitants (1982 estimate) to live near the coast. St. Vincent's adult literacy rate is 82% (1981) and it is a member of three major regional organizations: the Organization of Eastern Caribbean States (OECS); the Caribbean Community and Common Market (CARICOM); and the Caribbean Development Bank (CDB).

1.2 St. Vincent is one of the less-developed countries in the Eastern Caribbean, with a per capita GDP of US$731 in 1982 (GDP was US$82.9 million in 1982). It suffers from the usual small economy problems of heavy dependence on a single sector, a small internal market, and vulnerability to variations in the size and structure of its external trade. The small size of the market makes it imperative that some of its economic and energy sector issues be addressed in a regional context. Exports of goods and services represent 63% of GDP; imports account for 87%. As a result of this openness and trade imbalance, the balance of payments on current account recorded a deficit of US$12 million in 1982 (14% of GDP). Tourism is a major source of foreign exchange earnings, providing half of the total in 1982. 7/ The principal crop, bananas, accounts for 18% of total exports, while the major manufacturing activity, flour production, contributed 12%. Consumer goods (food, beverages and manufactured goods) account for 57% of imports (1982) and the fuel bill for 7%. 8/

1.3 Economic growth between 1975 and 1978 was impressive (7% p.a.). Agricultural output rose significantly, 9/ a small manufacturing sector

---

7/ Total foreign exchange earnings amounted to US$25.9 million; nearly 40% of this was derived from the Grenadines islands of Bequia, Mustique and Union.

8/ In 1981, fuel imports (US$5 million) represented about 8% of total imports and 16% of exports.

9/ In 1978 the output of bananas, the main export crop, reached its highest level in 10 years.

emerged, 10/ and tourist receipts doubled. However, in 1979 and 1980, the country experienced two successive natural disasters; eruption of the Soufriere volcano and massive damage caused by Hurricane Allen. Agricultural output declined by 18% in 1979 and a further 14% in 1980. Banana exports were particularly hard hit, falling by nearly 40% in volume.

Table 1.1: GDP TRENDS, 1975-82
(1977 prices)

	1975	1978	1979	1980	1981	1982
GDP (million EC$)	72.0	89.0	91.7	93.7	104.7	107.1
% Growth p.a.	—	7.3	3.0	2.2	11.7	2.3

Source: IBRD - St. Vincent and the Grenadines: Economic Situation and Medium-Term Prospects, April 1983.

1.4 The economy, following a strong recovery in 1981 (12% growth), exhibited signs of a slowdown in 1982, with GDP growing by only 2.3%. The slowdown reflected weak performance in agriculture due to a drought in the early part of the year, a decline in tourism and only modest growth in the other economic sectors. Gross domestic savings which were positive in 1981 turned negative in 1982 as consumption expenditures grew by almost 9%. The level of gross domestic investment was maintained, however, at 25% of GDP as a result of the continuing high inflows of project-related external public assistance.

1.5 The slowdown in 1982 may persist in 1983. The growth rate over the medium-term is expected to average around 5%, led by a strong expansion in industry and a slower recovery in both agriculture and tourism. Public sector finances should be expected to improve as cost reduction and tariff measures are adopted to strengthen the relatively weak finances of non-financial public enterprises. The expansion in project-related activities suggests that imports of capital goods are likely to rise rapidly. Exports are projected to recover, especially during the second half of the 1980s, as new manufacturing establishments become fully operational and export agriculture becomes competitive, assuming cost reduction measures are implemented. The current account deficit of the balance of payments is thus projected to increase initially and decline later on.

10/ A new flour mill and a boxing plant completed their first full year of operation in 1978.

Energy Balance

1.6 Table 1.2 shows that in 1982, total primary energy supply was 39,300 toe, of which 24,960 toe were used in final consumption. Per capita final energy use was about 220 kilograms of oil equivalent (kgoe), while per capita commercial energy was only 156 kgoe. Petroleum imports accounted for 53% of inland (excluding aviation and bunkers) primary energy supply. However, this represents only 7% of the total import bill and 9% of foreign exchange earnings from goods and non-factor services. Hydro power accounted for 2% of total energy supply and 4% of commercial energy supply. Fuelwood and bagasse account for the other 45% of primary energy, but these resources only contribute 30% of final consumption due to the low conversion efficiency of charcoal production in the country. Electricity generation consumes 25% of imported petroleum (all diesel). Within the power sector, hydro accounts for 38% of supply, with diesel making up the remainder. The household sector is the largest category of energy end-use (36%), followed by transport (35%). Industry and agriculture account for 16%, while the government and commercial sector consume the remaining 13%.

Energy Demand Projections

1.7 Between 1982 and 1985, energy demand is projected to grow at 2.1% p.a., assuming that the power loss reduction program will be in place and that petroleum demand increases at 2.3% p.a. During this period, the demand for kerosene will fall to a 2.7% p.a. growth rate, and growth in gasoline demand will be 2% p.a., reflecting the replacement of the old vehicles with a fuel-efficient fleet, wider use of the public transport system, and implementation of an efficient maintenance program.

1.8 Biomass resource use will approximate the population growth rate. By 1988, the Cumberland hydropower project will come on-stream, and hydro will provide 81% of total power generation (2.15). Diesel oil use in the power sector will decline to some 1,800 toe, from 5,160 toe in 1982, because of: (a) a shift in power source; (b) a reduction in transmission and distribution losses; and (c) a reduction in conversion losses due to a decline in diesel generation. Energy demand growth will decline to 0.7% p.a. between 1985 and 1990. This decrease reflects a reduction in the conversion losses for power generation.

Investment Implications

1.9 Besides US$32.5 million (EC$87.8 million) in the power sector, an investment of US$1.0 million (EC$2.7 million) would be required for a five-year initial program to establish 250 ha of short-rotation species for fuelwood supplies. Additional investment may be required depending on the results of regional studies on petroleum supplies and arrangements for common services for the utility company.

Table 1.2: ENERGY BALANCE FOR 1982 a/
('000 toe)

	Fuelwood	Charcoal	Bagasse	Electricity	Gasoline	Diesel	Kerosene	LPG	Avgas	Total Petroleum	Total Energy
Gross Supply											
Production	15,30		2,10	0,95							18,35
Imports					7,35	10,18	1,18	2,24	0,24	21,19	21,19
Bunkers									(0,24)	(0,24)	(0,24)
Total Supply	15,30		2,10	0,95	7,35	10,18	1,18	2,24		20,95	39,30
Conversion											
Power Generation (thermal)				5,16		(5,16)				(5,16)	
Charcoal Production	(12,60)	12,60									
Conversion Losses		(10,10)		(3,61)							(13,71)
Own-Use Losses				(0,05)							(0,05)
T & D Losses				(0,57)							(0,57)
Net Domestic Consumption	2,70	2,50	2,10	1,88	7,35	5,02	1,18	2,24		15,79	24,97
Sectoral Consumption											
Transport:											
Road					6,35	1,10				7,45	7,45
Marine					0,10	0,82				0,92	0,92
Industry & Agriculture			2,10	0,30	0,52	1,02	0,08	0,07		1,69	4,09
Government and Commerce				0,72	0,38	2,08		0,23		2,69	3,41
Households	2,70	2,50		0,86			1,10	1,94		3,04	9,10

a/ Figures in brackets indicate negative numbers

Source: Mission estimates.

Table 1.3: PRIMARY ENERGY DEMAND PROJECTIONS
('000 toe)

	1982	1985	1990	1982-90
				(Growth % p.a.)
Petroleum Products	21.2	22.7	20.8	(0.2)
Biomass	17.4	18.5	20.4	2.0
Hydropower	1.0	0.9	2.4	12.3
Total	39.6	42.1	43.6	
Growth % p.a.	-	2.1	0.7	1.2

Source: Mission estimates.

II. PETROLEUM

Historical Demand

2.1 Between 1977 and 1982, total demand for petroleum products increased from 14.4 thousand toe to 21.2 thousand toe -- an average growth rate of 8.1% p.a. (Table 2.1). Diesel oil (12.6% p.a.) and LPG (12.5% p.a.) experienced the highest growth in demand during this period.

2.2 In 1977, diesel oil accounted for 39% of total petroleum consumption, increasing to 48% by 1982. About 50% of diesel oil (and 24% of total petroleum demand in 1982) is used by the power company (Table 2.1). A deterioration in the operation of existing diesel generation has caused uncertainty in the power supply situation. This has led to the installation of small, private standby diesel units to generate power during outages (which at times have lasted for 12 hours). Extensive use of these standby power generators in the industrial and commercial sectors has also caused an increase in diesel use. LPG demand increased due to: (a) households substituting for kerosene (2.9% p.a. decline 11/ between 1977-82) in cooking; (b) growth in the tourist sector (hotels and restaurants) 12/; and (c) the emergence of a tobacco industry which uses LPG for leaf-curing. 13/

Table 2.1: PETROLEUM PRODUCT DEMAND, 1977-82
('000 toe)

	1977	1978	1979	1980	1981	1982	Growth (% p.a.)
Avgas	0.24	0.17	0.30	0.24	0.38	0.24	--
Gasoline	5.91	6.10	6.58	6.47	6.59	7.35	4.5
Diesel	5.62	6.40	8.83	8.98	9.94	10.18	12.6
Kerosene	1.37	1.43	1.17	0.95	1.15	1.18	(2.9)
LPG	1.24	1.21	1.73	1.85	1.85	2.24	12.5
Total	14.38	15.31	18.61	18.49	19.91	21.19	8.1

Source: Oil industry.

11/ The decline in kerosene also has been due to an increase in the number of households which have been electrified over the period.

12/ Between 1977 and 1982, the total number of visitors staying in hotels and guest houses increased by 13% p.a.

13/ Commercial production of Virginia tobacco began in 1978, and by 1982 it had reached a production level of about 70 tonnes p.a. of cured leaf.

2.3 Between 1977 and 1982, the number of cars and buses increased at 7.2% p.a., while gasoline consumption only increased at 4.5% p.a. There are two underlying trends which can account for this: (a) increasing imports of fuel-efficient vehicles (below 2000 cc); and (b) an improving public transport system. 14/

2.4 Table 2.2 shows petroleum demand by economic sectors (1982). Transport, in all forms, is the largest consumer (41%), followed by the power sector (24%). Direct household use is about 14%, the productive sectors (industry and agriculture) use only 8%, while the Government and commercial users account for the remaining 13%.

Table 2.2: PETROLEUM PRODUCT DEMAND BY ECONOMIC SECTOR, 1982
('000 toe)

Sector	Avgas	Gasoline	Diesel	Kerosene	LPG	Total	Percent
Aviation	0.24					0.24	1.1
Power Generation			5.16			5.16	24.4
Industry		0.05	0.82			0.87	4.1
Agriculture		0.47	0.20	0.08	0.07	0.82	3.9
Government		0.38	0.45			0.83	3.9
Commerce			1.63		0.23	1.86	8.8
Road Transport		6.35	1.10			7.45	35.2
Marine		0.10	0.82			0.92	4.3
Households				1.10	1.94	3.04	14.3
Total	0.24	7.35	10.18	1.18	2.24	21.19	100.0
%	1.1	34.7	48.0	5.6	10.6	100.0	

Source: Oil industry and Custom's records.

Petroleum Supplies and Distribution

2.5 In August 1981, Esso decided to pull out of the small markets in the Eastern Caribbean, selling all its assets to Shell. Two companies, Shell and Texaco, now share the 370 barrels per day (BD) market. All refined petroleum products are imported, mainly in 15,000 bbl capacity tankers which arrive, on average, every two weeks. The cargoes are

---

14/ The number of mini-buses has increased at a rate of 28% p.a. since 1977. These predominantly consist of imports which have a fuel efficiency of 18-20 mpg.

shared with other islands in the region. For example, a tanker loading at Texaco's Point-a-Pierre refinery in Trinidad may partly off-load in the British Virgin islands, Saba, Nevis, Montserrat, and Marie Galante, taking about five days before arriving in St. Vincent.

2.6 Currently, Trinidad and Tobago (T&T) and Curacao are the two main suppliers of petroleum products, with the former enjoying an advantage due to the common tariffs policy arrangement under the CARICOM Treaty. T&T had initiated an oil-financing facility 15/ to insulate CARICOM trading partners from short-term petroleum price increases. However, most of the Eastern Caribbean States have yet to receive financial assistance under this arrangement. Considering recent political and economic developments, the facility is not expected to continue. In 1982, about 80% of product imports originated from Trinidad and the balance from Shell's refinery in Curacao. The Government has no freight policy, and the costs are based on submissions from the oil industry. Currently, freight costs are estimated at US$2.93 per bbl, which compares with estimated World Scale/AFRA freight rates of US$0.45/bbl. 16/ The freight charged by the companies appears to reflect the notional cost of moving small cargoes on a single voyage basis from the point of loading, to each of the islands taken separately (IBRD Map No. 17800). The system operated by the companies differs from this in that cargoes are moved on a multiple destination voyage basis from the point of loading (2.5). In this way, freight costs are lowered to the companies. An important issue is: what is the difference in freight costs for small cargoes of the single versus multiple destination operational mode? Secondly, are there any economies to be gained by the use of larger tankers (given port limitations in certain destinations) moving larger cargoes to each island, on a multi-destination basis, more infrequently, and hence requiring the maintenance of higher inventories in each island? If there are economies in such a mode, what is the size of the potential savings? Finally, in the case of LPG, these issues are quite critical given that current freight costs (US$14/bbl) are about 50% of the f.o.b. price. The mission believes that these costs can be brought down by developing a least-cost regional transportation and supply strategy operated by the oil industry and has developed terms of reference for such a study (Annex 1-A).

15/ The facility which became retroactively effective on January 1, 1980 provided loans (15 years maturity, including 3 years grace at 2% p.a. interest) to meet the incremental cost of petroleum products over a base price obtained on January 1, 1979.

16/ These rates, however, apply to 16,000 DWT and larger tankers which cannot call at all terminals in the region. The calculations are based on World Scale quotations for the nearest Caribbean off-loading port and current World Scale/AFRA.

2.7 Texaco owns and operates a bulk terminal for LPG only, with storage capacity of 930 bbls, which covers about 25 days supply. 17/ Shell owns and operates a terminal (formerly owned by Esso) for all other petroleum products 18/ which has a capacity of 15,556 bbls, providing coverage for 45 days. The storage capacity and inventory management need to be reviewed as part of the regional least-cost petroleum supplies study (2.6).

2.8 The country is served through a network of about 13 retail outlets on St. Vincent and one each on Bequia and Union. 19/ Shell directly markets and transports diesel oil and gasoline; however, it uses contractors to haul and sell kerosene in rural areas. Texaco operates through a distribution agent who uplifts products from the Shell terminal. For this service, the agent receives a distribution fee of EC¢10/Ig (US¢3.1/Ag). The mission believes that the presence of two marketing companies in a small market of this size contributes to high distribution costs, 20/ and recommends that the Government give consideration to rationalizing market representation. The level of distribution and marketing costs in the small island economies in the Eastern Caribbean is another issue which should be addressed, but on a country-specific basis.

Petroleum Prices

2.9 Between 1977 and 1982, retail prices of controlled petroleum products (i.e. gasoline, diesel and kerosene) rose 16-20% p.a. on average (Table 2.3). However, up to November 1983 there had been no price increases over the previous year, mainly as a result of downward trends in international petroleum prices.

2.10 The Ministry of Trade, Industry and Agriculture (MTIA) is responsible for the pricing of petroleum products. The Government has followed a sound practice of passing all costs on to the consumer and no products are subsidized. However, there is no stated pricing policy and price adjustments are made on an ad-hoc basis in response to industry requests. The Government lacks the appropriate information and expertise to analyze the various cost elements within the petroleum pricing

---

17/ At 1982 consumption levels.

18/ Texaco draws other products from Shell's bulk terminal and pays a throughput charge of EC¢9.89/IG (USc3.1/AG).

19/ Currently, products are ferried to the Grenadines islands in drums. However, by the end of 1984, a 2,000 bbl storage terminal in Bequia will be completed and tankers are expected to off-load products directly.

20/ Current company margins are ECc70.6/Ig (USc21.8/Ag).

structures. A complex pricing structure has evolved which includes six types of taxes (Table 2.4) which are levied in response to Government revenue needs. 21/

Table 2.3: RETAIL PRICES OF CONTROLLED PETROLEUM PRODUCTS, 1977-82 a/ (EC$/Ig)

	1977	1978	1979	1980	1981	1982	Growth (% p.a.)
Gasoline	2.66	2.85	3.95	4.86	5.21	5.62	16.1
Diesel	1.99	2.13	3.32	4.10	4.36	4.85	19.5
Kerosene	1.90	2.07	3.66	4.15	4.30	4.71	19.9

a/ Prices on Bequia and Union Island in the Grenadines are EC¢20-40/Ig higher. This represents the transport cost to these islands from St. Vincent.

Source: Government of St. Vincent.

Table 2.4: RETAIL PRICE STRUCTURE OF CONTROLLED PETROLEUM PRODUCTS a/

Price Elements	Gasoline		Diesel Oil		Kerosene	
	(EC¢/Ig)	(US¢/Ag)	(EC¢/Ig)	(US¢/Ag)	(EC¢/IG)	(US¢/Ag)
F.O.B.	274.08	84.59	278.98	86.10	300.18	92.65
Freight	19.81	6.11	19.81	6.11	19.81	6.11
Insurance	0.15	0.05	0.15	0.05	0.15	0.05
C.I.F.	294.04	90.75	298.95	92.27	320.16	98.81
Import Duty	30.00	9.25	6.00	1.85	6.00	1.85
Consumption Tax	33.00	10.19	12.00	3.70	5.00	1.54
Remittance Tax	5.88	1.81	5.98	1.85	6.40	1.98
Stamp Duty	22.05	6.80	22.42	6.92	24.01	7.41
Tax Paid Cost	384.97	118.82	345.35	106.59	361.57	111.60
Excess Margin	10.00	3.09	—	—	—	—
Company Margin	67.61	20.87	67.61	20.87	67.61	20.87
3% Traders Tax	13.88	4.28	12.39	3.82	12.88	3.98
Wholesale Price	476.46	147.06	425.35	131.28	442.06	136.44
Retailers Margin	41.00	12.65	25.00	7.72	25.00	7.72
3% Traders Tax	15.52	4.79	13.51	4.17	—	—
Retail Price	533.00	164.51	443.00	136.73	456.00	140.70

a/ Price elements are for illustrative purposes only and do not add to the controlled retail price prevailing at the time of the mission.

Source: Calculated on the basis of data from the Government and oil industry.

21/ However, the Government, the power company and a number of other major consumers are exempted from paying taxes for petroleum purchases. Furthermore, there is a history of certain taxes being waived when implementation problems have been encountered.

2.11 The relative tax levels are highest on gasoline (22.6% of retail price), followed by diesel (16.3%) and kerosene (11.9%). The mission recommends that in order to remove complexities in the pricing structure and monitor various cost elements, petroleum products should be treated as a special commodity (for tax purposes). A long-term pricing policy should aim to present consumers with the correct signals regarding relative economic value of various products and encourage energy conservation and interfuel substitution. The price of LPG is not controlled, but the Government is informed of changes by the industry. This product is also subject to five categories of taxes (Table 2.5).

Table 2.5: PRICE STRUCTURE OF LPG a/

Pricing Elements	EC¢/lb	US¢/lb
F.O.B.	41.18	15.25
Freight	19.86	7.36
Insurance	0.03	0.01
C.I.F.	61.07	22.62
Consumption Tax	3.00	1.11
Stamp Duty	4.58	1.70
Remittance Tax	1.62	0.60
Traders Tax	0.46	0.17
Duty Paid Cost	70.73	26.20
Marketers Margin	45.56	16.87
Traders Tax	3.60	1.33
Current Selling Price		
20 lb bottle	110.50	40.93
100 lb bottle	108.45	40.17

a/ Price elements may not add up to totals and are only for illustrative purposes.

Source: Mission estimates based on data from the oil industry.

2.12 Marketers' and retailers' margins are high because of low sales volume and hence high allocated expenses. In the mission's view, the cost of distribution can be reduced if internal marketing is rationalized. 22/ As an example, Texaco claims and receives EC¢10/Ig in extra margin to cover its marketing costs stated to be over that of Shell, 23/ even though it operates through a distributor and does not maintain local

---

22/ Import costs may also be reduced if a regional petroleum supplies procurement/transportation system is established (Annex 1).

23/ Shell collects EC¢10/Ig extra from customers but pays it to the Government.

office. This preferential treatment may have resulted because Texaco is the sole supplier of banana spray oil (Spraytex) and the Government is concerned about the continued supply of this product.

2.13 The mission recommends that the Government create technical capabilities within the Energy Unit in the Ministry of Planning to handle petroleum pricing matters, establish files of relevant data and develop appropriate pricing policies and strategies. The mission also recommends that technical assistance be arranged on a regional basis (Annex 1-C) to develop petroleum pricing capabilities in all Eastern Caribbean islands.

Demand Projections

2.14 The mission projects the petroleum product demand to increase at 2.3% p.a. during the next three years. Diesel oil use in the power sector is expected to increase to some 5,700 toe by 1985, implying a 3.4% p.a. growth between 1982 and 1985 with use in the non-power sector increasing at about 2.3% p.a. Between 1985 and 1990, total petroleum demand is projected to decline at 1.7% p.a. (Table 2.6). Avgas demand should remain static. Any marginal increase in aviation fuels will be absorbed by kerosene (jet fuel). Gasoline demand should increase at about 2% p.a. or less than half the recent historic growth rate. This reflects a replacement of the old vehicle fleet by fuel-efficient cars and buses, and a higher utilization of the expanding and possibly more efficient public transport system and a change in the GDP growth trend. Considering the condition of the roads, the mission recommends that a concerted effort be made to improve road maintenance as well as car maintenance. 24/

Table 2.6: PETROLEUM DEMAND PROJECTIONS TO 1990

	1982	1985	Growth 1982-85	1990	Growth 1985-90
	('000 toe)	('000 toe)	(% p.a.)	('000 toe)	(% p.a.)
Avgas	0.2	0.2	-	0.2	-
Gasoline	7.4	7.8	2.0	8.6	2.0
Diesel	10.2	11.1	3.0	7.8	(6.8)
Kerosene	1.2	1.1	(2.7)	1.3	(3.0)
LPG	2.2	2.5	3.1	2.9	3.1
Total	21.2	22.7	2.3	20.8	(1.7)

24/ The issue of whether to use diesel or gasoline to fuel a mini-bus transport system will be addressed by CAESP through a study which is being financed by USAID.

2.15 A dramatic change will occur in the power sector's use of diesel oil in 1989 when the Cumberland hydro project comes on-stream. In 1990, hydro would supply 82% (27.5 GWh) of generation. This is in contrast to 38% (11 GWh) in 1982. Diesel oil use in the power sector by 1990 will decline therefore to some 1,600 toe from 5,160 toe in 1982. With non-power sector use of diesel oil expected to grow between 1985 and 1990 at about 2% p.a., consumption outside of the power sector in 1990 will be about 6,000 toe. This implies that total consumption of diesel oil will drop to some 7,800 toe in 1990 compared to 11,100 toe in 1985, a decline of 6.8% p.a.

2.16 The downturn in kerosene demand is expected to continue, so by 1990 demand should stabilize at about 6,000 barrels per year by 1990. LPG demand is believed to be reaching a maturity point and will not continue to grow at recent historic rates. Lower future growth (3.1% p.a. in the long term) will mainly reflect improvements in income and also the possible substitution of LPG by biomass resources in the tobacco industry. By 1990, total demand for petroleum will be about 20,800 toe — about 2% below that in 1982. The Cumberland project would have enabled the country to end the decade with roughly no increase in oil use relative to 1982.

Outlook for Petroleum Exploration

2.17 Like most of the Eastern Caribbean area, St. Vincent is considered by the oil industry to be a high-risk country for exploration. A World Bank exploration consultant confirmed this general conclusion in 1980 after reviewing the geology of the region, which is largely volcanic. Since less is known about the subsurface offshore, some interest in this area has been shown by a small foreign oil company in recent years. To date, however, no exploration contracts have been concluded.

2.18 In the winter of 1983/84, the Petro Canada International Assistance Corporation (PCIAC), an official entity of the Government of Canada, undertook on a grant basis an offshore seismic survey in the waters of the Tobago Basin, adjacent to St. Vincent, Barbados, Grenada, and St. Lucia. The data acquired is now being interpreted in Canada. In this connection, the World Bank, as executing agency for a UNDP project (Regional Caribbean Petroleum Exploration Promotion), will follow up on this. The Caribbean Regional Petroleum Exploration Project has been approved by the member States and the UNDP and is now in operation. The PCIAC project is expected to complement the scope of the UNDP project. Under the UNDP project, seminars will be designed to familiarize small groups in the governments of the Caribbean countries, including St. Vincent, with the basic activities and skills required to monitor oil exploration programs. There is no assurance that the results of the seismic survey will warrant exploration drilling in this area, or for that matter, anywhere in the Eastern Caribbean. If the results are positive, however, the UNDP project would, at low cost, prepare government personnel to monitor company exploration activities in an efficient manner.

III. ELECTRICITY

Supply/Demand

3.1 St. Vincent Electricity Services Ltd. (VINLEC) is the sole supplier of commercial electric power in St. Vincent and the island of Bequia in the Grenadines. The St. Vincent system is integrated, with all generation tied into a common distribution system. Currently, thermal generation is diesel oil-based, providing 62% of generation in 1982 through two stations (Kingstown and Cane Hall). Kingstown has a total installed capacity of 2,075 kW (four units: 1 x 315 kW, 1 x 460 kW, and 2 x 650 kW), while Cane Hall has 3,650 kW (1 x 1,126 kW, and 2 x 1,262 kW). There are two hydroelectric stations which contribute the other 38% of generation (1982); South Rivers (870 kW) on the eastern side of the island, and Richmond (1,100 kW) on the western side.

3.2 VINLEC delivers electricity to its customers through an 11-kV and 6-kV sub-transmission system of about 130 km in length covering the southern, western and eastern parts of the island. A total of 10 MVA step-down transformer capacity at several substations and 650 km of 415 V and 240 V distribution lines account for the distribution part of the system.

3.3 Bequia is supplied by a single generating station equipped with four 200-kW diesel units. Dependable available capacity at this station is about 525 kW due to the de-rating of these units below their nominal capacities. Units 1-3 were commissioned in 1968 and unit 4 in 1982. The distribution consists of 415 volts, three phase lines direct from the generating unit busbars to Hamilton and Port Elizabeth and 3.3/11 kV lines to St. Hilary. From the 3.3/11 kV line, secondary distribution is three phase at 415 volts.

3.4 Table 3.1 shows that total gross generation increased from 18.6 GWh in 1977 to 29.0 GWh in 1982 (9.3% p.a.). Between 1979 and 1982, growth was lower (5.7%) than between 1977 and 1979 (14.9% p.a.), reflecting the damage caused by a hurricane and a volcano eruption and the fact that between 1977 and 1979 a flour mill began operations. There was also a significant rise in line losses, load shedding increased due to forced outages, and economic conditions deteriorated. Line losses increased from 16% of net generation in 1979 to 23% in 1982. 25/ A power loss reduction study has recently been completed by consultants and their recommendations are discussed in paras 3.16-3.17.

25/ Line losses are estimated as the difference between net generation and sales; therefore, both technical and non-technical (faulty metering, power theft, etc.) losses are included.

3.5 Maximum demand registered lower growth (4.8% p.a.) than generation since 1977, indicating an improving system load factor. 26/ Increased industrial sales have been a major factor in this trend; however, high load shedding also may be responsible for artificially inflating the system load factor. During November 1983, load shedding was at a level of about 12 hours/day, because of forced outages involving all four diesel units at Kingstown and one unit at Cane Hall. It has been estimated that between January and November of 1983, about 1 GWh of generation (3.5%) has been lost due to load shedding, with an average of 800 kW of load being truncated during the evening peaks and also during the day time. The collapse of the supply system has been the most serious problem facing the sector and has become worse since 1981, culminating in November 1983 with the loss of one of the Cane Hall units and the entire Kingstown station. Indeed, the chief concern of electricity consumers (especially in the industrial and commercial sectors) has been with supply and not at all with price. This low level of supply security has given rise to a large increase in captive power generation with imports of these sets increasing significantly in 1983.

Table 3.1: ST. VINCENT POWER GENERATION, 1977-82

	1977	1978	1979	1980	1981	1982	Growth % p.a.
Gross Generation (GWh)	18.6	22.1	24.6	25.8	26.3	29.0	9.3
Diesel (GWh)	10.2	12.2	14.9	15.7	15.8	18.0	11.9
Hydro (GWh)	8.4	9.9	9.7	10.0	10.5	11.0	5.6
Maximum Demand (MW)	4.1	4.8	4.9	4.6	5.0	5.2	4.8
System Load Factor (%)	51.7	53.2	57.4	63.5	64.3	63.7	4.3

Source: VINLEC.

3.6 Total sales to final consumers grew from 15.2 GWh in 1977 to 21.8 GWh in 1982, an average rate of 7.5% p.a. (Table 3.2). There is an even more pronounced difference in growth between the two sub-periods 1977-79 (15% p.a.) and 1979-82 (2.7% p.a.) for sales than for generation. The high growth in the earlier period largely reflects the flour mill commencing operations in 1978. The mill accounts for nearly 70% of industrial sales, with four other establishments, a dairy, feed mill, a container plant, and copra factory accounting for a further 15%. Growth in domestic sales has averaged 5.5% p.a. between 1977 and 1982. This appears to reflect only increases in population (1.8% p.a.) and the number of new connections (4.5% p.a.), since average consumption has only increased from 73 kWh/month in 1977 to 76 kWh/month in 1982. In 1982,

---

26/ From 51.7% in 1977 to 63.7% in 1982.

commercial sales accounted for 37% of total sales, consisting of approximately 1,200 customers with an average consumption of 540 kWh/month. Growth averaged 6% p.a. between 1977 and 1982, with population and GDP being the main determinants. 27/

Table 3.2: ST. VINCENT ELECTRICITY SALES, 1977-82
(GWh)

	1977	1978	1979	1980	1981	1982	Growth % p.a.
Total sales	15.18	17.67	20.09	19.65	20.40	21.78	7.5
Domestic	7.64	8.05	8.76	8.93	9.17	9.97	5.5
Commercial	5.95	6.74	7.11	7.11	7.60	7.97	6.0
Industrial	1.26	2.58	3.91	3.23	3.24	3.44	22.2
Street Lights	0.32	0.31	0.31	0.39	0.39	0.40	4.6

Source: VINLEC.

3.7 Total sales to consumers in Bequia increased at an average annual rate of 3.1% between 1977 and 1983, from 703 MWh in 1977 to 843 MWh in 1983. Domestic sales account for about two-thirds of total sales. This relatively slow rate of growth in electricity sales contrasts with that of peek demand, which rose from 268 kW in 1977 to 375 kW in 1983 -- an average rate of 5.8% p.a.

Electricity Tariffs

3.8 Under the Electricity Supply Act of 1973, applications for rate increases are submitted to the Ministry of Communication and Works (MCW), which in turn makes recommendations to the Cabinet. If the request for a rate increase is rejected by the Cabinet, then the Act allows for arbitration.

3.9 The tariff structure has two basic components: a base tariff (of which there are four categories -- domestic, commercial, industrial

27/ Based on analysis done by Shawinigan Engineering Company Limited for the World Bank in 1982.

and street lighting) and a fuel surcharge. 28/ The fuel surcharge represents increases in diesel fuel costs since October 1973. Table 3.3 shows that the fuel surcharge has been the major source of electricity price increases in recent years. Whereas in 1979 the surcharge accounted for 25% of total revenues, by 1982 it had climbed to 35%. However, these increases have been insufficient to offset rising generation costs and, as a result, VINLEC experienced operating losses in 1979 and 1980. Furthermore, since VINLEC became operational as a limited company in 1973, few dividends have been paid and the company has been unable to make repayments of principal on loans to the CDC. 29/ Tariffs increased at about 1.4% p.a. in real terms over the 1972-82 period, essentially to meet increased fuel costs.

Table 3.3: AVERAGE REVENUE AND FUEL SURCHARGE, 1979-82
(ECc/kWh)

	1979	1980	1981	1982	Growth (% p.a.)
Average Revenue (excluding fuel surcharge)	19.5	24.9	26.8	30.5	16.2
Percentage Growth	--	27.7	7.6	14.2	--
Fuel Surcharge	6.5	12.1	16.2	16.5	36.4
Percentage Growth	--	86.2	33.9	1.9	--

Source: VINLEC.

3.10 The last tariff increase became effective from January 1, 1983, and the current rate structure for each class of consumers is shown in Table 3.4. The Government enjoys a 10% discount on all its bills, 30/ and a few of VINLEC's largest customers, including the flour mill, are given a 5% discount if bills are settled within seven days. 31/ It seems

---

28/ The fuel surcharge is calculated by dividing the total cost of fuel above the base price (EC$0.5284 per IG) by total electricity sales each month. The major deficiency with this approach is that no target heat rates are included, nor are system losses accounted for, thereby providing the utility with little incentive to reduce these. These issues are to be addressed in a tariff study initiated under the CAESP.

29/ These were rescheduled on three occasions: 1975-89, 1978-92 and 1983-96.

30/ The justification of which is unclear.

31/ The possibility of extending this incentive to other users should be examined as a means of reducing accounts receivable.

that this incentive has improved the cash flow position of the power company. Currently, a long run marginal cost tariff study is being done by consultants financed under the Caribbean Alternative Energy Systems Project (CAESP) which will recommend changes in the structure and level of tariffs to reflect the economic costs of supply.

Hydropower

3.11 In 1981/82, a UNDP-financed study 32/ examined the hydropower potential of five rivers: Cumberland, Colonaire, Colonaire/Union, Buccament and Yambou. In addition, the potential of expanding the two existing hydro schemes, South Rivers and Richmond, was also assessed, as well as a tentative review of the two northern rivers — the Wallibou and Rabacca.

3.12 Among the rivers studied, there is little variation in topographical and geological conditions. There is no economic possibility of significant storage reservoirs being built to regulate the river flows so that all hydro projects are of the run-of-the river mode with a maximum storage of a few hours. Although hydro has formed an important part of the St. Vincent power system for several years, the hydrological characteristics of the island pertinent to hydropower development are poorly understood. Rainfall data are adequate, but virtually no useable data on river flows exist save for one record at the existing South Rivers and Richmond plants. Average river flows had to be estimated from rainfall data over the drainage area less evapo-transpiration. Indeed, one of the critical investments that must be undertaken to ensure an adequate data base for hydro development in the 1990s is the establishment of a rainfall and stream gauging network on the rivers of potential importance. Some US$225,000 is provided for this in the Cumberland project.

3.13 In the case of the Wallibou and Rabacca Rivers, the consultants did not undertake any site reconnaissance. Hence estimates for these rivers must be viewed with caution. The flow pattern of these rivers is uncertain due to the loss of vegetative cover in the watershed area caused by the eruption of the volcano in 1979. Table 3.5 summarizes the estimated investment costs of developing the different schemes in 1982 prices.

32/ "St. Vincent Hydroelectric Scheme - Inception Report" (October 1982), Shawinigan Engineering Co.

3.14 Three main conclusions are:

(a) Developing St. Vincent's hydro potential would involve high cost schemes with investment costs ranging from US$4,000-7,100/kW. 33/

(b) The total installed potential of all schemes is about 15 MW with an annual average energy generation capability of some 80 GWh.

(c) Though the hydro resources are significant relative to current and projected power requirements, the economics of developing a large number of these schemes (Yambou, Colonaire and Colonaire/Union and Buccament-2) is marginal at current petroleum prices. These schemes would need careful evaluation before development. The Cumberland project has made financial provisions for this purpose.

Table 3.4: ELECTRICITY TARIFFS FOR ST. VINCENT, 1983 a/

	Charge (EC$/kWh)
Domestic	
Monthly minimum charge	5.85
Unit charge (EC$/kWh)	0.325
Commercial	
Monthly charge based on floor area b/	0.42
Unit charge (EC$/kWh) c/	0.34
Industrial	
Demand charge per kW d/	6.00
Unit charge (EC$/kWh)	0.28
Street Lighting	
Unit charge (EC$/kWh)	0.36

a/ Does not include Bequia. Rates there are 6-8% higher.
b/ Based on floor area in square feet divided by 50.
c/ Does not include surcharge, which averaged EC$0.155/kWh during 1983.
d/ Based on the installed capacity of connected motors and appliances.

Source: VINLEC.

33/ The Wallibou scheme is tentatively estimated to cost US$3,520/kW.

Table 3.5: POTENTIAL HYDRO POWER SCHEMES, 1982
(US$)

	Installed Capacity (kW)	Average Annual Energy (MWh)	Unit Costs Costs (US$/kW)
Cumberland - 1	1,370	8,230	4,300
Cumberland - 2	1,200	7,270	3,025
Cumberland - 3	800	4,950	4,350
Total	3,370	20,450	4,312
Buccament - 1	740	4,600	4,520
Buccament - 2	660	4,100	6,410
Total	1,400	8,700	5,410
Colonaire/Union - 1	1,040	6,500	5,040
Colonaire/Union - 2	1,040	6,500	4,670
Total	2,080	13,000	4,850
Colonaire - 1	590	3,700	5,520
Colonaire - 2	660	4,100	6,000
Total	1,250	7,800	5,780
Yambou - 1	490	3,100	7,110
Yambou - 2	700	4,300	5,780
Total	1,190	7,400	6,330
Rabacca	2,450	15,300	4,220
Wallibou	3,250	20,300	3,520
Expanded South Rivers a/	700	4,200	5,110
Expanded Richmond a/	1,040	5,000	4,070

a/ The South Rivers and Richmond schemes involve expansion and modification of the existing schemes. All data represent incremental capacity and costs.

Geothermal

3.15 Manifestations of geothermal activity outside the crater of the active Soufriere volcano are scarce and are not likely to be economically significant. Although a survey of the outside slopes of the volcano might reveal some thermal activity, the recurring volcanic eruptions inhibit development of such potential in any area around the Soufriere. The mission is not optimistic about the geothermal potential in the country and believes that exploration expenditures are not warranted at this time. However, it might be useful to do a reconnaissance survey to confirm these findings.

Power Sector Issues

Power Losses

3.16 Losses over the period 1977 to first quarter 1983 on the VINLEC system show an increasing trend (Table 3.6). System losses increased from 16.4% of net generation in 1977 to 23.3% in 1982. By first quarter 1983, they rose to about 29% of net generation, with losses over the 12-month period -- April 1982 to March 1983 -- being 26.3%. The new high level of losses in 1980 (above 20% of net generation) coincided with a hurricane which damaged equipment, a fire which destroyed company records, and the effects of a volcano eruption in 1979.

3.17 Recognizing the need to reduce losses, a power loss reduction study was done 34/ in 1983. The study identified the level and source of technical losses on the system and by difference estimated the size of non-technical losses. Table 3.7 shows that both the technical and non-technical losses are excessive. The non-technical losses are of immediate concern to VINLEC in that they represent foregone income of about EC$1 million p.a. (US$370,000) and are reflected in the current cash shortage. Indeed, to place this in its proper perspective, VINLEC's net income after tax in 1982 was EC$859,000 (US$318,000).

Table 3.6: VINLEC POWER LOSSES, 1977 - FIRST QUARTER 1983

	1977	1978	1980	1982	1983 a/	1983 b/
Total Energy Generated (GWh)	16.6	22.1	25.8	29.0	7.4	29.1
Utility's Own Use (GWh)	0.5	0.6	0.6	0.6	0.2	0.7
Net Generation (GWh)	18.2	21.6	25.1	28.4	7.2	28.8
Sales (GWh)	15.2	17.7	19.6	21.8	5.1	21.2
System Losses (GWh)	3.0	3.9	5.5	6.6	2.1	7.6
System Losses (% of net generation)	16.4	18.2	21.7	23.3	29.0	26.3

a/ First quarter 1983 results.
b/ 12-month period to March 1983.

34/ "Power Transmission and Distribution Loss Reduction Study - St. Vincent, Bequia and Union Island" (February 1984) by Adair and Brady International Inc., financed under the CAESP.

Table 3.7: LEVEL AND SOURCES OF SYSTEM LOSSES, 1982
(% of net generation)

	Percent
Technical Loss Component	
Step-up Transformers	2.0
Primary System	1.6
Distribution Transformers	2.4
Secondary Lines and Services	6.5
Total Technical Losses	12.5
Non-Technical Losses	
(Theft, inadequate records and metering	10.8
Total Losses	23.3

Source: VINLEC.

3.18 Nontechnical Losses. The non-technical losses appear to be due to: (a) theft; (b) customers not being billed since their records were never reestablished after the fire; (c) customers who have services installed but are not billed because the required information is not sent from the T&D department to the billing department; and (d) meter inaccuracy and poor security of meters (a number of old 5 amp meters severely damaged by overload were found during the study). In two cases, the energy recorded was less than one third of that being consumed.

3.19 Theft appears to be the most serious cause of non-technical losses. This is especially onerous since the study established that some of the largest consumers are involved. Such identified irregularities among about 12 customers accounted for about 3.1% of net generation, resulting in lost revenue to VINLEC of some EC$260,000 p.a. (US$96,000) 35/ or just less than one third of net income after tax for 1982. A further effect of the high non-technical losses is to increase the unit fuel adjustment charge to billable consumers. For example, in 1982, VINLEC's fuel cost above that in the rate base amounted to EC$3.6 million (US$1.3 million) which, when based on billings, gave an average unit fuel surcharge of EC¢16.5/kWh (US¢6.1/kWh). If all of the non-technical losses had been captured as sales, then the unit fuel surcharge to all billed customers would have been reduced by some 12%, to EC¢14.5/kWh (US¢5.4/kWh).

3.20 The mission supports the following measures recommended by the study which can reduce non-technical losses from the 10.8% level of net

35/ Based on the average rate base tariff in 1982 of EC¢30.0/kWh (US¢11.11/kWh).

generation in 1982 to 0.5% by 1988. An investment of EC$3.0 million (US$1.1 million) is required to achieve this target (in 1983 prices).

(a) Move all industrial and large commercial meter installations outside of the building immediately to clearly visible locations. The remaining commercial and then domestic meter installations should also be moved outside.

(b) Use kWh and kVA demand meters on all industrial and large commercial customers. This is linked to a tariff restructuring which would require kVA meters for such users. In this context, large consumers should be considered those having a demand of 5 kVA or more.

(c) Replace all old 5 and 10 amp meters on the system starting with the high use areas. This step should be combined with moving the new meters outside.

(d) Require all new meter installations to conform to standards set by VINLEC, defining outdoor location, socket type and mounting, etc.

(e) Survey all street lights to provide an appropriate data base. 36/

(f) Seal all meters on the system and routinely check for broken seals.

(g) Provide adequate staff and transport for checking defects reported by meter readers, taking out meters for testing and investigating immediately suspected cases of theft of service.

(h) Examine the introduction of an incentive system for the company for improving on current losses.

(i) Survey all customer connections to reestablish any accounts that may have been lost in the 1980 fire and to detect unmetered services.

(j) Improve the meter testing facility and staff to ensure a high throughput of meters.

(k) Streamline information flow between departments to ensure that when customers are connected, they are entered on the billing system.

36/ Unless these sales are accurately measured, some of them could appear under un-billed sales, thus adding to non-technical losses.

3.21 The target set for non-technical losses by the end of the decade is 19% of net generation and that for technical losses is about 6.5%. With VINLEC's own use of electricty it expected to be about 2.5% of gross generation; this implies that by 1989, total system losses including own use should be reduced to about 1%. These targets appear achievable based on the recommended investment program.

3.22 Technical Losses. Technical losses in 1982 were estimated to be 12.5%. These losses on a system the size of VINLEC's should be in the range of 6-7%. The major cause is the use of large transformers and extensive secondary lines for the low tension (L-T) system (Table 3.7). The secondary system is extensive. In some locations sampled it extended to points over 3,000 feet from the transformer, with the main conductor being No. 10 AWG copper in some sections. Both the high and low tension systems require maintenance: on the former bypassing of fuses due to spares shortages, and on the latter, problems related to poor connections due to the absence of spares were observed. The main projects proposed to reduce technical losses are: (a) capacitor installation on the high tension (H-T) system; (b) restructuring the L-T system by overlaying it with H-T, reducing the area of coverage by each transformer, and using small high-efficiency transformers; and (c) application of new standards incorporating larger conductor size and defining maximum length for L-T construction.

3.23 A total of 3,600 KVAR of fixed bank capacitors are proposed to be added to the H-T system between 1984-88 to improve the present system power factor from 75% to about 95%. Overcorrection is not expected to be a problem using fixed banks because the evening peak is due to incandescent lighting while the low power factor during the day is due to air-conditioning loads. The benefit/cost ratios of these investments range from about 4.6 to 16.5 depending on the feeder in question. 37/

3.24 In the case of the L-T system, it is estimated that overlaying with H-T would require an investment of some EC$3.7 million (US$1.4 million) over a three-year period resulting in a benefit/cost ratio of 1.4 while reducing energy losses on the L-T system by about 5.5% of net generation. The overall effect of lowering technical losses would be to reduce peak losses by 290 kW in 1986 and by about 450 kW in 1988, with energy losses reduced by some 2.3 GWh in 1988.

3.25 The investment program proposed to reduce losses (Table 3.8) includes an item for improving the productivity of the T&D department which is critical if set targets are to be achieved. It includes restructuring of line crews, provision of necessary vehicles and tools, workshop facilities and offices, and training and updating of line construction standards.

37/ Increasing investment costs by 25% and reducing the value of energy by one-third does not affect the results of these measures.

3.26 The mission considers this program to be of high priority to VINLEC as it will have a major impact on improving the company's finances and quality of service and ameliorate the rate of tariff increases needed by the company during the 1980s to remain financially sound. Total investments (in 1983 prices) to reduce non-technical and technical losses amount to EC¢3.0 million (US$1.1 million) and EC$3.8 million (US$1.4 million), respectively, with that for productivity improvement being EC$3.7 million (US$1.4 million).

Table 3.8: INVESTMENT PROGRAM - POWER LOSS REDUCTION, 1985-88 [a/]
(1983 EC$'000)

Year	Nontechnical Losses	Technical Losses	Production Improvement	Total
1985	1,198	1,302	1,624	4,124
1986	623	1,231	1,975	3,829
1987	597	1,217	41	1,855
1988	597	7	41	645
Total	3,015	3,757	3,681	10,453

a/ The net present value of investments in non-technical losses of EC$2.5 million results in a net present value of savings of EC$5.5 million up to 1990.

Electricity Demand Forecast and System Expansion Program

3.27 A major UNDP financed study 38/ of St. Vincent's hydro development possibilities made a detailed assessment of future power sales. Load forecasts were developed using three methodologies: (a) extrapolation of historical trends; (b) econometric correlation between electricity consumption and projected socio-economic indicators; and (c) detailed analyses of consumption by different customer categories. The forecasts based on the econometric approach were adopted by the consultants. The mission reviewed this forecast and endorses the approach followed and the underlying assumptions, which included 5% p.a. GDP growth to 1986 and a moderate growth in the late 1980s. Table 3.9 summarizes demand projections for the years 1982 and 1990.

3.28 Electricity sales are expected to increase at about 4.3% p.a. (1982-90), with sales to the industrial sector increasing at 10% p.a.

38/ "St. Vincent Hydroelectric Scheme" - by Shawinigan Engineering - Inception Report (October 1982).

Non-coincidental peak demand should increase modestly at 2.8% p.a., from 5,300 kW in 1982 to 6,600 kW in 1990. However, generation is projected to grow slowly at 2.0% p.a., from 29 GWh in 1982 to 34 GWh in 1990. Both relatively low rates of growth are due essentially to the effects reducing technical losses which is estimated to cut at least 450 kW off the peak by the late 1980s.

Table 3.9: ST. VINCENT SALES GENERATION AND PEAK DEMAND FORECAST, 1982-90

Sales Category	1982		1990		Average Annual Increases 1982-90
	(GWh)	(%)	(GWh)	(%)	(%)
Residential	10.0	34.5	12.1	35.6	2.4
Commercial	8.0	27.6	10.6	31.2	3.6
Industrial	3.4	11.7	7.3	21.4	10.0
Street Lighting	0.4	1.4	0.6	1.8	5.2
Total Sales	21.8	75.2	30.6	90.0	4.3
Total Losses a/	7.2	24.8	3.4	10.0	(9.0)
Total Generation	29.0	100.0	34.0	100.0	2.0
Maximum Demand (MW)	5.3	--	6.6	--	2.8

a/ Includes own-use and system losses.

3.29 From the demand standpoint, the reduction in losses (more than halving) and the increasing share of industrial sector sales (almost doubling) are the most significant structural effects expected to occur in the power sector during the second half of the 1980s. From the supply standpoint, two important changes should occur. First, and most important, the severe supply crisis should begin to abate somewhat from around February 1984 when the 3 x 600 kW diesel units should be commissioned (Kingstown). These were purchased on an emergency basis in 1983. The depth and frequency of load shedding should be further reduced from the last quarter 1984 when the CDB-financed 2,900 kW diesel unit comes on-stream. The second important supply development would be the commissioning of the Cumberland hydroelectric project in 1987/88, which should add some 3,370 kW of capacity to the system. The existing and planned additions to generating plant capacity during the 1980s are summarized in Annex Table 2.

3.30 As part of the studies financed by the UNDP, selection of the least-cost power generation expansion plan for 1983-92 was undertaken. The expansion program for the period 1981-84 was covered by a previous CDB-financed study which recommended the addition of a 2,500 kW medium-speed, four-stroke diesel unit by early 1983. As no arrangements existed for heavy fuel oil delivery to St. Vincent, this unit was designed to burn diesel and not 1,500 second' fuel oil. VINLEC eventually purchased a 2,900 MW set, because of attractive financial terms, though the large size of the unit relative to the system would have placed severe reserve requirements on the system if the 3 x 600 kW Cummings units were not purchased at the end of 1983.

3.31 In determining the least-cost options, five different hydro power schemes were examined (Cumberland, Colonaire/Union, Buccament, Yambou and Colonaire), as well as a program based on the addition of diesel units burning both distillate and residual fuels. To encompass the latter option, it was considered that, since the level of residual consumption would rise rapidly, arrangements would be made to deliver this fuel to St. Vincent. Among the hydro options, Cumberland was shown to be the best (Table 3.10).

Table 3.10: COMPARATIVE HYDRO SCHEMES

Hydro Alternative	Discount Rates at which Cumberland is least cost	Present Value of Capital Operation & Maintenance Costs at 10% Discount Rate
		(US$ million)
Cumberland	---	10.5
Colonaire & Yambou plus Buccament	All discount rates	14.4
Colonaire/Union plus Yambou	For all discount	13.4
Colonaire/Union plus Buccament	All discount	12.6

Source: World Bank Staff Appraisal Report (December 1983) - "First Power Project - St. Vincent and the Grenadines."

3.32 In the case of the thermal expansion options, Cumberland was shown to be the best when based on c.i.f. residual fuel oil prices of US$28/bbl and US$35/bbl for distillate fuel with no escalation in real terms. The present value of capital, operations and maintenance costs at 10% discount rate was about US$12.4 million in the case of the heavy fuel option, with Cumberland being least-cost for all discount rates below 12% (the opportunity cost of capital in St. Vincent is currently estimated at 10%). This difference is not significant.

3.33 The details of the power capacity balance between 1983 and 1990 are shown in Annex Table 3. The underlying assumptions regarding available capacity over this period are:

(a) firm (dry season) capacity of the existing run-of-the-river hydro plants remains at 1,200 kW;

(b) the new 3 x 600 kW Cummings diesels are commissioned by early 1984 at Cane Hall;

(c) the Kingstown power station should be maintained in service over the period until the Cumberland project comes on stream. As the four high-speed units at this station are old (about 25 years) and fuel inefficient, they can only be called on to do peaking duty. In the case of units 1 and 4 their ability to do merely 800 hours p.a. duty over the next four years is by no means certain. The station would be de-commissioned in 1989. It is assumed that only 900 kW of dependable capacity exists at this station;

(d) Cane Hall (No. 4), the 2,900 kW medium speed diesel unit would be commissioned by last quarter 1984;

(e) the Cumberland project would be in operation by 1989;

(f) during 1985 units 1, 2 and 3 at Cane Hall will have to undergo major overhaul (50,000 hours) and rehabilitation, resulting in only two of these three units, on average, being available during that year. Following this, units 2 and 3 (which have experienced severe thermal stress and crankshaft problems) are likely to be de-rated to operate at a maximum of 1,100 kW each; and

(g) the safe plant capacity (SPC) is defined as the firm peaking 39/ capacity minus the capacity of the two largest diesel units (Cane Hall Nos. 4 and 2) from 1984 onwards.

3.34 The following conclusions can be drawn from the capacity balance over the 1983-90 period:

(a) with the commissioning in early 1984 of the 3 x 600 kW Cummings diesels and the 2,900 kW medium speed unit towards the end of 1984, the system's generation security should improve, especially in the last quarter of 1984. This increased security would not, however, have been achieved unless the 3 x 600 kW diesels had been procured on an emergency basis in late 1983;

(b) the necessity of keeping the Kingstown station in service is evident especially in 1985, when major overhaul and rehabilitation of units 1-3 at Cane Hall will be undertaken. Annex Table

---

39/ Only to be consistent with the IDA Appraisal Report (April, 1984) No. 4854b-SV.

3 shows that in that year the SPC is estimated to be 100 kW below peak demand. Retirement of any of the Kingstown units before completion of this rehabilitation would require load-shedding to be reintroduced in 1985. Any such deterioration of service again should be avoided, especially since consumers will be facing escalating tariffs in this period due to the financing needs of the expansion program and the fact that they would only just have emerged from an extreme period of load-shedding between 1981-83; 40/

(c) the Kingstown station would be decommissioned during 1989 after the Cumberland project is completed. There would then be adequate capacity in the system to allow such decommissioning without affecting system security;

The above conclusions and Annex Table 3 highlight the importance of the Kingstown station over the short to medium-term.

3.35 In this regard, it is clear that if the Kingstown station is retired before Cumberland is commissioned additional diesel capacity would have to be purchased. The key question to be addressed therefore is the benefit/cost of such "early" retirement versus procuring additional diesel plant. Among the benefits claimed for early retirement are:

(a) elimination of overhead costs associated with running 2 thermal stations (estimated to be about USc0.9/kWh higher than for a new replacement set of Cane Hall);

(b) reduced fuel costs due to higher efficiency of new units (a benefit of some 0.7 kWh/IG due to this effect); and

(c) reduced operations and maintenance costs (including lube oil). This is estimated to be about USc2.2/kWh above equivalent costs for a new unit.

3.36 The Kingstown station is not expected to generate more than about 800 MWh p.a. up to 1988. The incremental costs outlined above of keeping the station in operation should not exceed about US$30,000 p.a. It would appear that even if it requires an additional US$30,000 p.a. in repairs and rehabilitation over and above these incremental costs that its decommissioning and replacement by a new set would not be justified on economic grounds. After 1988, when the Cumberland project comes on stream, diesel units would not be needed except during periods of peak demand because hydro would satisfy more than 80% of electrical energy needs. Therefore, if Kingstown Station is decommissioned prior to 1989,

---

40/ At the time of the green cover review in August, 1984, regular load shedding was still prevalent.

new, replacement diesel units would have little use from 1988 until well into the 1990s. In other words, such an investment in new diesels would have to be recovered within a very short period, 1985-88.

3.37 The change in the role of hydro is illustrated in Table 3.11. Whereas hydro only met 38% of generation (11 GWh) in 1982 and its share deteriorated to 34% (10.5 GWh) in 1986, with Cumberland on-stream in 1990 the situation is reversed and hydro would satisfy about 82% of total system supply. Diesel oil consumption in the power sector would increase from some 5,160 toe in 1982 to about 5,700 toe in 1986; however, by 1990 diesel demand would decline to only about 1,600 toe. Relative to 1982 diesel consumption levels in St. Vincent, this would represent about a 6.8% annual reduction in diesel use (2.15).

Power Sector Investment Program

3.38 VINLEC will be embarking on its largest ever expansion program over the period 1984-88. An estimated investment of about US$21 million, excluding price and physical contingencies, 41/ is needed over the rest of the decade to undertake the expansion program. Of this, VINLEC would be expected to finance about US$3 million. This raises the issue of VINLEC's financial performance.

Table 3.11: POWER GENERATION BY SOURCE, 1971-90
(GWh)

Source/Year	1971	1982	1986	1990
	(Actual)			
Gross Generation (GWh)	14.1 (100%)	29.0 (100%)	30.9 (100%)	33.6 (100%)
of which:				
Hydro	9.9 (70%)	11.0 (38%)	10.5 (34%)	27.5 (82%)
Diesel	4.2 (30%)	18.0 (62%)	20.4 (66%)	6.1 (18%)

Power Tariff and VINLEC's Financial Performance

3.39 VINLEC experienced significant losses in 1979 and 1980. After some tariff adjustments, the situation improved in 1981 and 1982, at

---

41/ These could account for up to an additional US$10 million.

which time the company made an EC$894,000 profit. VINLEC has been and remains in a cash starved position with small accumulated earnings to meet the massive investment program. Efforts to improve efficiencies of service and operations which are incorporated in the investment program need to be augmented by a series of annual tariff increases at least not less than inflation rates. As of end-1982, VINLEC's debt to equity ratio was 18:82 after including revaluation of its assets. Total equity stood at EC$12.1 million. With an investment program over the next five years in excess of four times the company's 1982 total assets, significant equity injection will be required to ensure that the increased debt burden remains at a manageable level. To achieve this, CIDA is providing EC$9.0 million equity financing within the framework of the Cumberland project.

Table 3.12: ESTIMATED POWER SECTOR INVESTMENT PROGRAM, 1984-90 (US$ 1983)

Item	US$ Million
Cumberland Hydro Scheme	13.5
Rainfall and Stream Gauging Networks	0.2
Upgrading of Diesel Units	0.9
Power Loss Reduction Program	3.9
Transmission and Distribution	0.8
Managerial Services	0.9
Training and Hydro Studies	0.9
Water Shed Management	0.5
Total	21.6

3.40 Added to the issue of the level of the tariff is the question of its structure. Present tariffs are based on the "accounting" approach which bears little relation to economic efficiency criteria for resource allocation. To reflect this, a long run marginal cost (LRMC) tariff study was completed in May 1984. The mission and the Bank are reviewing this study. The Government has agreed with the Bank to implement the recommendations of the study. Some of the issues addressed by this study are:

(a) the need for kVA demand metering for large customers;

(b) the structure of tariffs for high and low voltage customers, especially given the current structure in which commercial consumers pay a higher rate than domestic customers;

(c) restructuring of the fuel adjustment clause; and

(d) assessment of current arrangements for setting utility tariffs and recommend appropriate modifications.

Institutional Issues

3.41 The main institutions involved with the power sector are VINLEC, the Ministry of Communications and Works (MCW), the Ministry of Trade, Industry and Agriculture (MTIA), and the Central Planning Unit (CPU) in the Ministry of Finance (MF). VINLEC operates under an exclusive license granted in 1973 for 60 years to operate all generation and distribution facilities in the country as well as sell electricity. The MCW is responsible in the area of tariffs while the MTIA regulates fuel prices. The CPU, through its Energy Desk, is responsible for overall coordination of matters pertaining to energy as well as energy policy formulation. Given the limited skilled manpower available and the size of the power and energy sectors as a whole, these arrangements appear adequate. Under the framework of the Caribbean REAP, efforts are planned to assist in strengthening the coordinating, policy formulation and monitoring functions of the Energy Desk in the CPU. These measures are unlikely to materialize before 1985 when the REAP should be underway.

3.42 VINLEC is jointly owned by CDC (holding 51% of the shares) and the Government of St. Vincent (49%). Arrangements have been made for the Government to purchase CDC's shares. When this occurs, VINLEC would become a fully owned state company. This ownership transfer has resulted from CDC's expressed wish to withdraw from its historical role in the power sector in the Eastern Caribbean islands. VINLEC has 82,484 issued shares at EC$5 each.

3.43 There are three areas which are vital to the company and for which special efforts need to be made to ensure that effective new arrangements are made to cover the gap that CDC's withdrawal will create. These are:

(a) Procurement services. Provision for contracting a procurement agent would be required and benefits could occur if this was done jointly with other utilities in the OECS.

(b) Engineering services. The biannual visits of a CDC engineer provided a useful service to obtain an independent opinion and review of current issues as well as providing an opportunity for referring matters if additional expertise were needed. Here, too, the possibility of establishing common services arrangements with other OECS utilities needs assessment.

(c) Training function. This has principally focussed on field personnel, linemen, etc. It is best for technical training to be done locally by bringing in experts to work on the job with trainees. This does not deprive the company of staff during training (which would occur if they are sent abroad) and also enables training to be better geared to local issues (such as metering and theft).

3.44 The major constraint is the low number of skilled personnel in the company. This tends to result in senior management having little time to focus on system and operational planning functions; day-to-day operational issues have to take precedence. Despite these constraints, the management of the company is to be commended on the way it has coped with the rapidly deteriorating power supply over the past two years. Given the small size of the company and the country, it is difficult to justify a level of specialist staffing which would cover all of VINLEC's needs. To address this issue, the mission endorses the proposal in the Caribbean REAP for a regional study to assess what long-term common services can be provided to the OECS power utilities and through what institutional mechanism this can be achieved (Annex 1). The mission is fully aware of the problems likely to be encountered in establishing such a common services entity among the Eastern Caribbean states. However, it feels that the potential benefits relative to the costs to each company of "going-it-alone" warrant a serious effort.

3.45 In order to address the problem of specialist and management support to VINLEC over the medium term to deal with planning and technical problems beyond day-to-day issues, the Cumberland project has provided support:

(a) a project manager and support staff to administer the project;

(b) consultant services for providing managerial, administrative, financial and technical assistance;

(c) a training program;

(d) a specialist to assist in the implementation of the loss reduction program; and

(e) consultative services for studies related to the development of new hydroelectric schemes.

IV. BIOMASS, OTHER RENEWABLES AND CONSERVATION ISSUES

Biomass Consumption

4.1 A preliminary analysis of the recently completed CARICOM household energy survey shows that in 1981 St. Vincent used about 3,600 tonnes of charcoal and 8,000 tonnes of firewood for cooking, which translates to a total national domestic demand of 63,000 m^3 of wood or 15,000 toe. Assuming a 10% conversion efficiency (by weight) for the traditional earth kilns used in the country, some 46,000 m^3 of wood were lost during charcoal production. These figures indicate a national deficit ranging from 13,000-50,000 m^3 fuelwood p.a. based on yields of the unmanaged forests.

4.2 Charcoal is produced in various parts of the island but mostly in the northern areas of Owia, Sandy Bay and Fancy. A significant proportion of charcoal is produced by farmers who own woodlands. There is apparently no organized collection and transport by middlemen or traders; most producers are also sellers. 42/ Pricing of charcoal is not related to costs or a pricing formula. In the public markets, charcoal is currently sold at approximately EC$15-25 (US$5.50-9.25) per 50 pound bag (US$242-407/tonne) and EC$1.25 (US$0.46) for a tin which contains roughly 1 kg (about US$460/tonne). Firewood is not sold and users simply gather whatever they need from nearby scrubwood. There is no information on how much time is spent in firewood collection but for the present this generally does not appear to be a difficult task for rural households.

Table 4.1: COMPARATIVE COOKING COSTS a/

Fuel	Unit	EC$ Unit	Kcal/Unit	End-Use Efficiency	EC$/1,000 (kcal)
Charcoal	kg	0.5-1.25	7,000	20	0.36-0.89
Kerosene	lt	1.04	8,800	35	0.34
LPG	kg	2.41	10,800	55	0.41
Electricity	kWh	0.50	860	65	0.89

a/ Firewood is excluded as data on its prices and gathering time is not available.

42/ Records indicate a small export of 1-3 tonnes a year to Barbados valued at EC$1,000-3,000 (US$370-1,111).

4.3 As a cooking fuel, kerosene is probably the cheapest on a useful energy basis under the current pricing structure (Table 4.1). Charcoal bought by the bag, however, is comparable with kerosene. The cost per useful kilocalorie increases by about 2-1/2 times when charcoal is bought by the tin and becomes comparable to cooking with electricity.

4.4 Wood is also used in the commercial (bakeries, restaurants, etc.) and industrial (mainly the sugar factory) sectors, but the amount is negligible relative to household demand. Coconut shells and husks are used in limited quantities as supplemental fuel in households near estates where copra is processed. This is not likely to exceed 100 tonnes per year. Copra drying is done in diesel-fired dryers and by direct sun drying. Less than 10% of copra is dried in kilns fired with coconut residues, consuming only about 50 tonnes out of a total 930 tonnes of coconut shells generated by the industry. At present, there is little use of coconut stemwood. Despite its high potential, there are two major constraints to wider use. First, the charcoal produced is inferior to wood charcoal because it is lighter and fragile, and secondly it is more difficult to arrange large-scale felling and carbonizing the non-bearing trees.

Biomass Supplies

4.5 St. Vincent's biomass fuel resources consist of wood from natural forests and plantations, agricultural residues from the coconut, arrowroot, bagasse and animal wastes. Wood resources are in approximately 12,900 ha of forests and woodlands, which is roughly 38% of the total land area (Table 4.2).

Table 4.2: ESTIMATES OF FOREST AREAS

	Hectares
	('000)
State Forests	
Primary Forests	1.6
Secondary Forests	10.5
Plantations	0.2
Private Forests and Woodlands	0.6
Total	12.9

Source: Forest Division, and Mission estimates.

4.6 Wood for fuelwood and charcoal is obtained from private lands and secondary forests. Population pressure, expansion of commercial agricultural lands and shifting cultivation have rapidly reduced the amount of forested areas. The leasing of small areas for cultivation by landless farmers is practiced; about 1,700 ha of land is now leased in this manner. Due to the mountainous topography, cultivation has extended over the slopes and mountain tops, contributing heavily to soil erosion in many places.

4.7 Historically, reforestation rates have been low, although in 1980 financial assistance was provided for the establishment of 80 ha of timber plantations in three watershed areas as part of the USAID Basic Human Needs Program. Mostly commercial species have been planted, although limited plot trials of fast-growing fuelwood species such as leucaena, eucalyptus and caliandra were recently started.

4.8 No comprehensive forest inventory has been prepared and official estimates of annual increments and rate of loss of forest cover are not available. Assuming that the average increment is between 1-4 m^3/ha p.a., 43/ total annual yields of the unmanaged forests would range from 13,000-50,000 m^3. However, the available fuelwood supply is less than this figure due to the limited accessibility of the primary forests.

Fuelwood Issues

Forestry

4.9 The major issue in biomass is to ensure the adequacy of fuelwood supplies while minimizing the deterioration of the country's remaining forest resources. Continued pressure for agricultural land, combined with lack of control over forest encroachment and illegal cuttings, is endangering future fuelwood supplies and the protective role of the forest areas. In the north windward areas, for example, where much of present charcoal supplies originate, deforestation and soil erosion on the slopes and watershed areas are considered to be approaching critical levels. There is particular concern in watershed areas where encroachment and deforestation may lead, in the longer term, to erosion problems and siltation at hydro developments on the island. 44/

4.10 A lack of resources and institutional constraints have limited the ability of the Forest Division to do its normal protective functions,

---

43/ No official estimates are available for St. Vincent. These figures are based on estimates for St. Lucia's forests.

44/ The Cumberland project has allocated US$500,000 for a watershed management program.

let alone develop effective forest management procedures and establish plantations. No other indigenous energy supply could significantly displace fuelwood for domestic use in the foreseeable future. The only course of action is to embark on a program to establish plantations of fast-growing species and to properly manage existing forest areas.

4.11 The mission sees an urgent need to formulate a new forest policy for the country, and to develop a workable forest management plan in conjunction with an overall land use strategy. For this purpose, technical assistance similar to that extended by CIDA to the Government of St. Lucia should be sought. A fuelwood plantation program at the rate of about 50 ha/yr is recommended and should be within the capability of the Forest Division to implement, if appropriately strengthened. Priority sites would be Sandy Bay/Fancy (north windward) and Richmond/Windsor Forest (north leeward), where significant deforestation and soil erosion already have occurred. Two other sites in the Grenadines (Bequia and Union islands) should also be on the priority list, due to forest deterioration in these islands caused by charcoal-making, boat building and overgrazing. Some of the possible species are leucaena leucocephala (K8, K28), eucalyptus spp and casuarina. External assistance should be sought for a five-year initial program to establish 250 ha of short-rotation species in the areas. 45/ The Forest Division estimates that the total cost of this activity will be about EC$2.7 million (US$1.0 million), which not only covers plantation establishment expenditures but also short-term training, procurement of portable metal kilns for demonstration and two vehicles. At an average yield of 50 m^3/ha p.a. for giant leucaena, some 12,500 m^3 p.a. would be added to the fuelwood supply starting from the fifth year. The equivalent charcoal production using improved kilns would be about 2,000 tonnes. The high cost per hectare of this initial program is justifiable only as an instrument for the strengthening of the Forest Division and the potential demonstration effect of the managed plantation.

Charcoal

4.12 As in neighboring St. Lucia, the extensive use of charcoal (rather than wood) in this small island country where transport distances are short makes little energy sense. The strong preference for charcoal as a cooking fuel, however, is deeply ingrained in local culture and would be extremely difficult to change. On the demand side, efforts to reduce wood consumption should instead be directed towards: (a) discouraging excessive charcoal production by substantially raising the permit fees for wood cutting which, since 1945, have remained at EC¢46 (US¢17) per cord; (b) introducing improved techniques of charcoal-making;

45/ At the time of green cover review in August 1984, the mission was informed that the Government had already started discussions with CIDA and OAS for a forestry development program. Terms of reference for these projects have been developed.

and (c) promotion of higher efficiency 'coal-pots.' The use of TPI metal kilns, for example, could save up to five tonnes of wood for every tonne of charcoal produced. Other less capital intensive techniques could be promoted, such as the modification of traditional earth kilns by adding metal linings and chimneys made out of used oil drums ('Casamance' method). Progress in the development of improved coal pots has been reported in Montserrat and should be investigated for trials in St. Vincent. Theoretical wood savings resulting from improved wood and charcoal stoves are even larger than those from improved characoal kilns. However, stove dissemination is a much more extensive and problematic activity than introduction of improved charcoal kilns and should be accorded lower priority.

Interfuel Substitution

4.13 A third issue relates to the continued use of petroleum fuels for thermal purposes in estates where indigenous fuel substitutes in the form of agricultural residues are generated in substantial quantities. Orange Hill Estate, for example, which accounts for about half of copra production in St. Vincent, exclusively uses diesel-fired dryers for copra processing. 46/ Some 12,500 Ig of diesel oil were used for this purpose in 1982 to produce about 530 tonnes of copra. Of a total industry production of 1,150 tonnes copra, it is estimated that 750 tonnes were dried using diesel fuel (the rest by direct sun-drying and a minimal amount in kilns fueled by residues), consuming about 26,000 gallons or 86 toe a year.

4.14 The tobacco industry uses LPG and kerosene in curing-barns. Some 70 tonnes of cured leaf were produced in 1982/83 which used an estimated 60,000 kg of LPG and about 8,000 Ig of kerosene, or a total of 94 toe. Based on the production rate of coconut residues in most of these estates, there may be significant opportunities for economic fuel substitution. Available energy from shells and husks alone total 460 toe yearly, roughly 2.5 times the current annual consumption of petroleum fuels for agricultural drying.

4.15 Various well-developed biomass-based options are available. For copra drying, there are two options:

(a) retrofitting existing diesel-fired dryers with producer gas systems (e.g., the New Zealand hot air generators) fueled with raw or carbonized shells; and

(b) using steam engines fuelled by coconut residues (husks, shells and/or stemwood) to cogenerate process heat and electricity.

46/ A prefeasibility-study was done under the CAESP project in 1981.

The tobacco fuel-curing barns could be modified by replacing the gas or kerosene burners with appropriately designed biomass-fired furnaces.

4.16 The feasibility of these options should be prepared estate-by-estate. The economics will depend on production levels, local availability of residues and the type of facilities already in place. Conversion projects of this nature, if economic, should be encouraged by the Government through loan assistance and import incentives for the necessary equipment.

Coconut Residues

4.17 Coconut residues offer a significant potential. The average production between 1977 and 1979 was 7,900 tonnes of dry nuts, of which 4,450 were converted to about 1,150 tonnes of copra. The mission estimates that 930 tonnes of shells and 2,790 tonnes of husks are produced a year from copra processing with a combined energy equivalent of 1,050 toe (Table 4.3).

Table 4.3: FUEL POTENTIAL OF COCONUT RESIDUES

Residues	Production	Availability	Heating Value	Total
	(tonnes p.a.)	(tonnes p.a.)	(Kcal/kg)	(toe)
Shells	930	790	3,250 (30% MC)	85
Husks	2,790	1,395 a/	2,700 (40% MC)	377
Stemwood b/	1,000-2,000	750-1500	3,500 (25% MC)	263-525

a/ Assumes 50% availability.
b/ Exploitation rate of 1,500-3,000 trees p.a. over 5-10 years.

Source: Mission estimates.

4.18 Coconut stemwood use could increase the biomass supply by about 250-500 toe p.a.. This could be obtained by organized felling of unproductive trees which are about 15% of total stands in the country's 5,700 ha of coconut plantations. Assuming a cycle of 5-10 years, some 1,500-3,000 trees per year could be available either for direct use or for conversion to charcoal. The potential energy yield, if used directly, is about 250-500 toe, while losses in charcoal production would reduce this to 105-210 toe a year.

Sugar Industry Residues

4.19 During 1983, the sugar factory located near Georgetown produced 2,100 tonnes of raw sugar, generating in the process some 9,200 tonnes of bagasse. The bagasse is used as boiler fuel, but is insufficient for the mill's needs. During start-up, the bagasse is supplemented with undetermined quantities of wood, including coconut logs. Over 100,000 gallons of diesel oil also were used in 1983.

4.20 The main reason for the insufficient bagasse supply is low fiber content (12.9%) in the cane varieties planted. New cane varieties with at least 14% fiber are now planted and are expected to improve the bagasse fuel situation in subsequent milling seasons. However, due to the mill's small size (30 tonnes/hour of cane grinding rate), it is unlikely that investment for producing excess bagasse for export electricity generation would be economic. A recent Bank study 47/ concluded that for a "typical" sugar mill, capital investments for increasing bagasse production such as flue-gas bagasse dryers, higher pressure boilers, pre-evaporators, etc. can only be economic if the grinding capacity of the mill is at least 100-150 tonnes cane per hour. However, it obviously would be beneficial for the mill to pursue specific energy conservation activities that could reduce the consumption of diesel oil and other supplementary fuels but which do not require major capital outlays.

4.21 About 300,000 gallons of molasses by-product has resulted so far from the mill's 2-3 year's operation. The molasses is currently stored and is intended to be used as raw material to produce potable alcohol in an expanded distillery near the mill scheduled for 1984.

Biogas

4.22 The livestock population in the country is relatively small and has remained fairly constant in recent years (Table 4.4). Manure generation is estimated at 80 tonnes p.a. 48/ Converted to biogas, the theoretical energy potential is only about 1.7 toe. The Diamond Farm, with about 50 cattle now and intending to expand to about 300 heads, may be the only place where the installation of a manure-based biogas digester is worth considering, primarily as a waste disposal/fertilizer production option and only secondarily for its potential fuel benefits.

4.23 The arrowroot industry has some potential for biogas production. Starch recovery operations in the country's five major plants generate enough cellulosic waste material or "bittie" that is suitable for biodigestion. A CDB-financed laboratory study in 1981 to determine anaerobic digestion parameters for "bittie" showed that between 300 and

---

47/ "Identifying the Basic Conditions for Economic Generation of Public Electricity from Surplus Bagasse in Sugar Mills", 1983.

48/ Excluding goats and sheep manure, for which there is little biodigestion experience.

400 liters of biogas could be produced per kg of total solids. 49/ In 1982 when the industry operated at half the capacity, approximately 7,700 tonnes of arrowroot were processed, yielding 1,000 tonnes of starch and 1,300 tonnes (dry weight) of "bittie". This represents a biogas potential of about 200 toe. This volume can match diesel fuel requirements of the industry, provide energy for starch drying 50/ and, in some plants, can provide excess gas for crop drying (Table 4.5).

Table 4.4: LIVESTOCK POPULATION

	1980	1981	1982
Cattle	6,750	6,300	6,690
Pigs	6,300	5,000	5,757
Chicken	50,000	50,000	50,000
Goats	3,950	4,300	4,917
Sheep	11,480	12,500	14,010

Source: GOSV Ministry of Trade and Agriculture.

Table 4.5: ESTIMATED FUEL POTENTIAL OF ARROWROOT WASTES

Factory	Maximum Capacity	Starch Production	Waste Produced	Biogas Fuel Potential
	(tonnes arrowroot/day)	(tonnes p.a.)	(tonnes p.a.)	(toe) a/
Owia	23	359	402	65
Mt. Bentinck	28	437	490	79
Colonarie	28	437	490	79
Bellevue	28	437	490	79
Wallilabou	18	281	315	51
	125	1,951	2,187	353

a/ Based on 300 liters of biogas/kg TS, 5,400 kcal/m^3.

Source: Arrowroot Industry Association, and Mission estimates.

49/ Enerplan and Biogas of Colorado reports (1982).

50/ Starch is presently air-dried in racks for up to three weeks, a time that could be considerably shortened by utilizing biogas-fired dryers.

4.24 A demonstration biogas plant with about 500 m^3/day capacity is planned for the Wallilabou factory under the CDB/GATE Regional Biogas Extension Program. The mission supports the objectives of this activity. Experience with the pilot facility should provide a firmer basis for deciding whether "bittie" use as a fuel could reduce production costs and help the recovery of this ailing industry.

Solar and Wind Energy

4.25 At present there are no significant solar or wind energy activities in the country. A solar water heater has been installed at Kingstown Hospital and some solar stills are reportedly in use in Petit St. Vincent. A number of demonstration projects for the Grenadines (Bequia, Union and Canouan islands) have been proposed for OAS grant funding. These proposals are primarily relevant to the fishing industry and to a limited extent to water and electricity supplies. They include natural-convection solar food dryers, wind-powered cold stores, wind pumps, wind turbines up to 50 kW, and solar stills for converting brackish water to potable water. Although potentially useful, the applications are small and will have little impact on the national energy picture.

4.26 St. Vincent is also one of the six countries slated for resource measurements in the second phase of the Caribbean Regional Wind and Solar Energy Assessment and Wind Energy Demonstration project proposed by the CDB for 1984. Results of these measurements will be useful in determining the potential contribution of wind and solar energy to the country, and in pinpointing suitable sites for large-scale applications.

Energy Conservation

4.27 The major energy conservation measures recommended by the mission essentially cover two "supply-side" areas: (a) the power transmission and distribution loss reduction programme, and (b) the efforts to improve the efficiency of charcoal production. In this latter case, these measures would have an impact on reducing wood use to produce charcoal consumed in the household sector. The mission visited major energy users and reviewed some energy audits previously undertaken by the CAESP. The mission's conclusion is that, other than the above two conservation programmes, energy conservation opportunities are limited by several factors:

(a) the stock of equipment in many companies in the country is old, and consumers cannot afford the high costs needed to replace it. However, replacement of old equipment is vital on grounds of productivity, quite apart from energy conservation, though it is not undertaken because of the poor financial state of industries;

(b) due to the serious electricity supply problems, investments in increasing supply security are of high priority due to the high cost associated with lost production; and

(c) there are only a few large energy consumers, most are small and dispersed where an investment program in energy conservation would be difficult to implement and less attractive.

The mission visited a number of establishments to identify if any potential energy conservation opportunities (ECOs) existed in the various economic sectors. The mission's findings were:

4.28 Tourist Sector. Air conditioning, lighting and refrigeration are the most important end-uses of energy in hotels. Only one third of the 40 hotels and guest houses have air conditioned rooms. Moreover, the hotels are small (less than 30 rooms), with electricity consumption varying from 1,000 kWh per year per room in modest hotels to 9,000 kWh in those with air conditioning. There currently appears to be little enthusiasm to implement an energy conservation program.

4.29 Commercial Sector. This sector consists principally of small offices and shops, with lighting being the major use of energy. Energy costs make up only a small proportion of total expenditures and therefore there is little knowledge of or motivation for energy conservation.

4.30 Industry. This sector is dominated by the East Caribbean Flour Mill, consuming about 60% of all electricity in the sector. The sugar factory is also a major consumer, accounting for roughly 70% of diesel consumption. Both firms have started some conservation activities. In 1983 the sugar factory installed an air pre-heater for the boiler, costing EC$500,000 (US$185,000). This investment has paid for itself in the same year by halving diesel consumption. The flour mill purchased a capacitor bank for power factor correction. The larger and newer firms appear able to take energy conservation measures by themselves, but the smaller firms, with low energy consumption, are reluctant.

4.31 Government Sector. The Government is a large consumer of electricity (using more than 1.5 million kWh), mainly for air conditioning and lighting. These are excellent candidates for energy conservation efforts. An energy conservation project for government buildings would set a good example, especially when accompanied with the proper publicity. The mission recommends that the Government develop an energy conservation program for buildings, together with a publicity campaign. For this purpose, a small steering group should be formed consisting of the energy officer in the Central Planning Unit and personnel who are responsible for maintenance of air conditioning and lighting in government buildings. Responsibility for the entire program should be concentrated in one location. At present, maintenance of air conditioning and lighting are the responsibility of two different departments. Consolidation of the two services should be considered.

4.32 Transport Sector. In St. Vincent, the transport sector is the largest consumer of commercial energy. Most energy conservation measures in transport are effective only in the medium- and long-term. In the longer term, infrastructural measures (road maintenance, repair and construction), transport planning and mode shifts (towards public transport) should be considered. In the medium term, attention should be paid to the stock of vehicles. A positive development is the choice for small, energy-efficient vehicles. Fuel taxation and import duties could reinforce this trend. Finally, maintenance is of great importance. Obligatory inspection 51/ and improved training of car mechanics are likely to be effective measures.

Institutional Issues

4.33 The recommendation made to establish short-rotation fuelwood plantations and to intensify forest management activities in order to increase sustainable yields imply the adoption of measures to institutionally strengthen the Forest Division and to substantially increase the amount of resources allocated to it. Due to the long-term nature of forestry work, it has perennially ranked low in the allocation of government resources. The result is a poorly motivated and inadequately staffed Forest Division that appears unable to cope with even the basic responsibilities formally assigned to it.

4.34 The CDB is currently financing a regional study of the forestry sector. This should provide evidence on the crucial nature of forest management in the Caribbean island economies. To ensure adequate fuelwood supplies without jeopardizing the country's ecological future is a continuing priority task that requires an appropriately supported forestry group. The mission strongly recommends that the Government immediately review the condition of the Forest Division with a view to determine appropriate measures needed to strengthen it institutionally, as well as to identify the type and magnitude of resources required.

51/ The current inspection program only covers the issue of road worthiness and should be expanded to include fuel efficiency aspects also. The mission recommends that the proposed CAESP transport study evaluate the merits of such a program.

A. Regional Issues: Petroleum Supply Arrangements

Regional Petroleum Study - Terms of Reference

Title: A Regional Study of Petroleum Product Supplies, Tanker Size, Transportation and Storage in the Caribbean.

Objective: To review the existing systems, and develop and recommend a least-cost 51/ regional strategy with regard to security and continuity of supplies, tanker size, transportation logistics and storage facilities for petroleum products of appropriate quality over the medium and long term in the Caribbean. 52/ The study will be done in two phases.

Cost: Phase I - Approximately US$50,000
Phase II - Approximately US$70,000

Funding: Phase II - to be determined.
Phase I - UNDP Caribbean Regional Petroleum Exploration Promotion Project

Introduction

1. The current pattern of petroleum supply and distribution evolved during the pre-1973 era when oil companies competed for larger shares of an expanding petroleum product market. To meet the requirements of this project scenario, large investments were made in refinery capacities, tankers and storage facilities. This was the appropriate strategy at that time because of the high profit margins associated with crude oil production. However, with crude production passing from the hands of the multinationals to the oil producing countries in 1973 and the oil price increases of 1973 and 1979, the outlook has changed radically. Many refineries are operating well below optimum capacity. The increased product demand growth pattern has changed, and marketing overhead costs have increased. The Caribbean Region has been no exception. Indeed, several features of the regional mode of operating exacerbate the situation:

(a) refining capacity which is ill-adapted to present demand;

(b) high freight costs as compared with world standards;

51/ Subject to security and continuity-of-supply objectives.

52/ A sub-option for the Eastern Caribbean CARICOM countries also needs to be evaluated.

(c) inappropriate petroleum product pricing and taxation policies; and

(d) high marketing costs in small country economies.

Study Objective

2. The principal objective of the study is to develop a least-cost strategy for the supply and distribution of petroleum products of appropriate quality over the medium- and long- term in the oil-importing countries of the Region while maximizing the economic utilization of existing facilities and infrastructure and recognizing the need for security and continuity of supply.

Methodology

3. The consultants will be required to specify the methodology which they intend to use. This should be justified based on its advantages over other methodologies. Weaknesses should also be clarified. The framework should include an analysis of the costs and benefits of the main study recommendations and should facilitate sensitivity analysis of the least-cost solution, both to variations in critical parameters and to adjustments reflecting other objectives such as security and continuity of supply, and political, social and economic factors within the various countries in the Region. These conditions are essential to developing a robust and realistic set of recommendations with regard to the least-cost strategy for the Region.

Scope of Work

4. The consultants should develop a detailed picture of existing petroleum product supply and distribution in the Caribbean region, including in particular:

(a) infrastructure

refineries - review of configuration, capabilities, capacity utilization and reliability;

port facilities - review of draft limitations and tanker loading and unloading facilities and actual performance including documents;

storage capacities - review of storage capacities by product (including crude), company and country, and of current fuel inventory management practices; and

product handling facilities - review of product and crude pipelines, transfer pumps, utilities and related infrastucture.

(b) transportation

- review of tanker characteristics (including bunker consumption and cost), scheduling and actual performance;

- review of role of chartered versus oil-company-owned vessels;

- review of freight rates by product, tanker size, oil company, and country served;

- estimate of freight costs based on current tanker scheduling, inventory practices and storage capabilities; and

- in reviewing the existing transport system, the consultants should develop estimates of the freight costs for small cargoes being delivered on a single versus a multiple-destination basis. Since the current system operated by the companies is multiple-destination, the differential between these cost estimates and those for the single voyage mode would provide an indication of the savings of the present mode compared to the single country, single voyage option.

(c) supply

- review the existing petroleum product supply patterns to the market area in question from the refineries in the following terrritories:

  Aruba
  Curacao
  Trinidad (Port Fortin and Point-a-Pierre)
  Martinique
  Barbados
  Antigua
  Venezuela

- this review should highlight: which petroleum products (in what amounts, at what frequencies and prices) are supplied from each of the above refineries to the individual demand centers; and associated risks of stockouts.

(d) demand

- analysis of demand by product, company and country; review of marketing margin and description of distribution system; identification of interfuel competition; and review of petroleum taxation and supply security policies.

5. In the light of the data gathered under 4, the consultants should examine each part of the regional product supply and distribution system to pinpoint areas where costs are unusually high and where inefficiencies appear to exist.

6. Regarding refineries in the Region, the consultants need not undertake an independent examination of their technical configuration, operational efficiency, or source of the crude supply, as these matters are outside the scope of this study. The consultants should, however, include in their analysis potential efficiencies or cost savings in the export destination of refinery output, if any, in excess of domestic requirements.

7. Regarding product transportation and storage, the consultants should examine the benefits/costs of constructing a centrally-situated product transshipment terminal to enable large cargoes to be moved from supply centers, with smaller tankers being routed from the terminal to their ultimate destination, particularly in the case of LPG where transportation costs amount to up to 40% of final product cost. The consultants should propose an efficient system of tanker scheduling to minimize freight costs based on optimal inventory levels and associated storage capacities. The consultants should also examine ways to achieve rationalization of marketing and distribution, particularly in the small island economies, in the light of freight rates for movement of crude and products to the Region and between the countries of the Region. The consultants should indicate the potential savings from adopting their proposed least-cost mode of supply over the current system. In determining the optimal mode the consultants need to assess the costs/benefits of using larger tankers (given port limitations in certain destinations), moving larger cargoes to each island, on a multi-destination basis, more infrequently, and hence maintaining higher inventories on each island.

8. Regarding market demand, the consultants should formulate appropriate petroleum pricing policies reflecting economic costs of supply, incorporating inter-fuel substitution and energy conservation objectives and including an assessment of the impact of petroleum product taxation and import duties and fees.

9. Based on the data gathered and analysis undertaken as above, the consultants should formulate the least-cost option for supply and distribution of petroleum products to each country in the Region consistent with security of supply. The study recommendations should consist of an action programme, on both a regional and individual country basis, to achieve the least-cost allocation objective, incorporating both short- and longer-term adjustments to the supply, transport, distribution systems and without threatening reliability of supplies to the area.

Reports

10. The study is expected to take not more than 20 man-weeks over a period of 3 calendar months.

11. Not later than one calendar month after commencement of the study, the consultants should submit to the Bank for comment an interim report summarizing the results of the data gathered by them under para. 4 above, the main issues identified to that point, and a preliminary indication of the overall scope and contents of their final report.

12. Not later than two and one-half calendar months after commencement of the study, the consultants should submit to the Bank a draft final report for review with the Bank. The Final Study Report should be produced within two calendar weeks from concluding the review.

13. Throughout the study period, the consultants should maintain regular contact with Bank staff in Washington, D.C., and with Caribbean Development Bank staff in Barbados (where the consultants are expected to be based during the study period), submitting monthly progress reports to each. They should also ensure that all meetings with Government and oil company representatives are arranged by Bank or CDB staff on the basis of an agreed advance agenda.

Composition of Study Team

14. The Study team should consist of two or three specialists, including a supply and transportation specialist, and a petroleum marketing analyst.

B. Common Services for OECS Utilities

Title: Feasibility Study for Providing Common Services for LDC Power Utility Companies and Enhanced Cooperation Amongst CARICOM Utilities

Objectives: The overall objectives of the study are:

(a) to review current arrangements in the LDC power utility companies in the areas of operational, and financial system planning, training, technical and financial management and procurement services;

(b) to propose how these requirements can best be met so that whatever corporate arrangements are recommended are self-financing; and

(c) to assess the role, if any, which the larger utility companies in the region can play towards meeting these objectives, as well as in enhancing cooperation amongst CARICOM utility companies.

Cost: Approximately US$80,000 - 100,000.

Terms and Scope of Work:

15. There is a need for strengthening the areas of planning, training, technical and financial management and establishing planned maintenance programs in the power utility companies in the region, especially in the Lesser Developed Countries 53/ (LDC's). In recent years, a deterioration of service, including electrical outages and extensive load shedding, has occurred due to financial, technical and managerial problems. Tariff increases have been prevented from keeping pace with increased operating and financial costs; as a result, maintenance programs and development plans have suffered. The very high incidence of power system losses (especially non-technical losses) is but another symptom of this decline. Some of the large utilities in the region have enough technical, financial and managerial resources to enable them to address some of these issues. This is, however, not the case in most of the smaller utility companies in the LDC's and the situation may worsen with the expected disengagement of the Commonwealth Development Corporation (CDC) from their shareholding and management involvement in those Eastern Caribbean utilities 54/ where they operate at present.

16. In general, the agreements between CDC and the utilities in which it owns controlling interest cover two main areas:

(a) General Agent - under which CDC provides technical and other advice as needed and reviews the management of the company. In addition, important training functions of technical and financial personnel are undertaken.

(b) Buying Agent - CDC procures plant, machinery and equipment on behalf of the utility and examines all shipping documents related to purchases.

17. The first task of the study team therefore is to review current arrangements in each of the LDC utilities in the areas of operational, system and financial planning, training, technical and financial management and procurement services. Specifically, operations need to be reviewed from the standpoint of the adequacy of current arrangements and then areas identified which are amenable to a common services approach, focusing on the costs and benefits of pursuing such a path. The study team in this context should focus on the following, inter-alia:

(a) Training - especially of technical personnel;

53/ Antigua/Barbuda, Dominica, Grenada, Montserrat, St. Kitts/Nevis, St. Lucia, St. Vincent (the OECS countries), and Belize.

54/ Montserrat, St. Lucia and St. Vincent.

(b) Engineering - the role of a small engineering service group; and

(c) Procurement - possibility of common procurement agent.

18. The study team would need next to assess what role, if any, the larger utility companies in the CARICOM region could play towards supporting the provision of common services.

19. The study team will work closely with the CARICOM utility companies and Governments in undertaking this work; the team should consist of about three specialists: a power engineer, financial analyst, and an organizational specialist.

20. The principal objective of the study is to propose how the requirements, defined, above can best be met so that the corporate arrangements recommended, if any, will be self-financing.

Specific Tasks

21. In summary, some of the specific tasks to be undertaken in the study include:

(a) Review of the corporate management control exercised and the common service provided by CDC in those utilities where it has equity interests and management control. Undertaking a similar review for those LDC utilities in which CDC does not operate.

(b) Determine the degree to which these requirements will change after CDC's withdrawal.

(c) Review current management procedures, technical and accounting capabilities in those OECS utilities in which CDC does not hold equity interests and assess those areas in which capability needs to be strengthened.

(d) Assess what actions and policies would need to be instituted to stimulate private sector interest in acquiring some equity in the power utility companies, as well as in any new regional common services corporation.

(e) Assess the common services which any new regional corporate body would be expected to provide, inter-alia:

- appointment of agents for the supply of spare parts and other commodities f.om overseas suppliers;

- provision of and arranging for engineering services as needed;

- assistance for the utility companies in assessing their training needs, preparing programs to fulfill those needs, arranging training courses regionally and extra-regionally, and monitoring the results of such training;

- advice on management, engineering, financial and accounting matters; and

- assistance in preparing capital development programs.

(f) Propose the type of regional organization required to cater to these requirements and recommend the measures needed to establish such a body including its consitution, control, financing, staffing and contractual relationships with the power companies.

(g) Prepare estimates of the operational budget for such an entity for the first two years of its existence.

(h) Assess the extent to which the organization could solicit assistance, on a cost-of-service basis, from other, larger power companies in the region.

C. Petroleum Pricing Specialist

22. One man-year of advice and assistance to the Eastern Caribbean Island Governments on a reginal basis to set up a petroleum pricing mechanism.

Scope of Work:

23. Will work closely with the ministries/departments responsible for petroleum prices/policy. Main tasks would include review of domestic energy pricing structures, pricing policy in relation to development of indigenous energy resources, and preparation of guidelines and developing analytical ability in the ministries/departments establishing petroleum pricing policy and montoring systems. Terms of reference cover:

(a) development of strategy and guidelines for monitoring and reviewing domestic energy prices;

(b) economic evaluation of energy project proposals or options; and

(c) training of local counterparts in energy pricing and monitoring methods.

Table 1: ST. VINCENT ELECTRICITY STATISTICS, 1977-82

	1977	1978	1979	1980	1981	1982	Growth (% p.a.)
Gross Generation (GWh)	18.62	22.12	24.60	25.75	26.26	29.03	9.3
Diesel (GWh)	10.24	12.22	14.92	15.73	15.75	18.00	11.9
Hydro (GWh)	8.38	9.92	9.68	10.02	10.51	11.03	5.6
Fuel Consumption ('000 Ig)	652.2	797.5	950.3	970.8	1028.9	1152.2	--
(kWh/Ig)	15.7	15.3	15.7	16.2	15.3	15.6	--
Maximum Demand (MW)	4.11	4.75	4.89	4.66	5.01	5.52	6.1
System Load Forecast (%)	51.7	53.2	57.4	63.1	64.3	60.0	--
Own-Use (GWh) a/	0.47	0.55	0.62	0.64	0.66	0.65	--
(% Gross Generation)	2.5	2.5	2.5	2.5	2.5	2.3	--
Line Losses (GWh)	2.97	3.92	3.90	5.46	5.20	6.60	18.2
(% Net Generation)	16.4	18.2	16.2	21.7	20.3	23.3	--
Final Sales (GWh)	15.18	17.67	20.09	19.65	20.40	21.78	7.5
Domestic	7.64	8.05	8.76	8.93	9.17	9.97	5.5
Commercial	5.95	6.74	7.11	7.11	7.60	7.97	6.0
Industrial	1.26	2.58	3.91	3.23	3.24	3.44	22.2
Street Lights	0.32	0.31	0.31	0.39	0.39	0.40	4.6

a/ Includes station service and office use. Utility's own use was previously estimated at 5%. Actual value in 1982 was 2.25% of gross generation. Losses for previous years have been revised using an estimate of 2.5% of gross generation.

Source: VINLEC and Adair and Brady (Power Transmission and Distribution Loss Reduction Study).

Table 2: ST. VINCENT - POWER GENERATING CAPACITY, 1983-90
(kW)

Station/Unit	Type	Number of Units	Nominal Capacity	Firm a/ Capacity
(A) Existing Plant				
South Rivers	Hydro	3	870	700
Richmond	Hydro	2	1,100	500
Cane Hall	Diesel	3	3,650	3,300
Kingstown	Diesel b/	4	2,075	900
Cane Hall	Diesel c/	3	1,800	1,800
Total VINLEC		15	9,495	7,200
Captive Plant d/		13	1,800	1,500
Total Existing Plant		28	11,295	8,700
(B) Future Plant				
Cane Hall No. 4	Diesel	1	2,900	2,900
Cumberland (1987/88)	Hydro	5	3,370	2,335
Total Future Plant		6	6,270	5,235

a/ Power plant peak output realizeable at any time. Based on maximum continuous output for hydro, and for older diesel plant maximum output less than nominal rating.

b/ Due to the state of the units at this station, annual available energy cannot be expected to be better than indicated.

c/ This represents 3 x 600 kW Cummings diesel units installed at Cane Hall in January 1984, essentially for peaking duty use.

d/ Estimated by VINLEC, some of these plants not connected to the grid.

Table 3: ST. VINCENT - POWER CAPACITY BALANCE, 1983-1990
(kW)

	1983	1984	1985	1986	1987	1988	1989	1990
1. System Demand (kW)	5,500	5,700	5,800	6,000	6,100	6,300	6,400	6,600
2. Existing Plant								
(a) Hydro								
South Rivers	700	700	700	700	700	700	700	700
Richmond	500	500	500	500	500	500	500	500
Total Hydro a/	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
(b) Diesel								
Cane Hall b/	5,100	4,200	5,100	5,100	5,100	5,100	5,100	5,100
Kingstown c/	900	900	900	900	900	500	----	----
Total Diesel	6,000	5,100	6,000	6,000	6,000	5,600	5,100	5,100
3. Future Plant								
Cane Hall								
(No.4) Diesel	--	2,900	2,900	2,900	2,900	2,900	2,900	2,900
Cumberland (Hydro) d/	--	----	----	----	----	----	2,335	2,335
Total Future Plant	--	2,900	2,900	2,900	2,900	2,900	5,235	5,235
4. Firm Peaking Capacity (2+3)	7,200	10,100	9,200	10,100	10,100	9,700	11,535	11,535
5. Reserve Requirements e/	1,800	3,500	3,500	3,500	3,500	3,500	3,500	3,500
6. Safe Plant Capacity (4-5)	5,400	6,600	5,700	6,600	6,600	6,200	8,035	8,035
7. Balance (6-1)	-100	+900	-100	+600	+500	-100	+1,635	+1,435

a/ Based on the firm (dry season) capacity of the run-of-the-river plants at South Rivers and Richmond.

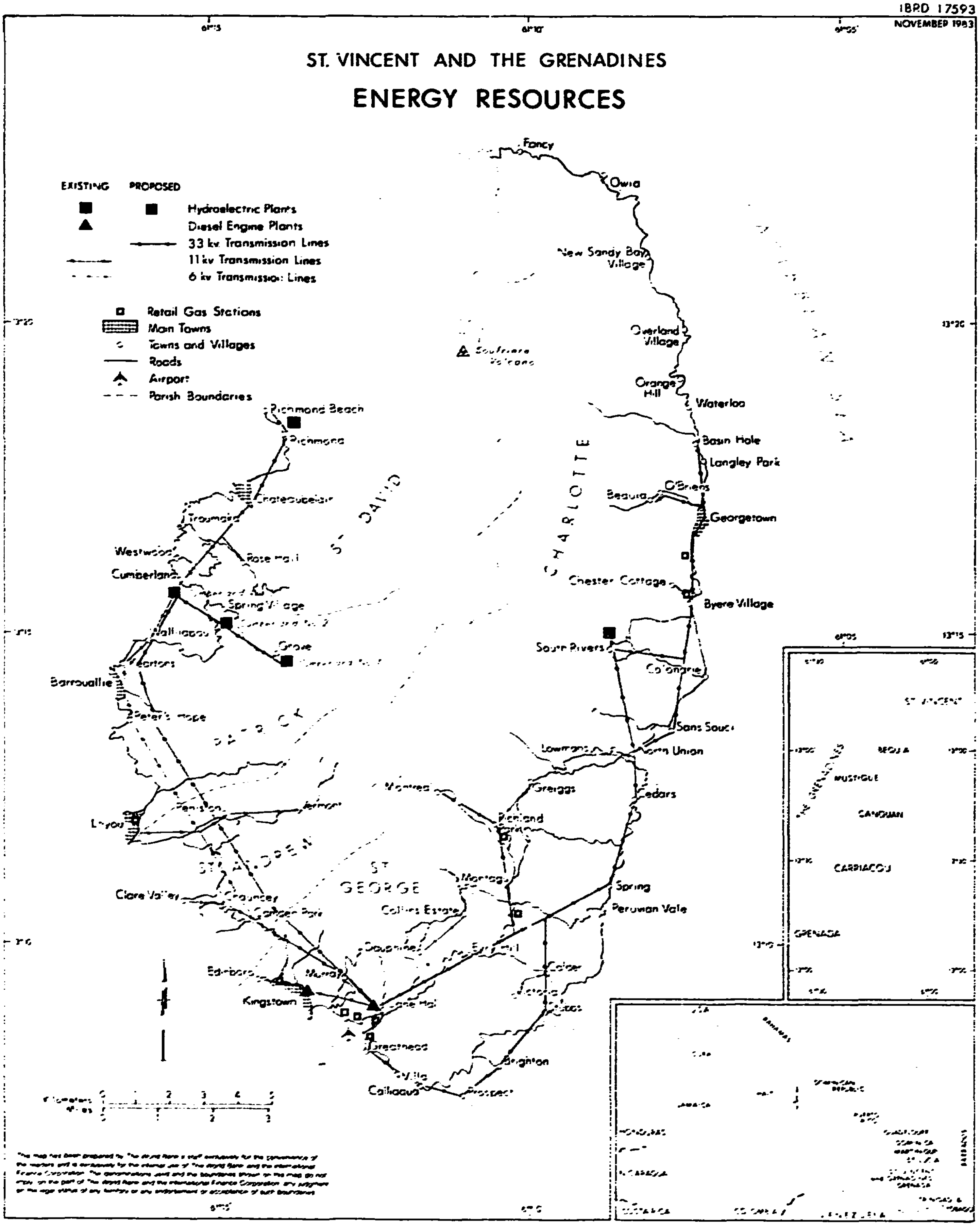
b/ Units 1, 2 and 3 at Cane Hall with available capacities of 1,100, 1,200 and 1,200 kW, respectively. After 1985, available capacities are 3 x 1,100 kW. In 1983, 3 x 600 kW diesel sets installed.

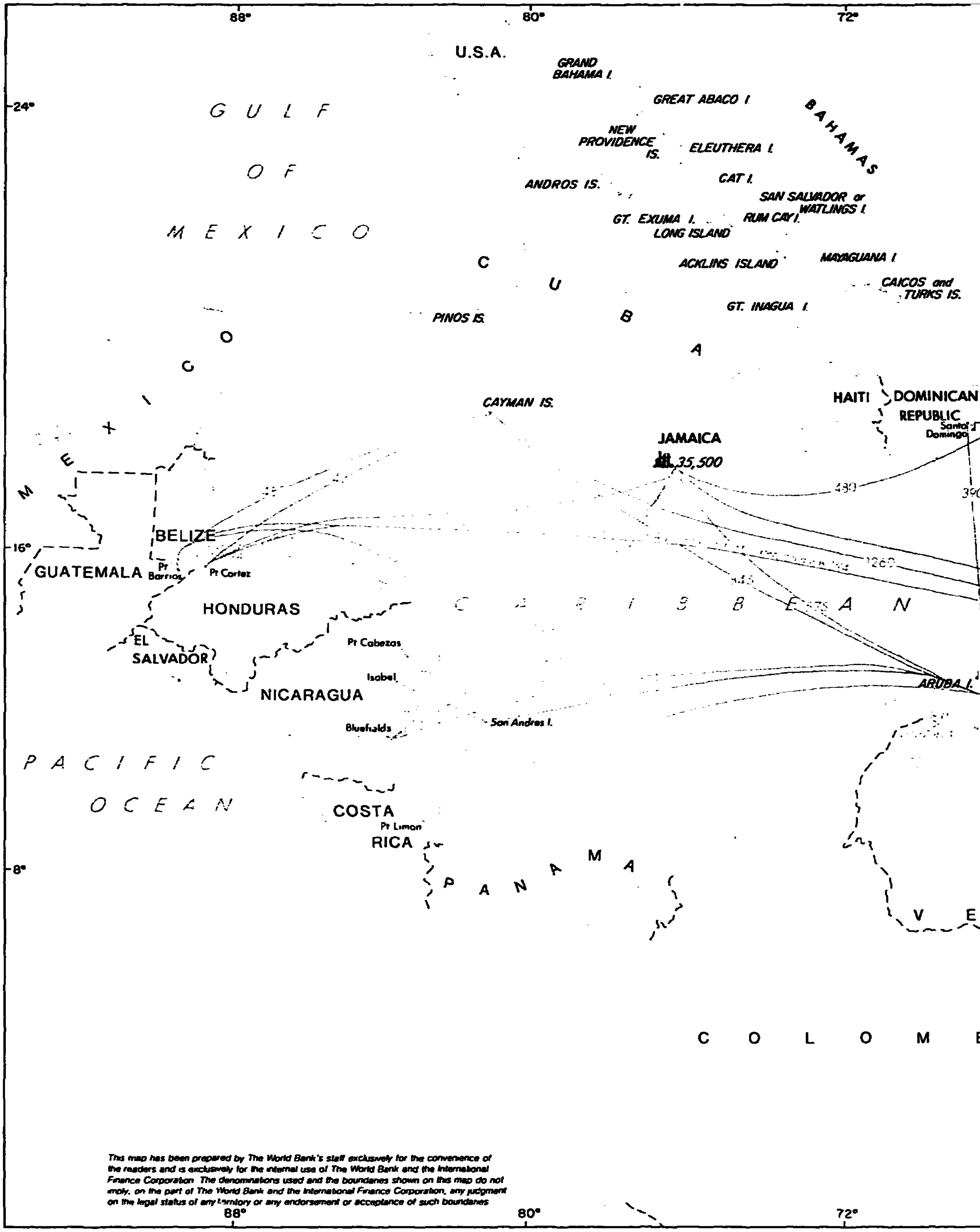
c/ Kingstown station retired in 1989.

d/ Based on the firm continuous output (2,335 kW).

e/ Reserve defined, solely for the purposes of consistency with IDA Appraisal Report No. 4854b-SV (April 1984), as the largest diesel unit and the largest Richmond hydro unit.

IBRD 17593


NOVEMBER 1983
ST. VINCENT AND THE GRENADINES
ENERGY RESOURCES
EXISTING
PROPOSED
Hydroelectric Plants
Diesel Engine Plants
33 kv Transmission Lines
11 kv Transmission Lines
6 kv Transmission Lines
Retail Gas Stations
Main Towns
Towns and Villages
Roads
Airport
Parish Boundaries
Fancy
Owia
New Sandy Bay Village
Overland Village
Orange Hill
Waterloo
Basin Hole
Langley Park
Georgetown
Chester Cottage
Byera Village
South Rivers
Sans Souci
Cedars
Spring
Peruvian Vale
Brighton
Prospect
Calliaqua
Kingstown
Edinboro
Clare Valley
Layou
Barrouallie
Cumberland
Westwood
Richmond Beach
Richmond
Chateaubelair
Troumaka
Spring Village
Grove
Penniston
Chauncey
Collins Estate
Greiggs
Richland Park
Lowmans
CHARLOTTE
ST DAVID
ST GEORGE
GRENADA
CARRIACOU
CANOUAN
MUSTIQUE
ST. VINCENT



This map has been prepared by The World Bank's staff exclusively for the convenience of the readers and is exclusively for the internal use of The World Bank and the International Finance Corporation. The denominations used and the boundaries shown on this map do not imply, on the part of The World Bank and the International Finance Corporation, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.

IBRD 17800
JANUARY 1984