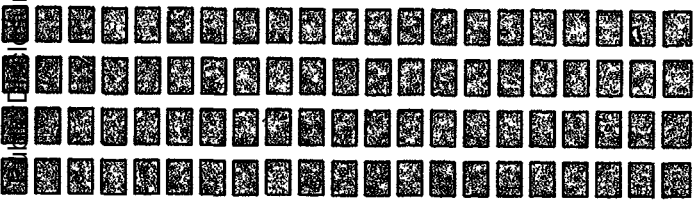


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ESMAP

Energy Sector Management Assistance Programme

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Jamaica

**Energy Sector Strategy and Investment Planning Study
Volume I: Main Report**

Report No. 135A/92

**JOINT UNDP / WORLD BANK
ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)**

PURPOSE

The Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) was launched in 1983 to complement the Energy Assessment Programme, established three years earlier. ESMAP's original purpose was to implement key recommendations of the Energy Assessment reports and ensure that proposed investments in the energy sector represented the most efficient use of scarce domestic and external resources. In 1990, an international Commission addressed ESMAP's role for the 1990s and, noting the vital role of adequate and affordable energy in economic growth, concluded that the Programme should intensify its efforts to assist developing countries to manage their energy sectors more effectively. The Commission also recommended that ESMAP concentrate on making long-term efforts in a smaller number of countries. The Commission's report was endorsed at ESMAP's November 1990 Annual Meeting and prompted an extensive reorganization and reorientation of the Programme. Today, ESMAP is conducting Energy Assessments, performing preinvestment and prefeasibility work, and providing institutional and policy advice in selected developing countries. Through these efforts, ESMAP aims to assist governments, donors, and potential investors in identifying, funding, and implementing economically and environmentally sound energy strategies.

GOVERNANCE AND OPERATIONS

ESMAP is governed by a Consultative Group (ESMAP CG), composed of representatives of the UNDP and World Bank, the governments and institutions providing financial support, and representatives of the recipients of ESMAP's assistance. The ESMAP CG is chaired by the World Bank's Vice President, Operations and Sector Policy, and advised by a Technical Advisory Group (TAG) of independent energy experts that reviews the Programme's strategic agenda, its work program, and other issues. The Manager of ESMAP, who reports to the World Bank's Vice President, Operations and Sector Policy, administers the Programme. The Manager is assisted by a Secretariat, headed by an Executive Secretary, which supports the ESMAP CG and the TAG and is responsible for relations with the donors and for securing funding for the Programme's activities. The Manager directs ESMAP's two Divisions: The Strategy and Programs Division advises on selection of countries for assistance, carries out Energy Assessments, prepares relevant programs of technical assistance, and supports the Secretariat on funding issues. The Operations Division is responsible for formulation of subsectoral strategies, preinvestment work, institutional studies, technical assistance, and training within the framework of ESMAP's country assistance programs.

FUNDING

ESMAP is a cooperative effort supported by the World Bank, UNDP and other United Nations agencies, the European Community, Organization of American States (OAS), Latin American Energy Organization (OLADE), and countries including Australia, Belgium, Canada, Denmark, Germany, Finland, France, Iceland, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, the United Kingdom, and the United States.

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JAMAICA

**ENERGY SECTOR STRATEGY
AND INVESTMENT PLANNING STUDY**

**VOLUME I
Main Report**

August 1992

**JAMAICA
ENERGY SECTOR STRATEGY AND INVESTMENT PLANNING STUDY**

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Part A: Petroleum Review

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Part A: Electric Power Sector Review

Part B: Electricity Demand Side Management and Industrial Energy Conservation Strategies

ABSTRACT

Building on structural adjustments begun in the mid-1980s, Jamaica now has the prospect of extending its recovery and sustaining economic growth at 3 to 4 percent a year during the 1990s. The burden of the energy sector on the economy decreased as a result of the drop in oil prices after 1986; however, Jamaica was among the hardest hit by price increases caused by the Persian Gulf Crisis in 1990. This shock reinforced concerns for the need to improve efficiency in the energy sector and reduce the energy intensity of the economy and its dependency on imported oil, which supplies more than 90 percent of Jamaica's commercial energy needs. The possibilities of increasing the mobilization of capital resources, and of improving the operating efficiency of the capital-intensive petroleum and power sectors, are apparent through expressions of interest by the private sector of participating in these subsectors with the ultimate objective of full divestiture by the government. The strategy recommended in this report supports the development of the energy sector with increasing private sector involvement through the further liberalization in the petroleum sector, preparation for divestiture of the power company (Jamaica Public Service Corporation) and the refinery (Petrojam), and development of energy conservation programs based on economic pricing and entrepreneurial pursuit of energy savings opportunities.

FOREWORD

This report was undertaken as a joint effort of the joint UNDP/World Bank Energy Sector Management Assistance Program (ESMAP) and the government of Jamaica and its agencies during the period November 1990 to April 1991. The ESMAP team comprised Joseph Gilling (ESMAP Senior Energy Economist and Task Manager), Robert van der Plas (ESMAP Household and Renewable Energy Specialist), and consultants Fred Gordon (electricity demand side management), Brian Kelly (energy conservation), William Matthews (petroleum economist), Thomas McCann (refinery engineer), Thomas Norris (power engineer), Thomas Steigerwald (petroleum pricing specialist), and Richard Thelwell (environmental specialist) and the firm of Touche, Ross, Ogle (financial modeling). The mission gratefully acknowledges the cooperation and substantive inputs provided Ministry of Mining and Energy (MME), Petroleum Corporation of Jamaica (PCJ), Petrojam (refinery), Jamaica Public Service Corporation (JPS), and Planning Institute of Jamaica (PIOJ), as well as the members of the Minister's Steering Committee on Private Participation in the Energy Sector. Through a Technical Assistance Agreement between PCJ and Lagoven (Venezuela), Mr. Ubaldo Hurtado (Commercial Analyst, Lagoven) worked closely with the mission on petroleum price forecasting. Mr. Zia Mian, Energy Policy Advisor, provided significant input to the work of the mission and in the review of reports. In addition, the mission worked closely with the World Bank team preparing the Energy Sector Deregulation and Privatization project: Suman Babbar (Senior Power Engineer), Abderrahmane Megateli (Senior Financial Analyst), and David Baughman (Economist), and Ms. Aysegul Akin-Karasapan (Task Manager, Private Sector Development Adjustment Project).

The Energy Sector and Investment Planning Study was financed by CIDA through ESMAP.

The report is presented in three volumes: Volume I, the Main Report; Volume II, Liquid Fuels (Petroleum and Ethanol); and Volume III, Power Sector Review and Energy Conservation. Volumes II and III, reports prepared by the ESMAP consultants, provide documentation of the analytical results as well as their findings and conclusions.

ABBREVIATIONS AND ACRONYMS

AAC	ambient air concentrations	HO	heating oil
ADO	automotive diesel oil	H₂S	hydrogen sulfide
ASTM	American Society for Testing and Materials	EIRR or IERR	internal economic rate of return
API	American Petroleum Institute	JPS	Jamaica Public Service Corporation
BCF	Bolivar Coastal Field, 17° gravity, a Venezuelan grade of crude oil	kBD	thousand barrels per day
B-C ratio	benefit-cost ratio	LCEP	least cost expansion plan
BPCD	barrels per calendar day	LDC	less developed country
BD or BPD	barrels per day (calendar day)	LPG	liquified petroleum gas
BPSD	barrels per stream day	LSFO	low sulfur fuel oil
C₃	propane	LV	liquid volume
C₄	butane	MBD	thousand barrels per day
CBI	Caribbean Basin Initiative	MDO	marine diesel oil
CFB	circulating fluidized-bed	MFPP	Ministry of Finance, Planning, and Production
C&I	commercial and industrial	mic	million
CIDA	Canadian International Development Agency	MME	Ministry of Mining and Energy
CPE	centrally planned economy	MOF	Jamaican Ministry of Finance
DAF	dissolved air flotation	MOGAS	motor gasoline
DERD	Defense Engineering Research and Development (a British standards/specifications body)	MTBE	methyltertiarybutylether, a high-octane blend stock for gasoline
DPSPP	Deregulation of the Petroleum Sector and Privatization of Petrojam (consultancy services and studies)	MW	megawatt
DSM	demand side management	NAAQS	National Ambient Air Quality Standards
EC	European Community	NCS	National Conservation Strategy
EIA	environmental impact assessment	NGO	nongovernmental organizations
ENDC	Energy Sector Development Committee	NO_x	nitrogen oxides
ESDPP	Energy Sector Deregulation and Privatization Project	NRCA	National Resources Conservation Authority
ESMAP	Energy Sector Management and Assistance Programme	NYH	New York Harbor
ESSIP	Energy Sector Strategy and Investment Planning Study	PSRF/JPS	Power Sector Regulatory Framework and Privatization of JPS studies
ETBE	ethyltertiarybutylether, a high octane blend stock for gasoline	RFP	Request for Proposals
FCC	fluid catalytic cracker	PV	present value
FCCU	fluid catalytic cracking unit	RON	Research Octane Number
FGD	flue gas desulfurizing	S	sulfur
FS	feedstock	SFS	Saybolt Furol Seconds
GPM	gallons per minute	SO₂	sulfur dioxide
GWh	gigawatt hours	SWECO	Swedish Energy Company
HFO	heavy fuel oil	T	tonne (metric ton)
HSFO	high-sulfur fuel oil	TEL	tetraethyl lead, an octane additive for gasoline
		USEC	United States East Coast
		USGC	United States Gulf Coast
		USMW	United States Midwest
		WS	worldscale

CURRENCY EQUIVALENTS

The Jamaican dollar is floating. The current exchange rate (July 1992) is J\$22/US\$. The rate used in preparing this report was J\$8.0/US\$.

ENERGY UNITS AND CONVERSIONS

	Gross energy (MJ/kg)	Oil equivalent (TOE/MT)
Fuelwood (5% mcwb)	15.0	0.36
Charcoal	30.0	0.72
Crude oil	42.6	1.00
LPG (propane)	50.0	1.17
Gasoline	46.5	1.09
Kerosene	46.4	1.09
Jet Fuel	46.4	1.09
Diesel (ADO)	46.0	1.08

1 kWh = 3.6 MJ = 860 kcal = 3,412 BTU = 0.086 kgoe
1 TOE = 7.3 barrels of oil equivalent = 11.63 MWh = 42 GJ =
10 million kcal = 39.68 million BTU

Gasoline : 1,360 liters per MT
Kerosene : 1,260 liters per MT
Diesel : 1,190 liters per MT

EXECUTIVE SUMMARY

Introduction

1. Jamaica, one of the largest islands in the Caribbean, has a total area of 11,000 km² with about 45 percent of the land used for agriculture. The population in 1990 was estimated at 2.4 million (of which about 55 percent live in urban areas) with an annual growth rate of 1.0 percent. The per capita GNP is US\$1,260 (1989), and the country is well endowed with natural resources, has a relatively well educated and skilled labor force, enjoys proximity to North American markets, and has a developed financial system. The economy, however, is dependent on external factors such as foreign demand for bauxite and alumina, tourism, and the price of oil. Based on structural adjustment begun in the mid-1980s, Jamaica has the potential for extending the recovery and sustaining economic growth at 3 to 4 percent a year during the 1990s.

Energy Demand and Supply

2. In 1990, imported energy (including energy for the bauxite and alumina sector) cost about US\$380 million, an increase of about US\$90 million over the 1989 import bill. The import bill for nonbauxite energy was about US\$270 million and represented more than 24 percent of foreign exchange earnings from merchandise exports and nonfactor services. As a direct consequence of the crisis in the Persian Gulf, the 1990 energy import cost for the nonbauxite sector increased by about US\$53 million.

3. Jamaica's petroleum demand is met mainly through local refining and direct import of refined petroleum products, which in 1990 amounted to about 18.5 million barrels of crude and petroleum products. Of this, about 7.2 million barrels of refined products were imported directly by the bauxite/alumina industry. Although the refinery's nominal capacity is 35,500 barrels per calendar day (BPCD), it imported 7.9 million barrels (21.6 KBPCD) of refinery feedstock and 3.3 million barrels (9.0 KPCD) of refined products. At present, the refinery feedstock is obtained from Mexico and Venezuela under the San Jose Accord (SJA). Refined products are partially bought under the SJA and partially from the cheapest sources.

4. Petroleum prices in the country were decontrolled, in the first phase, beyond the refinery loading rack in September 1990. Prices at the approximately 250 retail outlets and from company to company vary and reflect an element of competition in the market. Product prices up to the refinery rack, whether refined at the Petrojam refinery or imported, are set on the basis of an *ex-refinery billing price formula*, which determines the import parity price based on weekly variations in the U.S. Gulf Coast spot market prices with adjustments to meet Jamaican product specifications and allowing for the costs of deemed ocean freight, ocean losses, insurance, and imputed costs of terminaling. Because of the high rates of duties and taxes (more than 40 percent), Petrojam enjoys an effective monopoly on product imports for the nonbauxite sector. Taxes are added to the ex-refinery price according to government revenue needs to determine the overall refinery billing price for bulk sales.

5. In 1990, the balance of Jamaica's primary energy needs (3.6 million boe) were satisfied by bagasse (5 percent), which is used to generate steam in sugar factories; hydroelectric power (1 percent); and fuelwood (12 percent). About 90 MW of hydro power could be developed in the long term

but are currently not economic compared with thermal alternatives at projected fuel prices. The domestic consumption of fuelwood and charcoal was approximately 2.5 million boe, of which about three-quarters was converted into charcoal. The use of fuelwood by the commercial and industrial sectors is small, and little growth in fuelwood demand is expected.

Energy Demand Growth

6. Overall commercial energy growth (including coal after 1997) is expected to increase in line with the economy (assuming no further significant expansion in bauxite/alumina production) from 17.5 million boe in 1990 to about 26 million boe in 2000 (average growth, 4 percent). Growth in total petroleum demand is expected to slow considerably from the 1990 level of about 15 percent a year (which was due mainly to increases in bauxite/alumina production). In the period 1991-2000 it would average about 0.7 percent a year due to the introduction of a coal-fired power plant in 1997, which would reduce the total consumption of fuel oil. Prior to 1997, annual petroleum consumption growth is projected to average 3.4 percent including bauxite/alumina demand. The petroleum growth rate from 2000 to 2010 would be about 1.7 percent, as additional coal units are added to meet the bulk of electricity demand growth.

Energy Sector Issues, Policies, and Strategies

7. Many of the issues in the energy sector are the same as those identified in the 1985 World Bank Energy Assessment report although priorities and recommended strategies have changed in some cases in line with broad government policies such as the promotion of private sector involvement in the energy sector, and an increasing concern for the environment.¹ Within the context of the situation outlined above, Jamaica should gear its energy sector policy and strategy toward the following goals:

- a. Full deregulation and liberalization of energy sector (supplies, production, distribution and pricing, etc.) consistent with overall macro policies
- b. Increased reliance on private capital and private sector participation in the development of the energy sector (divestment programs and new investments)
- c. Decreasing the country's level of energy intensity through improved and efficient use (demand side management) and production (efficiency and loss reduction programs) of energy
- d. Reducing the risk of price shocks through diversification in the composition of imported energy to nonpetroleum and cheaper energy sources (primarily coal, and in the longer term, Orimulsion, if feasible)
- e. Strengthening the institutional structure in the sector for integrated planning and effective sector management, including greater attention to energy and environment linkages.

1. *Jamaica: Issues and Options in the Energy Sector, UNDP/World Bank Energy Assessment Program, April 1985.*

These issues and policy options and recommended strategies are discussed in the context of the energy subsectors and presented in a matrix at the end of this summary.

Petroleum

Sector Liberalization

8. The government of Jamaica is working to develop energy sector policies and strategies that are consistent with its overall macroeconomic policies. As a cornerstone of its policy, the government of Jamaica is committed to the broad objective of relying on market forces to achieve the efficient allocation of resources. This policy includes developing competition among suppliers and ensuring that foreign exchange and interest rates reflect their economic values. Following the liberalization of all other imports, the last effective monopoly for traded goods would rest with PCJ/Petrojam for the importation of petroleum products. Based on the crude and product price projections made in late 1990 and early 1991, the analysis of the least-cost supply option for petroleum indicates that the Petrojam refinery could be competitive with imported products, provided that minor debottlenecking and efficiency improvements take place. Under these conditions, there would be no apparent reason for delaying the liberalization of petroleum imports. *It is recommended, therefore, that the importation of petroleum products should be liberalized immediately by removing existing tariffs imposed under the Petroleum Act that provide effective protection to the refinery.*

9. As the cost of new storage tankage investment could be a barrier to entry to large consumers or new marketing firms wishing to import products and to ensure that competition among importers and the refinery can lead to the lowest landed cost of products, *it is recommended that the Kingston and Montego Bay terminals be operated on a common carrier basis with open access to qualified importers meeting public safety and financial requirements.* Under common carrier operation, the terminal would provide throughput and storage for a fixed fee according to operating conditions to be established under regulatory supervision.

10. In view of the possibility that anticompetitive practices ranging from dumping to price collusion and other oligopolistic trade practices could develop as well as the need for transitional mechanisms to implement the policy of trade liberalization in the petroleum subsector, the government has engaged consultants under World Bank supervision to provide detailed recommendations and draft legislation regarding a new pricing and taxation mechanism, removal of barriers to competition, and a strategy for the privatization of Petrojam.

Petroleum Pricing

11. The ex-refinery pricing formula was established in 1963 and last revised in 1988. The notional import parity pricing formula attempts to derive prices that would correspond to the least-cost alternative based on the importation of all products. Although reference prices that form the basis of final prices are adjusted weekly, the formula does not fully capture the dynamics of the market. With the liberalization of petroleum imports the pricing formula would be redundant except as a framework for monitoring prices. An analysis of the pricing formula revealed inherent biases that result in excess charges. The pricing formula is based on U.S. Gulf Coast spot market prices with adjustments to reflect

Jamaican product specifications, deemed ocean freight costs, terminaling and rack fees, and a Round Island Movement (RIM) fee to cover the transport costs to equalize ex-refinery prices at Kingston and Montego Bay.

12. An analysis of product specifications and each of the components of the ex-refinery pricing formula indicated that excess charges ranging from US\$9 to US\$15 million a year based on current volumes are attributable to unwarranted product specifications and components of the pricing formula. About one-third of the excess charges could result in savings in foreign exchange and could be achieved by changes in the product specifications, financing, insurance, and RIM costs. The remaining savings would be in local currency and would represent excess charges that would normally be absorbed by the supplier in a competitive market. Some of these excess charges result in increased cash flow to Petrojam and ultimately are consolidated in the public sector accounts. A compensating tax increase would be required to offset the loss in public revenue that could result from changes in the pricing formula. Revisions in the pricing formula, however, are recommended to provide incentives for efficient operations. It would be necessary to compensate for the loss in public sector revenue arising from changes in the pricing formula by restructuring the tax mechanism for petroleum products. As a result, not all the savings would be passed on to consumers.

Petroleum Industry Regulation

13. Following liberalization of imports and full price decontrol, regulatory oversight (although not necessarily a full regulatory body) of the petroleum industry will still be required to ensure adherence to the Antidumping Legislation and Competition Act. The Fair Trade and Monopolies Commission (FTMC) is also being established to enforce the Act's provisions.

14. Broad exposure to public review of comparative price information will be one of the most effective means of ensuring competition in the petroleum market. To meet this objective, it will be necessary to strengthen the Hydrocarbons Directorate within MPUTE with the responsibility as technical secretariat for all government of Jamaica petroleum regulation, monitoring, and sector management. The functions would include providing technical support to the FTMC, including common carrier terminal fee and capacity allocations, NRCA concerning industry environmental standards, JBS concerning product specifications, and other bodies concerned with health and safety, weights and measures and so. Staff should be experienced in international crude and product pricing, supply, affreightment, and marketing as well as on end-use product quality. The experience of the Directorate in the revision of the import parity pricing formula would serve as the foundation for subsequent price monitoring.

Petroleum Refining

15. Improvements in operating and administrative efficiency with respect to foreign exchange transactions would permit the refinery to achieve its nominal throughput capacity of 35,500 BPCD. Effective capacity has been only about 24,600 BPCD because of constraints in the gasoline production unit (powerformer) and unplanned outages caused by mechanical failures and foreign exchange constraints. Physical constraints were removed by year-end 1991; however, improvements in the opening of letters of credit and the management of foreign exchange requirements are also needed to avoid crude run-outs or refinery slowdowns. The use of standard hedging techniques available through NYMEX and financial houses is recommended to assist in foreign exchange risk management.

16. The options for least-cost petroleum product supply to Jamaica have been analyzed by comparing three petroleum supply scenarios. These scenarios were examined, on the basis of projected international market prices and Jamaican demand, to determine whether the refinery in its present or modified configuration could be part of the least-cost supply strategy. The scenarios range from (a) importing all products to (b) continuing to operate the existing refinery with minor modifications to (c) modifying and expanding refinery capacity to meet domestic requirements and provide products for export.

17. Since about 1986, refinery gross margins have been adequate to attract new investment in upgrading existing refineries in the region, but these margins are not sufficient to trigger the construction of new grass roots refineries in the region. The analysis carried out in this study indicates that refinery upgrading could be viable as a private sector venture in a freely competitive local and export market, provided refining margins remain at levels prevailing in early 1991. *The conclusions of this study do not, however, constitute specific recommendations and should not be used to direct private sector investors in refining.* Rather, private sector investors themselves should decide on the ultimate viability of the refinery and its optimum configuration, based on their own assessment of market conditions, risks, and expected profitability. The willingness of the private sector to invest in the refinery on terms acceptable to government of Jamaica will be the ultimate market test of viability.

18. A reduction in refining margins of 20 percent would make the refinery, whether in its existing configuration or upgraded, break even at best in comparison with 100 percent importation of product. A valuation of the refinery is being carried out as part of the consultancy services for the deregulation of the petroleum sector and privatization of Petrojam, which will also reassess the petroleum price projections in the light of developments since the Persian Gulf War and in view of the slow recovery of the world economy.

19. Nonetheless, a prefeasibility level study of supply options was carried out to provide a framework for government of Jamaica in evaluating proposals from private sector investors. About US\$1 million in investments in environmental improvements are required whether the refinery were to be shut down and operated as a terminal or continue to operate to clean up existing oil leakage, eliminate any oily water discharges to Kingston harbor, and improve the impermeation of tankage diked areas. Any upgrading of the refinery would require investments in environmental protection to current international standards, and these costs have been considered in the evaluation of the refining options.

20. Petroleum exploration has been supported by bilateral and multilateral sources; however, efforts carried out by international oil companies have not been successful, as witnessed by eleven dry holes and the lack of evidence from other geologic explorations. Further exploration has been discontinued since 1985 and would not be warranted at current oil prices.

Ethanol

21. An analysis of the costs of production of wet ethanol at PCJ's Petronol facility reveals that it is not competitive with other CBI-qualifying producers. The production of anhydrous ethanol at the Petrojam Ethanol facility located at the refinery, however, is expected to be profitable on the basis of the extension of the CBI preference and the availability of European wet alcohol at current prices or prices up to 50 percent greater than current prices. Since ethanol operations are peripheral to Jamaica's energy sector, and the government of Jamaica wishes to privatize the ethanol operations, *it is*

recommended that these operations should be divested as quickly as possible. Although it would be feasible to continue operations under separate refinery/ethanol plant ownership without relocating the plant, it is important that the sale of the ethanol plant should not be an encumbrance on the sale of the refinery.

Electric Power

22. Electricity demand on JPS facilities in 1990 amounted to 325 MW and 2,041 GWh and is expected to grow at about 6 percent to 1995 reducing to about 3 percent thereafter. The sent out capacity of JPS thermal generating stations will amount to some 499 MW, comprising 297 MW of oil-fired steam plant, 40 MW of low-speed diesel plant, and 162 MW of gas turbines, after rehabilitation by the end of 1993, with an additional hydro capacity of 24 MW in nine plants producing about 140 GWh.

Least-cost Expansion Plan

23. A least-cost expansion planning study has been carried out by consultants to JPS and reviewed in detail during this study through discussions with JPS, IDB, and the World Bank. Several options were found to be close in economic merit, based on the agreed demand projections and capital, operations and maintenance, and fuel cost assumptions. Taking into account the implementation schedule of the low-speed diesel units to be constructed as a BOO (Build, Own, Operate) project, the following sequence was found to be the least-cost expansion plan. This sequence does not consider the effect of demand side management programs, which are presently uncertain with regard to magnitude and timing.

Least-cost Expansion Program without DSM Load Reduction

1993	Gas turbine	1 x 30 MW
1994		
1995	Low-speed diesel	3 x 20 MW
1996	Gas turbine	1 x 30 MW
1997	Coal/oil fired steam station, Unit 1	1 x 61 MW
1998	2 & 3	2 x 61 MW
1999	4	1 x 61 MW
2000	5	1 x 61 MW

24. It is the intention of the government of Jamaica that all future generating additions should be carried out as BOO schemes by independent power producers, by a privatized successor to JPS, or both, depending on the ultimate restructuring of the power sector. Bidding for the first BOO scheme is under way for the installation of 3 x 20 MW of low-speed diesels under the Energy Sector Deregulation and Privatization (ESDP) project to be financed by World Bank and IDB. Depending on the degree of success with DSM programs, the commissioning of a coal/oil fired plant in 1997, the earliest estimated on-line date for the first unit could be deferred.

25. Because growth forecasts and cost conditions are continually changing, it is important that periodic reviews of the LCEP be carried out by JPS, even though future expansion will be financed as

BOO schemes. Generating plant proposed by BOO operators must be part of the overall expected long-term least-cost expansion program. The interaction of a proposed plant with existing and future plants as an integrated system could reveal that a proposed plant is less attractive than when analyzed in isolation. Requests for proposals should indicate the duty cycle (base/peak load). The operational advantage that the coal/oil station and possibly orimulsion would introduce in terms of the diversity of fuels available, protection against volatility of oil prices, and the ability burn the lowest-priced fuel available at any time can not be fully quantified but should be assessed through the RFP.

26. Because of the lead time required to prepare for the coal/oil fired plant, environmental studies should be undertaken without delay. Site selection is virtually complete, and CIDA is prepared to finance the Environmental Baseline Studies. An environmental audit of existing thermal plants has also been carried out for the existing Rockfort and Hunt's Bay sites in connection with preparations for the Energy Sector Deregulation and Privatization project.

27. Additional generating capacity may be forthcoming from industrial cogeneration, including sugar factories, provided that a standard offer buy-back tariff is established. The analysis carried out as part of the LCEP and DSM analysis in this study provides a basis for setting a buy-back tariff. Further action to formalize the tariff should be undertaken as part of the updating of the tariff study to be undertaken through consultancy services associated with the establishment of a power sector regulatory framework and the privatization of JPS.

Investment Program

28. In addition to future generation expansion, which would be financed as BOO projects, provision must be made for additions to the transmission and distribution investments. JPS's total investment program for FY93-FY97 is estimated at US\$236 million (J\$7,090 million) in constant 1992 prices, of which 32 percent would be for generation rehabilitation and two gas turbines on order, and 27 percent other plant and equipment including energy efficiency.

Preparation for Divestiture

29. Preparation for divestiture is under way, and consultants have been selected for services to prepare a power sector regulatory framework and privatization strategy for JPS with financing from the Japanese Technical Assistance Fund under World Bank supervision to outline the forms of sector organization. The studies will address key issues such as the optimum separation/integration of generating, transmission, and distribution functions; corporate and financial structure; regulatory framework and institutional requirements; degree of foreign/local participation; and timetable for divestiture. This is a major task with substantial specialist input concerning capital markets, macroeconomics, financial modeling, regulatory/legal issues, and power utility operations.

Energy Conservation and Electricity Demand Side Management

30. Since the oil price shocks of the 1970s, the government of Jamaica has stressed energy conservation as a major component of its national energy policy but has had difficulty in achieving lasting results due, in part, to previously low electricity prices and lack of sustained promotional efforts. USAID

financed a US\$30 million project including the provision of an Energy Credit Fund. Results were mixed, however, and the fund was eventually canceled after disbursing only US\$0.4 million. Despite the availability of funds, financing terms were found to be unattractive and procedures overly bureaucratic, among other difficulties. Following the recommendations of the 1985 UNDP/World Bank Energy Assessment, ESMAP provided assistance to the then Ministry of Mining and Energy in developing an Energy Efficiency Building Code (EEBC), Appliance Testing and Labeling (ATL) program, improved kerosene stoves project, and as well as other technical assistance.

31. The EEBC and ATL programs are being carried out through Jamaica Bureau of Standards (JBS) with the full participation of private sector engineers, architects, and appliance distributors and manufacturers. Public awareness and concern for energy conservation has increased significantly since the electricity tariff was increased in May 1990 by an average of 37 percent and continues to grow with further tariff revisions. One of the principal barriers to energy conservation has been considerably lowered by setting the electricity tariff in structure and level to reflect the economic costs of supply.

32. A price distortion still remains, however, in electricity pricing, since taxes on the supply of electricity are minimal (5 percent on generating equipment, no consumption tax on retail sales), while electrical equipment and energy efficiency equipment are heavily taxed with the exception of fluorescent lamps which have recently been zero-rated under provisions of the General Consumption Tax (GCT). The current tax structure creates a comparative bias in favor of electricity consumption, and the payback period to consumers for the purchase of energy-efficient equipment is thereby lengthened. Selective reductions in taxes on energy efficiency equipment are conceivable, but they are not recommended, as such a move would serve to introduce further distortions in the overall tax structure, which the government of Jamaica is working to remove. *In the absence of a general reduction of taxes in duties to remove price distortions throughout the economy, it is recommended that the GCT should be applied to electricity consumption.* The application of the GCT to electricity consumption would provide strong support to conservation and would support efforts to increase private participation in the power sector through private consumer financing of demand side measures as an alternative to supply expansion.

Electricity Demand Side Management

33. Major work is now under way in the area of demand side management (DSM) in the power sector. An Energy Conservation Unit (ECU) has been established in JPS and is carrying out pilot and demonstration projects in commercial and residential premises with current support from the Rockefeller Foundation and IDB. Grant funds are also expected from the Global Environment Fund. Benefits to be attained from DSM measures include energy savings through reduction in energy consumption through improved efficiency, energy savings through shifting to off-peak periods when fuel costs of generation are lower, and generating capacity savings through load reduction or peak shifting. GEF will also support a demonstration project for solar and cogeneration absorption air-conditioning systems.

34. To the extent that tariffs reflect the economic cost of supply, consumers have an incentive to make energy efficiency improvements. Lack of awareness, transaction costs in terms of arranging for energy audits and evaluating proposals, and a reluctance or inability to finance conservation measures are important barriers inhibiting energy conservation efforts. These barriers can be significantly reduced by DSM programs implemented by JPS with the support of MPUTE. In the longer term, it may be possible to rely on the private sector to undertake energy conservation and DSM programs through shared savings

programs offered by energy service companies. In the near to medium term, however, leadership and promotion by JPS in particular will be needed to demonstrate the benefits of DSM to consumers.

35. Eight possible energy efficiency programs have been examined by consultants to JPS and in the course of this study. Potential benefits that would be economically justified in terms of avoided cost to JPS could range as high as 25 percent; however, this level of savings would require significant investment by JPS that would have to be absorbed in the tariff base or supported by rebates and tax reductions paid by government of Jamaica. Such measures could be seen, however, as benefiting mainly the high-income, high-volume consumers. Without tax reductions or a corresponding increase in electricity tariffs, however, it is estimated that DSM savings would be limited to 5 to 10 percent of total consumption by 2000. Programs to capture these savings would be economically viable with rates of return in the 9 to 45 percent range depending on the program.

36. Industrial energy efficiency programs, primarily in the form of boiler tuneups, could readily be incorporated as part of the annual boiler safety inspection carried out under Ministry of Labor regulations by private sector inspectors. Coordination of MPUTE with Ministry of Labor would be needed to prepare a program that could save 10 to 20 percent in industrial energy use.

Transportation

37. The transport sector is a major consumer of oil in Jamaica, projected to consume about 5.2 million bbl of fuel in 1995, or about 27 percent of total petroleum products. A recent survey of vehicle registrations in Jamaica indicates about 144,000 vehicles.² Motorcars make up about 55 percent of the fleet; trucks, 18 percent; motorcycles, 16 percent; and the remaining 11 percent consists of vans, buses, tractors, and trailers. About 84 percent of the fleet consumes gasoline; the remainder consumes automotive diesel. Typical of developing countries are the large number of old vehicles—about 53 percent of the fleet is more than 10 years old. The slow rate of scrapping of vehicles is caused by low disposable incomes and the high cost of new vehicles; duty and taxes can add more than 100 percent to the import price.

38. The higher duties on cars over 2.0 liters and the restrictions on cars over 2.6 liters are effective means of limiting fuel consumption. In the long run, however, fuel efficiency will improve largely through the replacement of the existing vehicle fleet with newer, more efficient models. The recent policy of permitting the importation of second-hand vehicles up to three years old will thus help to improve the overall fleet efficiency, as newer vehicles are more fuel efficient. The high demand for public and private transportation, however, is unlikely to lead to an increase in the scrapping rate of older vehicles. Continued public information programs by MPUTE to encourage tuneups and improve maintenance are useful and recommended as a general measure but, except for large vehicle fleets, it would be difficult to carry out effective direct vehicle tuneup programs.

39. Improvements in transportation fuel efficiency can also be obtained by improvements in traffic management that bring additional benefits in the form of reduced congestion and time savings. Such measures as one-way street systems, coordination of traffic signals, widening of busy intersections, bus bays, turning movement restrictions, and greater enforcement of parking restrictions and traffic

2. The study was carried out by Petrojam to assess motor octane requirements.

regulation could significantly reduce fuel consumption by reducing idling time and increasing the average speed of traffic. A traffic management program would require detailed traffic surveys in peak and off-peak hours to identify the most heavily congested road sections and intersections in Kingston and Montego Bay. Because of the overall high rates of return for such projects and the benefits to road users, *it is recommended that user/beneficiary costs should be recovered through general fuel taxes or as identified road user charges and that MPUTE, Ministry of Transport, and local Parish Councils collaborate in studying the potential for traffic management.*

Household and Renewable Energies

Household Energy

40. As in most developing countries, the primary household energy requirement in Jamaica is for cooking. Total household primary energy use amounted to about 2.4 million boe in 1990, of which woodfuels (wood used for charcoal making plus wood burned directly) accounted for approximately 72 percent of the total, petroleum fuels for 21 percent, and electricity for 4 percent. In terms of *monetary value*, LPG accounts for 47 percent of the total worth of J\$475 (US\$ 59.4) million, charcoal for 22 percent, kerosene for 16 percent, and electricity for 15 percent.

41. For consumers, kerosene is the most attractive fuel at subsidized prices with a cost 0.13 J\$/MJ of end-use energy compared with 0.23 J\$/MJ for charcoal, 0.30 J\$/MJ for LPG, and 0.50 J\$/MJ for electricity including annualized costs of stoves. While electricity is delivered at its approximate economic cost, deregulated LPG retail prices are high compared with markets of similar size in other countries. Kerosene is cross-subsidized within the ex-refinery pricing structure by approximately 35 percent of economic cost. In the medium term, this subsidy is justifiable on environmental grounds, as it provides an incentive not to switch to charcoal for the 25 percent of the population using kerosene as a primary cooking fuel. Initial indications in ongoing survey work show that about one-half of household kerosene use charcoal as a cooking fuel in addition to LPG and kerosene and that 12 percent of the population uses charcoal as a primary fuel. The survey also reveals that existing kerosene stoves are inefficient. Removal of the kerosene subsidy would encourage the use of more fuel-efficient stoves so that there would be some offsetting of the higher kerosene prices.³ On the other hand, consumers could switch to charcoal as a preferred primary cooking fuel.

42. A switch to charcoal would place additional demand on fuel wood resources. Although estimates of woody biomass resources and of the volume of wood harvested for all purposes are highly uncertain, current indications are that 64 percent of total wood use is for charcoal making. If all kerosene users switch to charcoal as a preferred fuel because of the removal of the kerosene subsidy, total wood consumption from all uses could double because of the conversion losses in charcoal making.

43. Although tentative, current estimates suggest that woodfuel could remain a sustainable resource, since the annual increment exceeds current demand; however, regional problems of deforestation are evident. A National Forestry Action Plan (NFAP) has been designed to carry out priority activities in the forestry sector, but potential funding agencies have expressed concern that the

3. Trials are under way to introduce kerosene stoves that would be 10 to 20 percent more efficient than those presently in use.

plan should be more tightly focused and that institutional strengthening is required before the NFAP could be effective. The matter has not yet been fully resolved; however, an inventory of forest resources is under way. Other studies are required and have been identified in the household fuels area to improve the weak state of knowledge of this important energy subsector.

44. At present, no resource value for wood harvested from public lands for charcoaling is charged or collected by the government of Jamaica. A resource tax or stumpage fee applied to wood is recommended but is difficult to collect. Rather than attempting to collect stumpage fees through the public sector administration, *it is recommended that a brief study be undertaken to assess other options, including the feasibility of auctioning concession timber rights to public forest areas.* The concessionaire would be obliged to ensure the collection of stumpage fees, and, most importantly, would be responsible for replanting. Administrative responsibility would be confined to regulation and monitoring rather than collection and reforestation. Other measures are also required to ensure sustainable fuelwood use on private lands, where predial larceny is a common problem.

Kerosene Subsidy

45. *It is recommended that the kerosene subsidy be continued; however, administration through the food stamp program (to ensure a more direct targeting of low-income beneficiaries) is proposed. The subsidy should be eliminated from the refinery billing price and the price decontrolled at the retail level.* The present practice of restricting distribution to small drums should be discontinued. Sales through service stations at decontrolled prices would improve the availability to low-income groups, who would be able to use kerosene/food stamps as part payment. Targeting of low-income groups is being improved and the number of beneficiaries of the food stamp program expanded as part of the government's social safety net program.

Renewable Energies

46. Renewable energies that can be developed economically on a large scale in the medium term are limited to primarily to solar water heaters. An analysis of renewable energy technologies in Jamaica estimated that a market of about 10,000 existing water heaters could be replaced by solar water heaters with a simple payback of less than three years. An evaluation of a proposed bagasse cogeneration project by MPUTE and JPS concluded that the project would not be economic at current fuel costs. Photovoltaics would have a limited application, in remote areas, while biogas production and solar crop driers are more relevant in agricultural than in energy production. Small hydro development has been found to be uneconomic at projected energy price levels in the medium term but might attract donor interest to help combat global warming by avoiding CO₂ emissions.

Energy and the Environment

47. There is a strong and growing national concern for environmental protection and cleanup as the basis for sustainable development in addition for the need to maintain the quality of the environment in support of key economic sectors such as agriculture and tourism. There is also awareness that without proper management Jamaica could suffer irreversible environmental degradation, as has already occurred on other Caribbean islands, unless a strong environmental protection program is

established. The recent creation of the National Resource Conservation Authority under the NRCA Act has been a critical step in grouping existing environmental bodies under one authority. NRCA is empowered to monitor environmental quality, set standards, and enforce regulations.

48. As NRCA has only recently been established, it is important that the necessary national and international funding and technical assistance be put in place as quickly as possible. Initial work programs have been developed, and CIDA is contributing to the funding of these activities.

49. In the energy field, requirements for environmental improvements have been identified as part of the study of each subsector. An Energy/Environmental Steering Committee has been set up under the chairmanship of the Permanent Secretary MPUTE to supervise the execution of related studies and review the environmental impacts of proposed energy projects. The recommended environmental strategy and action plan for the energy sector consists of six elements:

- a. Carrying out Environmental Impact Assessments for new energy supply projects as carried out for the BOO power plants and planned for the coal-fired power plants
- b. Cleaning up existing sources of pollution, particularly at the refinery in advance of its divestiture and also at JPS power stations
- c. Reducing pollution through conservation and energy efficiency improvements implemented through JPS
- d. Strengthening institutions responsible for environmental management, notably NRCA
- e. Establishing baseline data for air quality as a priority project for NRCA and for forest coverage through the carrying out of a forest inventory as part of the NFAP
- f. Identifying environmental zones and setting standards according to the particular requirements of the zone (e.g., Kingston metropolitan area, tourist areas, bauxite mining areas).

50. An Environmental Emissions Survey is planned, with CIDA financing, to assess the impact of the use of high-sulfur fuel oil in Jamaica, as it is a source of acid rain, which could be having a damaging effect on vegetation downwind from major sources of emissions. These sources include bauxite/alumina factories, JPS, and other industries. The study would also aid in the identification (or exclusion) of potential power and industrial sites, depending on the severity of SO₂ emissions. Depending on the impact of SO₂, it may be necessary to reduce the sulfur specification in HFO below the current level of 3 percent. This possible requirement has implications for the choice of crude oil and the need for desulfurization equipment in power plants and industry.

51. Where environmental standards have not yet been established, it is recommended that World Bank guidelines be accepted as the basis for energy sector planning. Based on cost and benefit evaluations using the baseline data to be collected, the need for revising the interim standards should be assessed according to the requirement of each environmental zone.

ENERGY SECTOR STRATEGY AND INVESTMENT PLANNING STUDY

SUMMARY MATRIX: ISSUES, STRATEGIES, ACTIONS

Policy Issues	Strategy Recommendations	Follow-up Actions	Status/Comments
<p>Macro Policy - Trade Regime</p>	<ul style="list-style-type: none"> - maintain consistency in energy sector with overall macro policies 		
<p>Petroleum Sector Liberalization</p>	<ul style="list-style-type: none"> - liberalize importation of petroleum products to induce competition to lower supply cost 	<ul style="list-style-type: none"> - revise Petroleum Act (1979) by removing protective import duties and tariffs - put Montego Bay and Kingston product terminals under common carrier regulation 	<ul style="list-style-type: none"> - regulatory framework is being developed under consultancy services for the Deregulation of the Petroleum Subsector and Privatization of Petrojam (DPSP), Part I Task A- import and pricing regime, dumping
<p>Petroleum pricing to reflect least-cost supply option</p>	<ul style="list-style-type: none"> - set product standards to meet Jamaican requirements - liberalize petroleum importation on competitive basis 	<ul style="list-style-type: none"> - JBS to be responsible for setting and enforcing standards - revise pricing formula to reflect specifications and costs in a competitive market as interim measure 	<p>Task B - review of barriers to competition (storage, transportation, market structure), possibilities of unfair competition practices.</p>
<p>Antidumping prevention and assurance of open competition</p>	<ul style="list-style-type: none"> - enforce Antidumping Legislation enacted in 1988 - Competition and Fair Trade Practices Act 	<ul style="list-style-type: none"> - deregulate prices totally once antidumping commission has been established - set up and strengthen Antidumping Commission to review market irregularities - pass legislation (late 1991) and reinforce Prices Commission as agency for enforcement 	

Policy Issues	Strategy Recommendations	Follow-up Actions	Status/Comments
Privatization and Divestiture			
Petrojam refinery	<ul style="list-style-type: none"> - prepare for divestiture immediately - invest only in environmental cleanup and powerformer upgrade 	<ul style="list-style-type: none"> - prepare RFP with consultant funded under Energy Sector Deregulation and Privatization project - carry out environmental engineering and design 	<ul style="list-style-type: none"> - DPSPP, Task II - parallel environmental study to DPSPP under way for environmental cleanup - powerformer upgrade complete
Ethanol Operations	<ul style="list-style-type: none"> - divest immediately 	<ul style="list-style-type: none"> - prepare RFP 	<ul style="list-style-type: none"> - Under preparation
JPS	<ul style="list-style-type: none"> - increase private participation through BOO schemes for all new generating plant including replacements 	<ul style="list-style-type: none"> - Energy Sector Deregulation and Privatization (ESDP) project implementation - establish buy-back tariff for small supplies 	<ul style="list-style-type: none"> - World Bank loan approved July 1992 - included under TORs for tariff study update
Power sector restructuring	<ul style="list-style-type: none"> - prepare strategy for divestiture by assessing options such as (a) retaining JPS as core utility responsible for system planning, transmission, and distribution; (b) developing local distribution companies; (c) separating generation, transmission, and distribution functions 	<ul style="list-style-type: none"> - in-depth assessment of the various options for restructuring and privatizing outlined in initial studies - carry out corporate planning study investigating all aspects of capital market, financial planning, tariff impact, legal requirements; tie in with regulatory study 	<ul style="list-style-type: none"> - Consultancy services for Power Sector Regulatory Framework and Privatization of JPS have been engaged: Phase I - Broad Structure and Ownership of Power Sector Phase II - Detailed Organizational Structure and Regulatory Framework
Regulation	<ul style="list-style-type: none"> - establish performance-based framework for all aspects of power sector regulation - set up autonomous regulatory board following recommendations of study 	<ul style="list-style-type: none"> - carry out regulatory framework study 	<ul style="list-style-type: none"> Phase III - Implementation Program Studies to be completed Qtr I/1993
Energy Sector Financing	<ul style="list-style-type: none"> - develop access to foreign and local capital markets for power sector 	<ul style="list-style-type: none"> - Implementation of Energy Sector Deregulation and Privatization project - investigate local capital markets as part of divestiture planning 	

Policy Issues	Strategy Recommendations	Follow-up Actions	Status/Comments
Energy Conservation			
Power Sector DSM	<ul style="list-style-type: none"> - provide incentives for Demand Side Management by correcting price distortions caused by tax differentials - pursue economically viable energy conservation opportunities 	<ul style="list-style-type: none"> - apply same tax treatment to power generation as to appliances; put taxes and duties on power supply inputs and GCT on sales or level all taxes to lower, uniform rate - build institutional delivery capacity within JPS. 	<ul style="list-style-type: none"> - ongoing with funding from Rockefeller Fund, IDB, and anticipated from GEF
Building codes	<ul style="list-style-type: none"> - make energy efficiency an integral part of design and construction 	<ul style="list-style-type: none"> - continue support for technology transfer primarily through JIE and JIA - identify and implement retrofit possibilities in existing buildings 	<ul style="list-style-type: none"> - part of JPS DSM program
Industrial energy conservation	<ul style="list-style-type: none"> - pursue low/no-cost measures in improving combustion efficiency - follow up with longer-payback energy conservation measures 	<ul style="list-style-type: none"> - identify conservation opportunities during walk-through audits in conjunction with boiler inspection - carry out detailed audits and develop conservation projects 	<ul style="list-style-type: none"> - coordination needed between MPUTE and Ministry of Labour
Transportation	<ul style="list-style-type: none"> - improve fuel efficiency and reduce fuel consumption - improve urban traffic flow 	<ul style="list-style-type: none"> - maintain high fuel taxes and road-user charges - traffic management study in Kingston metropolitan area 	<ul style="list-style-type: none"> - fuel taxes to be proposed under DPSPP studies
Household, Biomass, and Renewable Energies	<ul style="list-style-type: none"> - assess volume and sustainability of biomass resources - improve management of forest resources - capture resource value of woodfuel - encourage use of kerosene by low income households - improve efficiency of kerosene distribution 	<ul style="list-style-type: none"> - carry out biomass inventory under National Forestry Action Plan - study means of levying and collecting stumpage fees and ensuring replanting of trees - target kerosene subsidy through food stamp program - apply tax/remove subsidy from retail price 	<ul style="list-style-type: none"> - aerial photo survey completed

Policy Issues	Strategy Recommendations	Follow-up Actions	Status/Comments
Environment	<ul style="list-style-type: none"> - internalize environmental costs in energy supply - determine energy/environment linkages; identify sensitive areas as part of power system planning - clean up existing pollution sources 	<ul style="list-style-type: none"> - mandatory environmental impact assessment (EIAs) for specified energy projects - staff up NRCA as quickly as possible - baseline emissions studies - power generation site inventory - engineering studies and investment required for refinery and power plants 	<ul style="list-style-type: none"> - completed for BOO power projects, audits included in power and petroleum sector privatization consultancies - To be financed by CIDA - covered under consultancy services engaged for privatization of Petrojam and JPS
Institutional	<ul style="list-style-type: none"> - consolidate focus of responsibility for energy policy within MPUTE; leave sector entities to function under clear mandates and authority - accelerate privatization process 	<ul style="list-style-type: none"> - strengthen MPUTE in major policy areas with small number of well-qualified and motivated staff - tighten the focus of Minister's Steering Committee on Private Sector Privatization, establish more compact working groups with technical assistance, as required 	<ul style="list-style-type: none"> - regulatory framework studies for power and petroleum sectors will define specific requirements - Specialized working groups established during preparation of ESDP project, consultancy services now under way

JAMAICA

**ENERGY SECTOR STRATEGY
AND INVESTMENT PLANNING STUDY**

**VOLUME I
Main Report**

August 1992

I. OVERVIEW AND BACKGROUND OF ENERGY SECTOR

Energy Sector and the Economy

Background

1.1 Jamaica, the largest English-speaking island in the Caribbean, has a total area of 11,000 square kilometers, with about 45 percent of the land used for agriculture. The estimated population growth rate of 1.0 percent in 1990 was lower than the 1.4 percent growth of 1989, and 1990 population was estimated at 2.42 million, of which about 55 percent live in urban areas. The per capita GNP is US\$1,260 (1989), and the country is well-endowed with natural resources, has a relatively well-educated and skilled labor force in adequate supply, enjoys proximity to North American markets, and has a developed financial system.

1.2 The Jamaican economy, however, is highly sensitive to external developments, such as foreign demand for its exports, price of energy, international interest rates, tourism preferences, and so on. Unexpected changes in any of these variables can make large differences in the country's economic situation and prospects. Jamaica depends for about 99 percent of its commercial energy needs on imported oil (97 percent) and coal (2 percent). Principal economic activities are bauxite/alumina mining and processing, tourism, manufacturing, and agriculture. Together, these sectors accounted for (in 1990) about 55 percent of the GDP, 50 percent of employment, and 75 percent of foreign exchange earnings. In the recent past, nontraditional exports such as garments, furniture, and leather goods have also been developed.

The Economy

1.3 ***Economic Performance in the 1970s.*** From its independence in 1962 up to 1972, Jamaica enjoyed a steady growth, spurred by direct foreign investment in the capital-intensive bauxite/alumina sector and also in the more labor intensive tourism sector. As a consequence, whereas the GDP increased at an average rate of 5 percent per year, employment grew at a much slower rate despite the growth in tourism. Between 1973 and 1980, the economy experienced a period of sustained decline that resulted from increases in energy costs; the impact of the mid-1970s recession in the industrial countries on the sugar and alumina industries; the increase in international interest rates; an overextended public sector; and a disruption of production caused by the increased role of the state in the economy. An erosion of the private sector's confidence in the government led to reduced productive investment and an outflow of capital and skilled manpower.

1.4 ***Economic Adjustment in the 1980s.*** The first half of the 1980s saw no real economic growth in Jamaica. During that period, as the policy adjustments were being put in place, bauxite and

alumina exports fell. Jamaica developed unsustainable fiscal and external balances, with public sector and current account deficits averaging 15 percent and 17 percent of GDP, respectively. The external debt more than doubled from 1980 to 1985, with official creditors accounting for virtually all of the US\$2.2 billion increase in debt.

1.5 During the second half of the 1980s, the reforms, as well as stabilization efforts, were deepened. The economy responded slowly but positively to the program of economic reforms, which had been aimed at liberalizing the economy, developing export industries including tourism, and raising the domestic savings rate, especially that of the public sector. Vastly improved terms of trade (induced by a fall in oil prices and sustained increases in export prices for alumina, sugar, and bananas) brought about an economic turnaround. Between 1986 and 1988, GDP growth averaged 3 percent per year (compared with 0 percent between 1981 and 1985), the overall public sector deficit equaled about 4 percent of GDP (compared to 16 percent in the earlier period), inflation averaged 10 percent a year (15 percent during 1981-1985), and the external current deficit (excluding grants) equalled 6 percent of GDP (from 14 percent in first half of that decade). Had it not been for the dislocation caused by Hurricane Gilbert in September 1988, Jamaica's performance would have been even better, especially in terms of economic growth and reduction of the public sector deficit.

1.6 *Recent Economic Performance.* Since 1989, the new government has advanced significantly in reducing the overall public sector deficit by increasing revenues, controlling noninterest expenditures, and improving the performance of public sector enterprises, largely through tariff increases and reduction in general subsidies. Beginning in FY88/89, the overall public sector deficit, including grants and divestment proceeds, was reduced from 16 percent of GDP to 1.8 percent of GDP.

1.7 The government's response to the Guif crisis of 1990 also indicated its commitment to adjustment and stabilization. In September 1990 it decontrolled domestic petroleum prices (except for kerosene for domestic use, which is cross-subsidized through the ex-refinery pricing structure for environmental and social reasons) and allowed a full pass-through of the higher international oil prices, including devaluation effects, to the consumer. At the same time, electricity tariffs were raised to reflect higher fuel costs; water charges were increased; and, as a part of the policy of phasing out general food subsidies, prices of food products were increased. Thus, most of the external shock was absorbed through domestic adjustment.

1.8 Considering the adverse exogenous factors that affected the economy, economic performance in 1990 was positive, and GDP, in real terms, increased by 4.2 percent in 1990. The growth was largely supported by agriculture, forestry, and fishing; mining and quarrying; and the financial sector.

1.9 *Growth Prospects.* For a relatively small island economy, Jamaica retains unusually diverse opportunities for growth. The short-term economic outlook depends on successful implementation of stabilization and adjustment programs. Barring major external shocks and a continued macroeconomic adjustment process, supported by IMF, the World Bank, and the Inter-American Development Bank (IDB), GDP growth is expected to be fairly broad-based, averaging at least 3 to 4 percent a year in the

period 1992-95 and to increase gradually to about 6 percent by 1999. Sectors that are closely linked to growth in energy demand show above-average prospects for growth. The manufacturing sector is expected to grow at an average 3.8 percent and 6.0 percent a year in the corresponding periods. These higher growth rates are expected to be in response to improvements in the incentive framework for private sector investment. A more rapid growth in services, including tourism, is forecast to grow at 5.4 percent between 1995 and 1999, compared with 2.8 percent in the period 1989-94. Tourism has become more competitive as a result of exchange rate developments and is expected to grow steadily through the 1990s.

1.10 The mining sector (bauxite and alumina) accounted for roughly 60 percent of total merchandise exports (and about 25 percent of total exports of goods and nonfactor services) in 1990. The sector is operating close to capacity and cannot grow appreciably in the medium term. Profitability, however, could increase with real price increases in aluminum and real price declines in oil prices in the medium term, thereby stimulating an expansion of capacity beyond 1995.

Energy and the Economy

1.11 As the Jamaican economy is highly energy intensive, developments in the energy sector significantly affect the overall economic performance. In the period 1989-90, total energy consumption increased at about 17 percent a year, and the commercial energy consumption at an average of about 21 percent a year. Growth came mainly from the bauxite, alumina, and power subsectors.

1.12 In 1990, total primary energy consumption (before conversion losses) in Jamaica was about 21 million barrels of fuel oil equivalent (boe), as shown in the energy balance, Annex 1.1. Commercial energy consumption was about 83 percent (17.5 million boe), represented by petroleum (80 percent), coal (2 percent), and hydropower (1 percent). Noncommercial energy consumption consisted of wood and charcoal (12 percent), and bagasse (5 percent). About 99 percent of the commercial energy needs were met from imported petroleum (97 percent) and coal (2 percent). Indigenous energy sources (hydropower, bagasse, and peat) are limited, have low potential, and are not yet fully developed; solar energy shows economic potential for domestic water heating, however.

1.13 Of the total primary energy consumption in 1990, the bauxite industry accounted for about 34 percent (consuming 43 percent of the country's petroleum); the power sector, 20 percent (25 percent of petroleum); the transport sector, 13 percent (16 percent of petroleum); aviation, 6 percent (7 percent of petroleum); the sugar industry, 6 percent (mainly bagasse); and the cement industry, 3 percent (mainly coal).

1.14 In 1990, imported energy (including energy for the bauxite and alumina sector) cost about US\$380 million, an increase of about US\$90 million over the 1989 import bill. The import bill for nonbauxite energy was about US\$270 million and represented more than 24 percent of foreign exchange earnings from merchandise exports and nonfactor services. As a direct consequence of crisis in the Persian Gulf, 1990 energy import cost for the nonbauxite sector increased by about US\$53 million.

Energy Supplies

1.15 Jamaica's petroleum demand is mainly met through local refining and direct import of refined petroleum products. In 1990, Jamaica imported about 18.5 million barrels of petroleum and petroleum products. Of this, about 7.2 million barrels of refined products were imported directly by the bauxite/alumina industry. Although the refinery's nominal rated capacity is at 35,500 barrels per day (BPCD), bottlenecks in the refining process currently reduce the effective throughput capacity to 26,400 BPCD, and Jamaica imported 7.9 million barrels (21.6 KBPCD) of refinery feedstock and 3.3 million barrels (9.0 KPCD) of refined products.

1.16 At present, the refinery feedstock is obtained from Mexico and Venezuela under the San Jose Accord (SJA). Refined products are also bought under the SJA and from the cheapest alternate sources. The refinery sells refined and imported petroleum products to four petroleum marketing companies: ESSO, Shell, Texaco, and the PCJ subsidiary, PETCOM. The transportation fuels, gasoline, and diesel are sold through a network of some 250 retail outlets owned or operated by the affiliates of the international marketing companies and PETCOM (three stations). The outlets are supplied by road tanker from loading racks in Kingston and Montego Bay by a group of independent road haulage contractors.

1.17 As household kerosene is used for cooking by about 25 percent of the low-income population, it continues to be subsidized. To ensure that the intended consumers benefit from this subsidy, kerosene is sold in tins or bottles to urban and rural households by peddlers and local shops.

1.18 The petroleum prices in the country were decontrolled, in the first phase, beyond the refinery rack in September 1990. Every week the refinery publishes ex-refinery billing prices, which are based on reference postings in the U.S. Gulf; deemed freight, ocean losses, and insurance costs to Jamaica; imputed terminal and financing costs to supply products ex-terminal; and a tax element that is fixed by government of Jamaica based on its revenue needs. The oil companies add to this price their own operating margins and transport costs and establish wholesale prices to the retailers. The retail traders add their operational costs and margins and post ex-outlet prices.

1.19 Prices from outlet to outlet and company to company vary and reflect an element of competition in the market. The program of decontrolling petroleum prices has proceeded smoothly. In the short run, retail margins rose, as was expected, and are now beginning to stabilize as greater competition is occurring.

1.20 Jamaica has 3 million barrels of crude and product storage capacity among the refinery and marketers, not including tankage at large customers' premises, which represents about four months of inland consumption.

1.21 To reduce dependence on petroleum imports, the government has taken several initiatives to broaden and develop the country's indigenous sources of energy. Bilateral (Canada) and multilateral

(IDB and IBRD) donors have supported the search for oil and gas. An exploration program has been in place since 1955. On-shore drilling has been carried out by international companies. Jamaica's oil exploration efforts have not been successful, and drilling (eleven dry holes) and the geologic explorations have not produced evidence of hydrocarbons.

1.22 The joint UNDP/World Bank energy sector assessment in 1985 concluded that although "systematic geologic studies of the area could continue which would throw additional light on the unknown geologic aspects of the perspective areas additional exploration drilling should be dependent upon the result of further studies and should be undertaken by the private sector alone or by private sector risk participation."

1.23 The balance of Jamaica's primary energy needs are satisfied by bagasse (5 percent), which is used to generate steam in sugar factories; hydroelectric power (1 percent); and fuelwood (12 percent). Nine hydroelectric power plants are currently installed, with an aggregate capacity of 24 MW (about 4 percent of Jamaica's installed capacity). The hydropower potential, which may be economically developed during the next 15 to 20 years, depending on long-term real petroleum price increases, is estimated at about 90 MW of generating capacity. This would substitute for petroleum-based power generation at the rate of about 1 million barrels per year.

1.24 In 1990, the sugar industry consumed 1.1 million boe of bagasse and about 200,000 barrels of fuel oil. With an energy efficiency program, sugar factories should be able to satisfy all their own energy needs and supply surplus power to the national grid.

1.25 Peat is the only indigenous proven fossil energy resource available in Jamaica; it is not currently exploited, and the economic viability of its development has not been demonstrated. Moreover, the environmental implications in its development are serious. Peat is therefore not considered as a viable option within the horizon of this study.

1.26 Solar energy for water heating could make an economic contribution to the reduction of electricity demand, provided costs to consumers can be reduced to increase market penetration (para. 1.12).

1.27 Although Jamaica currently produces fuel ethanol, its viability depends on the prices of wine alcohol in Europe (currently heavily subsidized by the European Community; EC) and on the favorable treatment of its imports to the U.S. market under the Caribbean Basin Initiative (CBI). For the domestic market, it is not economic for blending with gasoline, given the opportunity to export to the U.S. market and the present low petroleum prices.

1.28 In 1990, the domestic consumption of fuelwood and charcoal was approximately 2.5 million boe, of which 64 percent was converted into charcoal. The use of fuelwood by the commercial and industrial sectors is small, and little growth in fuelwood demand is expected. Further efforts are being made through the National Forest Action Plan and the ESMAP Cookstoves Project to optimize the use of fuelwood and charcoal (para. 6.1).

1.29 The UNDP/World Bank Energy Assessment Program Report, with a view to alleviating the serious drain on the country's foreign exchange reserves caused by imports, emphasized the need for further developing Jamaica's indigenous sources of energy, improving efficiency in energy use, and effectively managing the energy sector. A number of agencies, including CIDA (through ESMAP), IDB, and the Rockefeller Foundation are currently providing assistance to the government to design and implement a program to improve energy efficiency in supply and end use (para. 5.18).

Energy Demand

1.30 Barring significant discoveries of oil and gas or unforeseen technological breakthroughs, the country will continue to rely on imported oil to meet most of its energy requirements during the next two decades. In 1990, petroleum consumption totaled 17.6 million barrels. Of that, the Jamaica Public Service Company (JPS) consumed 4.1 million barrels, the bauxite industry consumed an additional 7.3 million barrels, gasoline consumption accounted for 2.0 million barrels, and automotive and marine diesel oil consumption was 2.6 million barrels. In the past three years, demand for petroleum products has increased about 14.6 percent a year, mainly from the increased demand of the bauxite/alumina industry and the power sector. During the next decade, in line with macroeconomic growth prospects, demand for gasolines is projected to increase at about 3 percent per year, for kerosene at 3.4 percent per year, and for automotive diesel at 3.8 percent per year. For a summary, see the energy balance, annex 1.1.

Institutional Structure and Energy Sector Enterprises

1.31 Energy sector policies and the activities of energy sector entities are coordinated by the Ministry of Public Utilities, Transport and Energy (MPUTE). The two main public sector entities in the energy sector are JPS in the power subsector, and the Petroleum Corporation of Jamaica (PCJ) in the petroleum subsector. Rationalization in 1989 to bring both these subsectors under the portfolio a single ministry has significantly improved the coordination of energy sector policies.⁴ It has also facilitated the formulation of a national energy policy, based in part on this ESSIP study.

1.32 To coordinate the activities and provide policy guidelines required for the introduction of the private sector in energy development, the government formed, in November 1990, a Steering Committee on Private Sector Participation chaired by the Minister of Energy and including representatives from the Ministry of Public Utilities, Transport and Energy, the Ministry of Finance, as well as JPS, PCJ, PIOJ, the Attorney General's Office, and BOJ and is intended to serve as a focal point for the formulation and adoption of policies regarding the participation of private sector investors in energy as well as overseeing the implementation of these policies. MPUTE is the Secretariat of the Steering Committee and is responsible for all coordination. Also at the request of the government, the World Bank seconded a staff member to the government to assist in the development of energy sector policy.

4. Until January 1992, the Ministry of Mining and Energy (MME); now the Ministry of Public Utilities, Transport and Energy.

1.33 PCJ is a wholly owned state corporation established under the Petroleum Act of 1979. Its core functions are (a) to import, export, refine, and distribute petroleum and petroleum products; and (b) to explore, develop, and manage petroleum resources. Its most important subsidiaries are Petrojam, responsible for oil refining, and PETCOM, the most recent entry into petroleum product marketing. Following a strategic review in 1990, PCJ divested itself of a number of nonenergy activities (relating to tourism and engineering services, for example) were judged by the government to be beyond the scope of the Petroleum Act, and at the same time, significantly reduced the size of the headquarters staff.

1.34 The overall management of petroleum product marketing is dominated by the three local affiliates of international majors—ESSO, Shell, and Texaco—with minor participation by PETCOM. The road transportation and operation of retail outlets is in the hands of private Jamaican entrepreneurs.

1.35 JPS, the only power utility in Jamaica, has exclusive responsibility for the generation, transmission, and distribution of electric power for public consumption. The government of Jamaica has 99 percent ownership of the company, which is regulated by MPUTE.

Energy Sector Policies, Issues, and Strategies

1.36 Many issues in the energy sector are the same as those identified in the 1985 World Bank Energy Assessment report (para. 1.29), although priorities and recommended strategies have changed in some cases in line with broad government policies, such as the promotion of private sector involvement in the energy sector and an increasing concern for the environment. Within the context of the situation outlined above, Jamaica should gear its energy sector policy and strategy as follows:

- a.** Fully deregulating and liberalizing the energy sector (supplies, production, distribution, pricing, etc.) consistent with overall macro policies
- b.** Increasing reliance on private capital and private sector participation in the development of the energy sector (divestment programs and new investments)
- c.** Decreasing the country's level of energy intensity through improved and efficient use (demand side management) and production (efficiency and loss reduction programs) of energy
- d.** Reducing the risk of price shocks through diversification in the composition of imported energy to nonpetroleum and cheaper energy sources (primarily coal, and in the longer term, oil emulsion, if feasible) taking into account environmental impacts
- e.** Strengthening the institutional structure in the sector for integrated planning and effective sector management, including greater attention to energy/environment linkages.

1.37 Each of these issues is set out in chapter II; detailed analyses and discussion of subsectoral strategies are given in corresponding chapters.

Past World Bank Involvement

1.38 The World Bank has made four loans to JPS, which total US\$90.5 million. Prominent in these lending operations have been (a) financing construction of generation, transmission, and distribution facilities; and (b) providing technical assistance for improving operations and maintenance practices and overall efficiency. The latter was particularly important during the implementation period of the second loan (1516-JM, US\$20.0 million, 1978) when adverse macroeconomic conditions took a toll on the company.

1.39 The third and fourth loans, in addition to financing construction and providing technical assistance and training, focused on rehabilitating plants and general upgrading of the power system. In particular, the ongoing fourth loan (2869-JM, US\$18.0 million, 1987) aimed to improve operating efficiency within the JPS system by (a) expanding and upgrading transmission lines, substations, and the distribution network; (b) establishing a permanent training center and training program; and (c) providing engineering/consultant services for JPS. The project was designed to help JPS meet its power needs through 1992.

1.40 In July 1992, the Energy Sector Deregulation and Privatization Project loan number 92-0070 (US\$60 million out of US\$165 million total project cost) was approved to install about 120MW of generating capacity (90MW in the private sector and 30MW in the public sector) and transmission lines, establish and operate a Private Sector Energy Fund to provide long-term financing for private investments in the power sector, provide consulting services to assist in the development of BOO projects and a regulatory framework for the power sector, and develop and implement a privatization strategy for JPS and Petrojam.

1.41 Institution building has been a major focus of all World Bank lending operations in the Jamaican power sector. Training and strengthening of sector human resources have also received particular attention. In the Energy Sector Deregulation and Privatization Project, the primary concern will be to establish the institutional and incentive framework, as well as the local financial and technical capability needed to attract and support private sector development. Accordingly, the project will incorporate a strong technical assistance component as a short-term measure to make up for local deficiencies in technical expertise.

1.42 The Petroleum Exploration Loan (2017-JM, US\$ 7.5 million, 1981) was aimed at promoting the exploration for and development of Jamaica's hydrocarbon potential. Although no commercial discovery was reported, the project partially achieved its objectives by increasing knowledge of the prospectivity of the Pedro Bank area offshore and of the northern and western areas onshore. The interpretations of the survey data enhanced the understanding of the areas explored and identified areas such as New Bank on the South Coast Shelf, where further exploratory work would be warranted at higher oil prices (para. 3.29). The negative results of the exploration activities and the lack of sound alternative uses led in January 1986 to closure of the loan and cancellation of about 50 percent of the approved funds.

II. ENERGY SECTOR POLICY ISSUES AND STRATEGIES

Macro Policies

Trade Regime

2.1 The development of energy sector policies and strategies must be consistent with government of Jamaica's overall macroeconomic policies. As a cornerstone of its policy, the government of Jamaica is committed to the broad objective of relying on market forces to achieve the efficient allocation of resources. This policy includes developing competition among suppliers and ensuring that foreign exchange and interest rates reflect their economic values. Since 1987, the government has been working toward liberalizing trade, particularly with respect to tariffs and duties. Under the Common External Tariff (CET) of Caricom introduced in February 1991, protection of local manufactures has been reduced so that the maximum duty is 45 percent, and exemptions will be severely limited.⁵ A General Consumption Tax (GCT) or equivalent of 10 percent was introduced in 1991.

2.2 These measures are expected to result in cheaper, higher-quality goods for consumers and a more efficient allocation and use of resources; however, unless similar policies are applied to the pricing of electricity, a tax distortion will remain against energy efficiency improvements, since electricity is not subject to sales tax nor is heavy fuel oil, which accounts for about 80 percent of generation, taxed. This distortion works significantly against a major government objective—to increase energy end-use efficiency.

Petroleum Importation

2.3 Following the liberalization of all other imports, the last effective monopoly for traded goods rests with the Petroleum Corporation of Jamaica (PCJ) and Petrojam for the importation of petroleum products. Analysis of the least-cost supply option for petroleum—based on crude and project price projections made in late 1990 and early 1991—indicates that the Petrojam refinery could be competitive with imported products following minor debottlenecking and efficiency improvements. Under these conditions, there would be no apparent reason for delaying the liberalization of petroleum imports.

2.4 PCJ/Petrojam, however, raised concerns (Annex 2.1) regarding the viability of the refinery in a liberalized market and requested interim protection at least. This and other issues discussed below are the subject of the Deregulation of the Petroleum Sector and Privatization of Petrojam Study (DPSPP). Footnotes throughout this chapter refer to relevant sections of the DPSPP (Annex 2.2).

⁵ The government had set an objective of a tariff range of 5 to 20 percent and will continue to press for a further reduction within CARICOM, which presently has a common external tariff structure of 0 to 45 percent.

2.5 Petroleum products are covered by the CET and are subject to ex-refinery taxes, which were projected to contribute about J\$740 in FY91/92, or 8 percent of total indirect taxes. *It is therefore recommended that the importation of petroleum products should be liberalized immediately by removing existing tariffs imposed under the Petroleum Act that provide effective protection to the refinery.*² Liberalization of imports would also put pressure on the refinery to make efficiency improvements as rapidly as possible.

2.6 To ensure that competition among importers and the refinery can lead to the lowest landed cost of products, *it is recommended that the Kingston and Montego Bay terminals be operated on a common carrier basis, with open access to qualified importers meeting standards for public safety and financial soundness, for storage for a fixed fee and operating conditions under regulatory supervision.*³

Petroleum Pricing

2.7 In case full liberalization could not occur immediately, some time might be required to ensure that product specifications were established and that continuity of supply would be assured at all times should significant changes occur in trading patterns. During the interim period, it might be necessary to revise the ex-refinery pricing formula (para. 3.34) to reflect the required product specifications and terminaling and delivery rack charges that would obtain in a competitive market. C.i.f. reference prices for products imported under the formula pricing arrangement should continue to be based on *Platt's* spot price quotes for U.S. Gulf Coast.⁴

2.8 The review of the pricing formula carried out by the consultants to the mission indicated that the application of the present pricing formula may be leading to overcharging or excess costs of supply of up to about US\$15 million for petroleum products, leading in part to additional profits by Petrojam. As these profits form part of the consolidated surpluses of public sector corporations in meeting the IMF tests, it is essential that under any revised pricing formula, adjustments and made to the tax formula in order to retain the surpluses as part of public revenues.⁵

2. *In comments on the draft report (Annex 2.1), Petrojam proposed a 36-month phase-in period for import liberalization to permit the acquisition of downstream distribution outlets. The phase-in period is to be addressed in DPSPP studies (Regulatory Framework, Task A (b)).*

3. *Petrojam commented that shared tankage arrangements should be left up to the petroleum industry itself rather than imposed by government. This approach could help to achieve economies of scale in tankage. The entry of small independent marketers could still be inhibited because of the need to construct or otherwise gain access to storage facilities. To be further addressed under DPSPP (Regulatory Framework, Task B (i) and Privatization Strategy, Task (b)).*

4. *Revisions to the pricing formula to be proposed under DPSPP (Regulatory Framework, Task A (c)).*

5. *Tax revision proposals to be made under DPSPP (Regulatory Framework, Task A (b)).*

Antidumping and Competition Policy

2.9 PCJ/Petrojam have expressed concerns that free importation of petroleum products could lead to dumping; however, antidumping legislation was enacted in 1988, and the Prices Commission will be strengthened to carry out the necessary technical accounting and economic investigations. The Commission is expected to become operational during 1992 under the Ministry of Industry, Commerce, and Production.⁶ As a further measure to ensure fair trade, the government of Jamaica has begun development of a competition policy that covers restrictive business practices, mergers, price fixing, resale price maintenance, consumer protection, and other aspects of policy. This policy is also expected to become effective during 1992. Given the small number of petroleum marketers and the vertical integration in the present industry structure, the potential for unfair trade practices is greater than in other markets both from dumping of bulk imports or from restrictions in retail trade.⁷

Privatization and Divestiture

2.10 The National Investment Bank of Jamaica (NIBJ), reporting to the Prime Minister's office, has been assigned the responsibility of coordinating and implementing the privatization of energy sector entities including JPS, Petrojam (refinery), Petrojam (Belize), and the ethanol operations.

Petroleum Corporation of Jamaica

2.11 ***Petrojam Refinery.*** The analysis of the least-cost petroleum supply options (chapter 3)—based on 1990-91 data—concluded that the Petrojam refinery, with minor upgrading, could compete profitably with imported products in the local market, thereby minimizing petroleum supply costs based on current and projected conditions in the regional petroleum markets. With more extensive upgrading through the addition of a catalytic cracker, the refinery could be competitive in export markets and could run at close to full utilization. It would be up to private sector investors, however, to judge the expected long-term viability of the refinery and the potential value of upgrading options. This expectation would then be reflected in the price they would be willing to pay. Since this judgment can only be tested through bona fide offers, technical assistance is being provided under the Petroleum Deregulation and Privatization Study to prepare a detailed privatization strategy including a valuation of Petrojam and a prospectus to offer it for sale.

2.12 So that the sale of the refinery will not be delayed or prejudiced, *it is recommended that no investments for expansion or modification should be made before divestiture except for (a) environmental cleanup and (b) the debottlenecking of the powerformer.*⁸ The environmental cleanup

6. Technical assistance will be provided under the World Bank Second Trade and Financial Sector Adjustment Loan, 1991.

7. Fair trade and competition issues to be addressed under DPSP (Regulatory Framework, Task A(d) and Task B(ii)).

8. The powerformer is the unit for gasoline production.

would be required even in the event that the refinery were closed and the tankage were to be used for terminaling. Furthermore, it would remove any reason for discounting the sale price because of possible concerns of purchasers for eventual liability for inherent environmental defects. As for the powerformer, it would have a payback period of less than 12 months.⁹

2.13 ***Ethanol Operations.*** Because the cost of producing fuel-grade alcohol in Jamaica is greater than the equivalent cost of gasoline, dry alcohol production is viable only for export to the United States under the CBI preference and based on the availability of European wet alcohol (para. 3 and Vol. II-B). Production of wet alcohol at Petronol is not competitive with regionally produced wet ethanol that would qualify under the CBI, and it is concluded that the Petronol operations are uneconomic. Production of dry ethanol, however, is expected to remain profitable, since the CBI preference has been extended to the year 2000, provided that European wet alcohol remains available.

2.14 Since ethanol operations are peripheral to Jamaica's energy sector and the government wishes to privatize ethanol operations, *it is recommended that these operations should be divested as quickly as possible.* If a private sector buyer saw a profitable opportunity, then the sale would go quickly. It is understood that interest has already been expressed in the Petrojam Ethanol facility located adjacent to the petroleum refinery. Because of the physical location of the anhydrous ethanol distillation unit close to the refinery, it is important that the sale of the ethanol plant should not be an encumbrance to the sale of the refinery; however, it would be feasible to continue operations under separate refinery/ethanol plant ownership without relocating the plant.

Jamaica Public Service Corporation

2.15 The government of Jamaica's long-run goal in the power sector is divestiture, although it recognizes that the process for power is likely to require more time than for the petroleum sector and should begin with more limited forms of private sector participation such as the use of BOO projects for generation. The objectives of private participation are as follows:

- a. Increase sector efficiency to meet electricity demand at lowest cost to the nation and consumers.
- b. Increase access to foreign and local funding for system expansion.
- c. Provide a stimulus for local capital markets.
- d. Transfer to private capital the business risks inherent in investment in the power sector.
- e. Reduce public sector debt through the sale of assets.
- f. Reduce the involvement of government in the operation of the power sector.

2.16 Although some of these objectives can be achieved only with private participation, efficiency improvements and increases in local funding—at a minimum—can be achieved by improved regulation of JPS as a public corporation, including a greater reliance on internal cash generation by

⁹ Petrojam undertook the powerformer upgrade as part of annual maintenance in late 1991. An environmental audit is being done in parallel with the Deregulation and Privatization study.

raising tariffs as required. Private sector initiatives and market-oriented behavior can be expected to stimulate better performance and productive efficiency. In this respect, the role privatization can play is akin to that of regulatory measures that focus on incentives rather than on government intervention in the administration of the sector.

2.17 In an effort to further the initial steps taken by the government, a study, consisting of three phases, has been commissioned by the government and is being administered by the World Bank under the ESDP project (TORs, Annex 2.3). The first phase of the study will recommend the broad structure and ownership of the power sector and an appropriate regulatory framework for the privatized power sector. The second phase of the study addresses the detailed implications of the recommended structure, including the organizations required for the new structure, including the regulatory institutions, allocation of assets in the sector, required tariff adjustment mechanism, and so on. The third phase of the study addresses the implementation program, including the required legislative and regulatory changes, and a detailed strategy, program, and implementation schedule for the privatization. Consultancy services are being provided by a major international firm (Coopers and Lybrand) and are scheduled for completion in Quarter I 1993. Issues to be addressed in the study, among others, are outlined below.

2.18 *Scope for Competition.* Power systems have traditionally been organized as vertically integrated natural monopoly industries with the attendant need for regulation to prevent excess profits from being extracted. Natural monopolies are characterized by economies of scale (declining average unit cost); economies of multiproduct outputs; and a high degree of sunk costs (large investments in fixed plant with no alternative uses leading to low short-run marginal costs). There is thus a natural barrier to entry for any new firm wishing to offer the service and a clear diseconomy in duplication of services in the same geographic territory. A situation wherein it is cheaper for a single firm to produce the output rather than for two or more firms to produce it is the essential feature of a natural monopoly.

2.19 It is generally accepted that transmission and distribution constitute natural monopolies and should continue to be treated as such. Whether they adjust as an integrated entity or as separate firms, regulation will be required, since competition will not be feasible. There is, however, much discussion in the literature concerning the scope for competition at the generating level. There is a further possibility that transmission and distribution networks could act as common carriers according to a standard tariff of wheeling charges to permit the sale of power from an individual generating firm to a specific purchaser. In this manner, a generation company could compete with a distribution company that purchases power in bulk for resale. These options become economic when a single generating plant is relatively small in comparison with the total system demand and economies of scale have been exhausted. This situation is found in large systems such as in the U.S., U.K., and a number of the larger developing countries. The limit to economies of scale is reached for unit sizes in the order of 500 to 800 MW, and the existence of power pools with a large number of generating stations renders marginal the output from an individual unit.

2.20 An examination of the situation of Jamaica suggests that economies of scale in generation have not yet been exhausted. The Least-cost Generation Expansion Plan (LCEP), for example, shows

that larger units benefiting from economies of scale should be brought on line as the peak demand continues to grow (para. 4.45).¹⁰ Because of the relatively small maximum demand, lumpiness of investment in generation, and the small extent of the transmission network, the Jamaican power system can be expected for some time to exhibit the characteristics of a traditional power utility. In transmission and distribution, unit costs will decline with load growth as transmission voltage increases and load density increases in distribution.

2.21 Competition can occur in generation expansion through a build, own, and operate (BOO) bidding process at the time the investment is to be made and through power purchase contracts that ensure short-run cost minimization through merit-order dispatching.

2.22 *Power Sector Regulation.* A BOO contract will essentially meet many of the overall objectives of sound power system regulation. Bids will be made on the basis of clear specifications of output, including incentives and penalties for good and poor performance, respectively. To ensure the continued development of new generating facilities using the BOO concept, it is important to establish a consistent and transparent regulatory framework so that the rules of the game can be evenly applied to all participants as they join in (assuming that several operators would eventually become involved). Precedents will be established, with the initial agreements for the proposed 3 x 20 MW low-speed diesels, that should form the basis for future contracts.

2.23 A recent World Bank study concluded that ownership is not critical to good performance; rather, performance depends on management capacity and degree of autonomy.¹¹ General conclusions drawn by the study are that effective regulation is most likely to be achieved where

- a. Legislation has been put in place to establish the relationship between government and industry
- b. Regulations are clearly spelled out concerning the procedures for setting prices, limits on borrowings, and investment program
- c. An independent regulatory body with clear rules and authority to function according to the legislation and regulations
- d. Government focuses on strategy and policy through a corporate plan or performance contract to be administered by the regulatory body
- e. Financial incentives are used within the power sector to reward good performance and impose penalties, including loss of job status where targets are not being met.

10. The next additions in capacity will be 20 MW units; 60 MW coal-fired units have been found to be part of the LCEP in later years.

11. *A Review of Regulation of the Power Sectors in the Developing Countries, Industry and Energy Department Energy Series Working Paper No. 22, February 1990. Autonomy would be expected to be increased with greater degrees of private participation and ownership.*

These aspects will be examined in the context of Jamaica under Phase I of the Power Sector Regulatory Framework and Privatization of JPS studies.

2.24 *Power Sector Restructuring.* The establishment of private power generation companies would involve a minor restructuring of the power sector. Further restructuring could be considered to separate the existing JPS generation from the transmission and distribution functions. Although it is conceivable that regional distribution companies could be established to buy in bulk from the transmission system, there do not appear a priori to be any cost advantages, given the small size of the JPS system. On the contrary, there would likely be increased administrative costs and regulatory problems in maintaining uniform island-wide tariffs. As pointed out above, ownership is not the key to achieving improved performance, and the introduction of BOO operators as power suppliers to JPS involves only the purchase of power rather than direct competition. For this reason, the option that JPS should remain in its present structure—as the core utility buying power from independent BOO and cogeneration suppliers and as responsible for island-wide transmission and distribution—and other fundamental questions are being examined as part of the Regulatory Framework/Privatization studies (para. 2.23).

2.25 *System Planning.* As the core utility, JPS should continue to be responsible for all aspects of system planning. Least-cost generation expansion plans should be revised annually, with major reassessments every two years. BOO bids for new generation additions should be requested as required on the basis of the duty cycle that the plant type should perform (base/peak load, etc.). The LCEP (chap. 4) indicated that several plant sequences were close in economic merit; hence, it is important to reevaluate the expansion program regularly to take into account changed conditions of load growth, fuel, and capacity costs. In the broadest circumstances, the fuel and plant type need not necessarily be specified (only the duty cycle, i.e., whether base or peak load) if it can be reasonably expected that serious offers will be obtained by leaving these specifications open. The bids should then be evaluated using the LCEP planning models to take into account the impact the proposed plant would have on the future expansion plan.

2.26 The avoided costs of generation should also be determined as part of the system planning exercise. These costs for marginal capacity and energy should then be used to establish a standard buyback tariff for small independent producers or cogenerators up to, say, 20 MW. Larger cogeneration cases based on bagasse or other energy sources should be treated as fully independent power projects subject to the same evaluation as BOO projects.

2.27 *Preparation for Increased Private Participation and Divestiture.* Although the government's goal is for complete divestiture of JPS, the process must begin with performance improvements through increased private participation. *As a general guideline, consideration should be given to putting out to contract any component of JPS's administration or operation that could conceivably be supplied more cost-effectively than by JPS itself.* Use of contractors is the norm in large construction projects; however, routine operations for which performance standards and incentives can be defined should be considered for contracting out. Billing and collection in particular could be contracted out and would have clearly measurable results in terms of reduced administrative losses. In order to assess the performance in individual areas, bulk meters should be installed on feeders to cross-

check total billings with supply and to aid in tracking losses. The contractor should receive incentives for reducing losses or suffer penalties for not meeting agreed targets. The standard commercial practice of using agencies for collecting past-due bills should also be followed by JPS.

2.28 Greater competition could help reduce costs of fuel supply. Liberalized petroleum imports would allow JPS to arrange its own fuel contracts from the cheapest source. Consideration should be given, however, to letting contracts on the basis of a total service package to help reduce the cost of energy used rather than the cost of fuel supplied. By using this approach, JPS could obtain technical assistance and investment in facilities by a fuel supplier to permit JPS to use cheaper, lower-quality fuel oil. The purchase of fuel oil futures contracts should also be explored as a hedging technique.

2.29 The capital market in Jamaica probably would be able to absorb a limited share offering over a given period. Phase III of the Regulatory Framework/Privatization studies will consider the capital markets from institutions and individual investors. The cost of capital and creditworthiness of JPS for bond offerings should also be investigated, along with the possibility that a large share offering could crowd out other capital requirements. The sale of existing assets now held by the public sector to the private sector would help retire the public debt but would not result in new productive investments. The sale of shares and debt instruments could be tied to incremental capital requirements.

2.30 Until JPS as a public sector or mixed private/public company becomes creditworthy in its own right for nonrecourse foreign exchange financing, JPS will have to continue to finance its own transmission and distribution program (as distinct from private power generation projects) through traditional public sector sources. In the long term, however, JPS is expected to finance investments (other than for generation) entirely through internal cash generation.

2.31 *Corporate Planning for Divestiture.* JPS has established its corporate planning department under the Director of Planning and is presently responsible for investment planning under the framework of a public sector corporation. Setting out the scenarios for increased private sector participation and divestiture is a major task. Substantial specialist input is being provided through the consultancy services for the Regulatory Framework/Privatization Studies concerning (a) capital markets, (b) macroeconomics, (c) financial modeling, (d) regulatory/legal issues, and (e) power utility operations.

2.32 A number of key questions are being addressed, including the following:

- a. What forms of sector organization are relevant to Jamaica—ranging from separate generating, transmission, and distribution companies to various combinations thereof?
- b. How should divestiture proceed?
- c. What performance standards can be established?
- d. What rate of performance improvement can be expected, and with what costs and benefits?
- e. What will be the impact on tariffs, taking into account expected performance increases?
- f. What degree of foreign participation should be sought?
- g. What are the balance of payment implications of debt servicing and dividend repatriation?
- h. What are the personnel and labor relations implications of each option for divestiture?

2.33 *Rate Setting.* Rate-setting principles should be established early in the planning process and should be coordinated closely with the regulatory studies (para. 2.17). The basic principles now in place should remain unchanged but will need modification to reflect power purchases from private suppliers. These principles are as follows:

- a. Rates should reflect full costs, including duties and taxes that are applied to all other industries.
- b. Overall revenue requirements should be established on the basis of existing loan agreements with international agencies and the government to meet rate-of-return and self-financing tests with adjustments for inflation based on a retail price index minus an incentive factor for productivity improvement (generally known as the RPI minus X formula, as used in the UK).
- c. Indexing of foreign exchange and fuel-cost fluctuations.
- d. Tariffs should be structured according to marginal cost principles according to peak and off-peak cost, voltage level, capacity, and energy costs, and so on.
- e. Pass-through of purchased power charges and adjustments with initial contracts subject to regulatory board approval.

Energy Conservation and Efficiency

2.34 On a macro level, Jamaica is subject to external factors—such as movements in bauxite, alumina, and oil prices—that have an immediate impact on the balance of payments. Because of the relatively high energy intensity of the economy, the oil price shocks experienced during the 1990 Gulf Crisis were particularly acute. Fuel diversification, energy conservation, and efficiency improvements are thus essential in an overall energy strategy to reduce costs of energy and risks of shocks. Such a strategy, however, should not lead to the selection of energy alternatives that would still be uneconomic with due allowance for risk-reduction benefits. A reduction in energy intensity will be achieved in the long run through consistent macro policies and the reduction in price distortions. Details of the energy conservation and efficiency strategy are given in chapter V and in vol. III-B.

2.35 Efficiency improvements on the supply side are already programmed in the power sector (para. 4.3). A review of the performance of the petroleum refinery has revealed opportunities for process and operational improvements (para. 3.47), and liberalization of imports would help to ensure petroleum supplies at lowest cost.

2.36 *Power Sector Demand Side Management.* Demand Side Management (DSM) in the power sector has become a generic program for many power utilities, particularly in North America, to induce consumers to use electricity more efficiently. It is apparent in many jurisdictions that the cost of a kilowatt hour saved is less than the cost of an additional kilowatt hour supplied. On this basis, it appears economic to invest in DSM programs as a supply alternative. Often, however, consumers

themselves do not invest in conservation because the price of electricity does not reflect the full cost of supply; hence, the savings to the consumer do not provide enough incentive. The case is then made by DSM advocates that the power company should invest on behalf of consumers and put the costs in the rate base or that the government should reduce taxes or provide other incentives. Although these measures would overcome the intrasectoral problem of price distortions, they would constitute a second-best solution by introducing further distortions in the broader macroeconomic context. *The recommended first-best strategy to be applied in Jamaica, as elsewhere, is to level the entire playing field by reducing all taxes to a uniform level or by increasing the price of electricity to include the same taxes as levied on other goods and services, including the GCT when it is introduced.*¹²

2.37 JPS is currently carrying out pilot and demonstration projects with assistance from several international agencies and is preparing a project for financing by the Global Environment Facility (GEF).¹³ These projects will provide the necessary experience to establish a DSM program in the industrial, commercial, and residential sectors. The ESSIP study has analyzed the proposed programs and found the economic rates of return to vary in the 10 to 30 percent range. Several programs would be unattractive to consumers unless savings were increased by higher electricity prices or tax reduction. *Until price distortions can be overcome, it is recommended that DSM efforts should focus on programs that provide sufficient user savings to be of interest to consumers under prevailing market prices.*

2.38 Even with evident consumer benefits, barriers and constraints to implementing energy conservation programs (para. 5.3) remain, deriving mainly from a lack of information both to consumers and potential suppliers of conservation equipment. At present, the energy conservation industry in Jamaica is limited, although one is emerging through activities now under way.

2.39 *Building Codes.* An Energy Efficiency Building Code (EEBC) is currently being implemented by Jamaican engineers and architects with assistance from international consultants. After three workshops, designers already report changes to their normal specifications and designs. The code is mandatory for public buildings and voluntary for private investors. Application of the code and guidelines to the standards set through cost-benefit analysis has shown that in some designs an energy-efficient building can require lower investment as well as lower operating cost.

2.40 Jamaican engineers and architects, through the professional associations and with the assistance of the Jamaican Bureau of Standards, have demonstrated a strong commitment to the implementation of the EEBC and have requested continued support in the process of technology transfer. *It is recommended that technical assistance for implementation of the Energy Efficiency Building Code be continued with financing through MPUTE and other agencies as required.*

12. A recent World Bank report discussed by the Board of Directors, "Lessons of Tax Reform," March 1991, countered the argument for low fuel prices (based in part on low tax rates) by pointing out that "there is no known negative relationship between domestic petroleum prices and growth, whereas there is documented evidence of a strong positive relationship between energy prices and energy efficiency." The same study recommended reducing the use of tax preferences and exemptions to promote specific economic and social objectives.

13. Sources of assistance include CIDA, through ESMAP; GTZ; IDB; and the Rockefeller Fund.

2.41 Industrial Energy Conservation. In addition to electrical DSM opportunities, there is a potential for low-cost/no-cost savings of about 20 percent in fuel use in industries through improvements in fuel-fired hot-water and steam systems. Boiler tuneups are among the lowest-cost measures and should be combined with the annual boiler inspection required by law. Other energy conservation opportunities can be identified during walk-through audits to be carried out in conjunction with the boiler inspection (para. 5.45).

2.42 Transportation. Improvements in fuel efficiency in vehicles can be achieved through tuneups and through replacements of the existing fleet, 50 percent of which is more than ten years old. The average age of vehicles will be reduced and fuel efficiency increased by the increased importation of new and second-hand vehicles. Government strategy in this area should be confined to maintaining relatively high levels of taxes and road user charges on automotive diesel fuel and gasoline to encourage attention to fuel consumption. Government support should also be given to the dissemination of information concerning possible fuel economy measures.

2.43 Improvements in traffic management and in roadways will lead to reduced engine idling and lower fuel use. These measures are justified even more when benefits in reduced congestion and time savings are considered. Responsibility for improvements in this area lies primarily with the Ministry of Transport and with the Parish Councils.

2.44 Regulations and Standards. The imposition of standards for vehicle fuel performance, appliances, and so on, is not recommended. A consistent macroeconomic policy—with the reduction in price distortions coupled with consumer information—is more likely to lead to optimal choices than regulations that are costly and extremely difficult to administer. Appliance and equipment testing relevant to Jamaica is warranted, however, as an input to providing consumer information. *It is recommended that the appliance testing and labeling program now under way at JBS be broadened to include other appliances such as stoves, water heaters, and lighting fixtures, in addition to refrigerators and freezers.*

Financing Energy Sector Development

2.45 The need for Jamaica to increase access to external financing that does not require a sovereign guarantee increases the incentive to involve private foreign partners in energy-sector development. With the planned divestiture of Petrojam and Petcom, future financing requirements for the petroleum supply sector would then be met entirely by the private sector. In the power sector, future generation is expected to be provided through private BOO projects, and by 1996-97 JPS should be able to finance 100 percent of its own capital investment program through internally generated funds, increasing from 48 percent in 1992-93. The self-financing capability, of course, will depend on the timely approval of adequate tariff increases and efficient operation of JPS.¹⁴

14. *Jamaica: Energy Sector Deregulation and Privatization Project, Appraisal Mission estimates, June 1992.*

Household, Biomass, and Renewable Energies

2.46 About 12 percent of the population use charcoal as their main cooking fuel, and 25 percent use kerosene; however, charcoal accounts for about 20 percent of end-use energy, indicating that many consumers use charcoal in addition to kerosene and LPG (para. 6.1). Because of its controlled and subsidized price, kerosene is cheaper in end-use cost than charcoal and is regarded as the "poor man's fuel" (Table 6.2). Charcoal use accounts for over half of total primary energy consumption because of the conversion losses in the charcoaling process. It is estimated that in an extreme case, total wood requirements would double if all users were to switch to charcoal if the kerosene subsidy were eliminated.

2.47 The subsidy of kerosene is justified on environmental as well as social grounds; however, the present form of market segregation between industrial sales (taxed) and domestic (untaxed/subsidized) is inefficient because of the higher costs of distributing kerosene in small drums to avoid the adulteration of more expensive transportation fuels with domestic kerosene. The current strengthening and broadening of the food stamp program under the Ministry of Labor, Welfare, and Sports could provide the means of providing a targeted subsidy to the approximately 20 percent of low-income consumers who now qualify for food stamps. *Consideration of the use of kerosene stamps (or the equivalent broadening of the food stamp program to include kerosene) is recommended in place of the general subsidy on domestic kerosene stamps domestic kerosene. The tax increase for domestic kerosene and revenues collected for the volume equivalent of current consumption should then be transferred to the food stamp program.* Before such a program could be implemented, a study would be needed to review the operation of the existing kerosene program and the feasibility of targeting and administering a kerosene stamp program through the existing administrative structure.

2.48 The rapid growth in the use of charcoal (by about 2.6 times in the last decade), the increased commercialization of charcoaling on public lands in addition to woodcutting for other uses, and evidence of related environmental degradation heighten the urgency of improving forest management. Knowledge concerning biomass resources and their use is inadequate at present (para. 6.7). Although the National Forestry Action Plan has been drawn up, institutional weaknesses are hampering the implementation of the program.

2.49 Improved forest management could be achieved by auctioning timber rights on public lands with an obligation for replanting. The concessionaire would be required to collect a stumpage fee to be set by the government of Jamaica that would reflect the resource value of the wood, cover the cost of the replanting, and return a royalty to the government of Jamaica. The charcoal price would be expected to increase with the incorporation of a stumpage fee, thereby promoting the use of more efficient stoves and substitute fuels such as kerosene.

2.50 To address the issues relating to biomass fuels and household energy use, further studies are recommended (para. 6.22), including the following:

- a. A forest resource inventory
- b. Forest management systems including auctioning of concessions for timber rights, the introduction of stumpage fees, and the obligation for replanting
- c. Periodic household energy surveys
- d. An analysis of possible means of reducing the cost of LPG supply and distribution
- e. Testing and safety certification of kerosene stoves as part of the Bureau of Standards Appliance Testing and Labelling Program
- f. Review of the kerosene subsidy program to improve targeting and permit the sale of all kerosene at a single price based on actual cost.

Environment

2.51 The environment is an essential part of the national patrimony and, hence, is the principal national economic resource. Jamaicans are increasingly concerned about the impact of energy supply and use on the environment and are pressing for government action. The government of Jamaica's strategy to consolidate environmental responsibilities under the National Resources Conservation Authority is sound, but considerable institution building is required to make it effective. In the meantime, specific environmental action programs are recommended in connection with existing and proposed energy projects. The cost of environmental protection measures to meet international standards should be internalized as project costs and thus reflected in the price of petroleum products and electricity.

2.52 Chapter 7 (paras. 7.21-7.31) sets out an energy and environmental strategy and action plan to focus on the following activities:

- a. Carrying out Environmental Impact Assessments on new power plants beginning with the 3 x 20 MW low-speed diesels funded under the Energy Sector Deregulation and Privatization Project while starting the baseline environmental studies for the coal-fired power station (to be funded by CIDA)
- b. Cleaning up existing sources of pollution, notably JPS power stations (para. 4.49 n-s) and the Petrojam refinery (para. 3.59);
- c. Reducing pollution through conservation and energy efficiency improvements (chapter 5)

- d. **Strengthening NRCA to fulfill its mandate under the Act (para. 7.28)**
- e. **Establishing baseline data for air quality and forest resources (para. 7.29)**
- f. **Identifying standards required for particular environmental zones such as the Kingston metropolitan area, tourist areas, and so on. (paras. 7.30-7.31).**

2.53 Implementation of many of these recommendations is now under way or is planned. Consultants to the government of Jamaica prepared Environmental Assessment Reports on the low-speed diesels and the gas turbines to be financed under the ESDP project. Consulting services and equipment to assist in implementing mitigation and monitoring measures at the Rockfort and Hunt's Bay sites will also be financed under the project. CIDA is prepared to finance the baseline environmental studies for the coal-fired plant prior to the Environmental Impact Assessment, which is to be conducted by the private sector. Moreover, an environmental screening of the facilities in the power and petroleum subsectors would be undertaken, and provisions are included in the privatization studies under the ESPD project. These studies will analyze and recommend mechanisms to be included in the regulatory framework for the energy sector to ensure compliance with environmental regulations.

Institutional

2.54 Institutional problems within government have been recognized for many years but have proven difficult to resolve. The practice of creating public corporations and parastatal entities to take on many of the traditional responsibilities of ministries has led to a weakening of the public service and a demoralization of those who remain. Increased reliance on the private sector for the functional delivery of products and services is well established as a strategy. The principal requirement that remains, however, is to refocus and consolidate the responsibilities for energy sector policy analysis within MPUTE. This objective, however, can only be accomplished through the recruitment of a sufficient number of highly motivated and experienced professionals, complemented by consulting and technical assistance services as necessary.

III. LIQUID FUELS

A. PETROLEUM

Introduction and Conclusions

3.1 On the basis of demand and price projections made in late 1990 and early 1991 (with the expectation of sustained high refining margins caused by high levels of refinery utilization in the U.S. Gulf Coast region), this study indicates that petroleum products could be supplied in Jamaica at the least-cost to the economy through an optimal combination of imports and local refining. A liberalized market based on private sector ownership and operation would encourage efficient operations within the sector. The options for least-cost supply have been analyzed by comparing three petroleum supply scenarios. These scenarios were examined on the basis of projected international market prices for crude and products and Jamaican demand to determine whether the refinery, in its present configuration or a modified one, could be part of the least-cost supply strategy. The scenarios range from (a) importing all products to (b) continuing to operate the existing refinery with minor modifications to (c) modifying and expanding refinery capacity to meet domestic requirements and provide products for export.

3.2 A detailed economic and financial analysis of the options for least-cost petroleum supply has been carried out (Vol. II Liquid Fuels, Consultant's Report) to (a) provide government of Jamaica with insights concerning the expected least-cost option and (b) establish a framework for reviewing proposals that will be requested from potential investors. *The conclusions of this study do not constitute specific recommendations, however, and should not be used to direct private sector investors in refining.* Rather, private sector investors themselves should decide on the ultimate viability of the refinery and its optimum configuration, on the basis of their own assessment of market conditions, risks, and expected profitability. The willingness of the private sector to invest in the refinery on terms acceptable to government of Jamaica will be the ultimate market test of viability.

3.3 Petroleum supply options were compared over a 20-year study period by determining the yearly optimum refinery throughput and crude selection together with product imports to meet domestic demand and to sell into the export market on a competitive basis. A linear programming (LP) model was used to optimize refinery operations for each year. Annual cash flows were then discounted at a 15 percent rate to determine the present value of each option once optimized. This discount rate is appropriate for evaluation in the petroleum sector because of the inherent uncertainty in petroleum crude and product price forecasts.

3.4 Since about 1986, refinery gross margins have been adequate to attract new investment in upgrading existing refineries in the region, but these margins are not sufficient to trigger the construction of new grass roots refineries in the region (para. 3.92). Operators who own or control crude oil production and are also vertically integrated in product markets may find a logistical advantage in

expanding the existing refinery to gain a satisfactory netback to crude production. Any evaluation of this type of arrangement in this report would be speculative, as it would require full knowledge of the investor's particular circumstances.

3.5 The refinery's long-term ability to compete in local and export markets depends primarily on the gross refining margin (i.e., the difference between the prices of finished products, the yield and price of crudes, and the transport costs). Product prices in the regional spot market are determined on the basis of international competition using full conversion refineries. In contrast, the Petrojam refinery is a simple hydroskimming refinery, which cannot convert fuel oil to clean products (gasoline and automotive diesel) to compete in export markets. It does, however, enjoy a logistic advantage for crude importation from Venezuela and Mexico—apart from any San Jose Accord (SJA) benefits—as well as for product sales together with a relatively large local market for fuel oil, particularly for power generation.

3.6 Continued refining with the existing refinery was found viable under the projected demand and price conditions reflecting margins higher than in the 1980s but also dependent on access to the local market. An upgraded refinery would be less dependent on the local market and could be competitive in the export market.

3.7 Analysis of variations in throughput for the existing refinery showed, however, the sensitivity of its viability to refining margin and volume. A sustained reduction in either of these two parameters by 20 percent would eliminate any advantage the existing refinery would have over importing. With 20 percent reduced demand on the refinery for light products, the optimum throughput and hence refinery utilization would also decrease from about 80 to 85 percent to 55 to 60 percent in the near term. A reduction of margins and demand in the near term would have a stronger impact than it would in later years because of the 15 percent discount rate used in the economic evaluation.

3.8 A 20 percent reduction of refining margin on the upgraded refinery would result in a break-even situation compared with 100 percent importing of products, although the refinery, when upgraded, would be less sensitive to loss of local market. In view of this important sensitivity, the crude and product price forecast will be reviewed as part of the Deregulation and Privatization study and the valuation of the refinery through an evaluation of future income streams.¹

3.9 Low utilization of existing refining capacity in the past has been caused by a variety of factors, including process bottlenecks, forced outages, and crude shortages caused by shortages of foreign exchange. For whatever reasons, historical utilization had been about 40 percent in the late 1980s, rising to 68 percent by September 1991. Further sensitivity analysis reveals that at about 50 percent utilization, with 1991 prices and demand levels, the economic advantage of refining would be eliminated in comparison with importing all products.

1. Deregulation and Privatization Study, Privatization Strategy, Task (d).

3.10 Petrojam has carried out an upgrade of the powerformer, which has been a significant bottleneck to increasing refinery utilization.² Further improvements to mechanisms to ensure the availability of foreign exchange and the timely opening of letters of credit are also needed as part of the strategy to increase refinery utilization.

3.11 The benefits expected from liberalization of imports (i.e., greater efficiency and lower petroleum supply costs) can be realized only if genuine competition exists. The substitution of a private monopoly for a public monopoly in refining or product importing likewise would not lead to least-cost supply. Opportunities must be available for importers aside from the existing three international marketing companies to compete in the market. Access to storage capacity can be a barrier to entry for small operators or large consumers such as JPS. *Therefore, to ensure full competition in supply, it is recommended that a system of common carrier terminaling be established that would give access to the existing tankage in Kingston and Montego Bay to all importers, and to the refinery.* The refinery would then compete directly with importers, and the ex-refinery pricing formula would become redundant except as a means of price monitoring by the government of Jamaica.

Comments by Government of Jamaica on the Draft Report

3.12 In its comments on the draft report (Annex 2.1) through MPUTE, PCJ/Petrojam disagreed with a number of recommendations that are at the heart of the liberalization strategy. Although agreeing with the desirability of liberalizing the importation of petroleum products, the government also expressed its concern regarding the modalities for (a) establishing a truly competitive environment and (b) ensuring that government revenues in local currency and foreign exchange from the San Jose Accord could be maintained at least in a revenue-neutral manner. In particular, the need to reduce the allowed import parity price, as recommended in this report, would reduce the profitability of Petrojam and, hence, the government revenues obtained through consolidation of the financial results of public sector entities. Compensatory revisions in excise or other taxes would then be required to compensate for the lost revenue.

3.13 The need to define in detail a regulatory framework, interim adjustment of the pricing formula, and development of a prospectus to offer the refinery for sale was agreed during the preparation of the Energy Sector Deregulation and Privatization Project as a necessary part of the preparatory work for privatization of Petrojam. To this end, bilateral trust funds were obtained to finance a study to be undertaken under World Bank supervision by a major accounting and management consulting firm with extensive experience in the regulation of the petroleum subsector and the privatization of state-owned enterprises including oil refining companies.³ Terms of reference for the study are shown in Annex 2.2.

2. *The powerformer is the refining unit for producing gasoline.*

3. *The firm Arthur D. Little of Cambridge, Mass., was ultimately selected to carry out the study.*

Sector Organization and Institutions

Legislation

3.14 The present institutional structure was established through the Petroleum Act of 1979, whereby the Petroleum Corporation (PCJ) was created to manage the entire sector under the supervision of the Ministry of Mining and Energy (MME). PCJ was empowered to engage in petroleum exploration, refining, and importation of crude oil and petroleum products. It was also free, with the approval of the minister, to form subsidiaries to carry out any activities permitted under the Act and has done so, notably, in setting up Petrojam as the refining subsidiary in 1982. Petrojam itself owns subsidiaries engaged in petroleum product distribution and ethanol production in Jamaica and in Belize.

3.15 The Petroleum Act permits PCJ to engage in a wide range of activities including marketing and transportation. PCJ/Petrojam can import crude and products free of duties and taxes. Other importers are required under the Act to pay customs duties ranging from 10 to 30 percent, depending on the product, and an additional stamp duty of 40 percent plus consumption taxes also included in the ex-refinery billing price. As a result, Petrojam enjoys an effective monopoly on product imports. There is no justification for protection of the refinery in the current market situation given the present level of refining margins and the potential for increased operating efficiency. Increased competition would encourage efficiency improvements to maintain profitability.

Sector Organization

3.16 Major petroleum companies active in Jamaica as product marketers include ESSO, Shell, and Texaco. In addition, Petrojam operates a small subsidiary, Petcom, which operates three service stations and distributes LPG. Following deregulation of retail prices of most products in September 1990, increased competition has become evident through increased investment in that service station facilities of several Jamaican-owned distribution companies. A new distributing organization of independent service stations has recently been formed. Before September 1990, MME was responsible for reviewing and approving changes in controlled product prices; however, since the decontrol of all retail product prices except for domestic kerosene, MME (succeeded in January 1992 by MPUTE) has monitored only price changes.

Supply Infrastructure

Refining

3.17 Petrojam owns and operates a simple hydroskimming refinery in Kingston with a nominal crude capacity of 35,500 barrels per calendar day. Its port facilities are able to accommodate tankers of up to 50,000 deadweight tonnes (DWT). The refinery has total crude oil and product tankage of some

2.2 million barrels, including about 300,000 barrels of tankage used for marketing and loading rack sales. The refinery supplies product to the three marketers in Kingston through a refinery-owned loading rack.

Marketing and Distribution

3.18 ESSO, Shell, and Texaco each maintain product storage terminals in Kingston, through which, prior to the construction of the refinery, they imported finished products. These terminals still have an import capability, although they each have their particular limits as tanker size and draft, product capacities, and product segregations. The marketers share a joint aviation depot at Norman Manley airport, Kingston. In Montego Bay, Shell and ESSO own and operate separate terminals for independent product receiving, storage, and onward sales. Total marketing company storage capacity in both Kingston and Montego Bay is about 1 million barrels.

3.19 The two main transportation fuels, gasoline and diesel, are sold through a network of about 250 branded retail outlets, which are about equally divided among the three multinational marketers but now also include a growing number of independent dealers. The retail networks are supplied by road tankers from loading racks in Kingston and Montego Bay. The marketing company outlets are about 60 percent company-owned and leased to dealers; the remainder are owned and operated by dealers. Only two outlets in Jamaica are both owned and operated directly by salaried company staff. The road transportation between loading rack and the outlets is provided by a group of independent road haulage contractors.

3.20 The deregulation of the retail products market has spurred the opening of new service stations. Procedures for site acquisition do not appear restrictive, and environmental regulations are more likely than town planning issues to be a controlling factor. Because the profitability of service stations is highly dependent on volume sold, increased competition brought about by deregulation is likely to cause a shakeout in the retail supply network as retail margins are reduced after the initial increases. Eventually a reduction in the number of service stations could occur. The overcapacity in road haulage tankers also would likely be reduced through competition. There is no apparent reason or justification for government involvement in petroleum marketing other than to ensure the uniform application of the competition policy that is now in the final draft stages.

Supply Agreements

San Jose Accord

3.21 Jamaica is party to two supply agreements—the San Jose Accord (SJA) and a bilateral agreement with the government of Nigeria. The SJA was originally established in August 1980 by the supplying countries of Venezuela and Mexico and was renewed for the eleventh time in August 1990 on the following terms:

- a. The supplying countries would continue to provide each up to 13 KBPD of crude and products, depending on requirements of beneficiaries and availability of supplies.
- b. Supplies are controlled by the policies and commercial practices of the state oil companies of Mexico and Venezuela with regard to letter of credit requirements and pricing.
- c. Government-to-government credits will be granted through official financing entities for 20 percent of the invoiced value of a cargo; the general commercial exchange of goods and services will be financed under the short-term credit, and economic development projects will be financed under a second tranche, longer term, more concessionary arrangement.
- d. Short-term credits for general financing purposes are granted in U.S. dollars at 8 percent per annum interest for up to 5 years; long-term credits for development projects are granted for up to 12 years at 6 percent per annum interest.

3.22 Under an informal arrangement, Jamaica presently could lift up to 13 KBPD from Mexico and 11 KBPD from Venezuela. Volumes lifted in the fiscal year (1990-91) did not exceed about 10.2 KBPD from each of the two San Jose Accord sources, on a total crude run of 20.4 KBPD. During the previous four years, total crude runs were even lower, averaging some 15 KBPD over the period. The lifting rule on sourcing of crudes at the refinery has been to force in equal volumes of Venezuelan and Mexican up to the SJA limits. Beyond these limits, the most economic crude based on the available feedstock slate is to be selected on the basis of short-run optimization performed with the help of the refinery's linear programming models.

3.23 As of mid-1991, the gross value of the short-term financing under the SJA was about US\$0.30 per barrel at marginal government of Jamaica borrowing rates of 12 percent and an average crude cost of US\$16.00 per barrel.⁴ Because of complications in converting the short-term credit to the more concessionary long-term financing, there is no additional benefit from this aspect of the SJA. These complications relate to the difficult process of getting Venezuelan or Mexican approval for qualifying development projects under the second tranche of long term credits, and in restrictions placed by the Venezuelans and Mexicans on sourcing of project equipment and services. These latter restrictions diminish, if not render negative, the value of the long-term credit, even if a development project were approved. Even without consideration of the SJA benefits, however, the SJA crudes provide the least-cost crude source in most cases, as discussed below.

Crude Selection Under the San Jose Accord

3.24 The limits under the SJA have never been reached; therefore, lifting procedures have not been put to the test. The economics of running non-Accord crudes such as Oriente from Ecuador, as well as traditional SJA grades such as BCF 17 and BCF 24 from Venezuela (including spike components as

4. *Mission estimate.*

options) and the Isthmus/Maya mix from Mexico was analyzed extensively using the linear programming models of the refinery in its existing configuration as well as with modifications. The analysis revealed that the two Venezuelan grades, Mexican Isthmus and Oriente from Ecuador, are roughly equal in economic attractiveness based on projected spot market crude prices c.i.f. Kingston. One or another of these crudes has found to be optimal at various times for a given demand pattern and configuration. A drop in price of US\$0.10-0.20/bbl for the other crudes would make them equally attractive in the optimal solution.

3.25 Mayan crude from Mexico and Forcados from Nigeria were tested in the analysis of refinery operations in both the existing and modified configurations and were not found economic in any case. Their prices would have to drop by US\$0.70 to US\$1.00 per barrel in the case of Mayan and US\$3.00 to US\$4.00 per barrel for Forcados to be competitive with the optimal crudes.

3.26 The fact that the Mexico obliges its customers, including Petrojam, to take a minimum of 30 percent Maya along with the more attractive Isthmus grade makes the Isthmus/Maya mix about US\$0.20 to US\$0.30 per barrel less attractive than the Venezuelan and Oriente grades. The effect of the SJA credit, therefore, is to put the Venezuelan grade at an advantage over Mexican mix or Oriente, equivalent to the amount of this credit. *The government of Jamaica should press Mexico to relax the requirement for minimum liftings of the Maya grade, because its inclusion at 30 percent along with Isthmus nullifies any SJA benefits.*

3.27 *It is also recommended that government of Jamaica take account of crude sources and any potential loss in benefits under the San Jose Accord when reviewing proposals for private sector purchase of the refinery.*

Nigeria Supply Agreement

3.28 Under this government to government agreement, Jamaica, through PCJ, can lift up to 20 KBPD to provide the balance of its internal requirements not covered by the SJA. Jamaica is free to process the crude in its own or a third-party refinery or to swap the cargo through standard industry arrangements. The refinery operational analysis confirms that it is not economic to process Nigerian crude in Jamaica. PCJ therefore employs consultants and traders to assist in the commercial arrangements necessary to derive maximum benefit from this agreement.

Petroleum Exploration

3.29 Since 1955, eleven exploratory wells—all dry holes—have been drilled in Jamaica; in addition, about 7,000 lines-km of seismic have been shot on the offshore prospects (Pedro Bank) and about 400 lines-km onshore. There has been no exploration work since 1985 consequent to the recommendations of the Energy Assessment Report. This report endorses the 1985 recommendation. The last major seismic data acquisition was in 1984, to investigate areas other than Pedro Bank. Several

prospects between the shore and Pedro Bank were identified but not pursued because of lack of interest from the petroleum industry in view of falling oil prices. The task of reviewing and organizing all previously generated seismic acquisition and interpretation data is under way in PCJ and is expected to be completed in mid-1991.

3.30 Given the projected price levels for crude, however, *it is recommended that no major expenditures should be incurred for further promotional activity and that further exploration should be left to the private sector with the proviso that only a multi-well program should be permitted, as a single dry well could condemn the area entirely.*

Sector Issues and Strategies

Introduction

3.31 The essential issue in the petroleum subsector is the need to increase the efficiency of supply operations. Marketing companies and consumers are free to import products; however, the duties and taxes levied under the Petroleum Act effectively block any imports. Petrojam is exonerated from paying duty on crude or products.⁵ The virtual monopoly position and the margins built into the ex-refinery pricing formula provide little incentive to the refinery to improve its efficiency and discourages marketing companies and large consumers such as JPS from seeking to reduce their own costs through negotiation with alternative suppliers and importation on their own account.⁶

Ex-Refinery Pricing

3.32 The ex-refinery pricing formula was established in 1963 and last revised in 1988. The notional import parity pricing formula attempts to derive prices that would correspond to the least-cost alternative based on the importation of all products. Although it seeks to reflect the factors a private sector operator would consider in price setting, the pricing formula cannot capture the dynamics of the market and has been found to have inherent biases that raise the cost of products to consumers as well as to the country.

3.33 Ex-refinery prices regardless of product source are adjusted weekly on the basis of prices derived from U.S. Gulf Coast spot market prices for comparable products plus cost adjustments to yield ex-refinery prices as discussed below.⁷ The refinery billing price includes the duties and taxes, which

5. *In mid-1990, Shell imported a cargo of lead-free gasoline and was exempted from paying duties on the grounds that Petrojam was unable to manufacture the product and, hence, did not require protection.*

6. *Bauxite companies are allowed to import petroleum products free of tax under terms of their agreement.*

7. *Prices taken from Platt's Oilgram.*

are revised periodically and applied to the ex-refinery price to yield the price paid by marketing companies and other bulk purchasers. To retain the buoyancy in the tax system in the event of significant movements in international prices above a set level, an ad valorem consumption duty is levied in addition to the consumption tax. Taxes are adjusted as required to close the government of Jamaica's financing gap under agreement with the IMF. The expected yield for FY91/92 was J\$454 million.

3.34 Details of the ex-refinery pricing formula are discussed below:

- a. Reference Price defined as the mean of U.S. Gulf Coast water-borne spot prices with some adjustments related to specific products, such as leaded gasoline, for which a reference price is no longer available (para. 3.40).
- b. An Acquisition Differential specific to each product based on the differences between Jamaica's requirements or capabilities and U.S. Gulf Coast norms in the areas of cargo size, credit terms, and product quality (paras. 3.48-3.49).
- c. Cargo Insurance, 0.07 percent of C & F price (para. 3.43).
- d. Ocean Freight based on prevailing market rates from the U.S. Gulf Coast for appropriate vessel size and load port combinations applicable to the specific product (para. 3.51).
- e. Ocean Loss as percent of c.i.f. price; 0.5 percent for LPG, Gasoline, Kero/Turbo; 0.4 percent for ADO and MDO; 0.25 percent for HFO and asphalt (para. 3.52).
- f. Terminal Fee based on the actual operating costs and charges on depreciated replacement cost and inventory of operating a terminal at the refinery site (para. 3.53)
- g. Round Island Movement (RIM) fee representing the cost of shipping products by ocean tanker from Kingston around to Montego Bay (para. 3.54).
- h. Rack Fee representing recovery of costs of product truck loading operations (para. 3.53).
- i. The latest official exchange rate is applied to the sum of the above factors, all denominated in US\$, to arrive at a total ex-refinery price in J\$/IG.

3.35 Because international conditions are constantly changing, the pricing formula, even if reviewed periodically, cannot ensure least-cost supply to the nation and final consumers. Each component in the pricing formula was reviewed by the mission with respect to its rationale, impact on ex-refinery price, and cost to consumers. It was estimated that excess charges—a minimum of US\$9 million and possibly up to US\$15 million, depending on the assumptions—are attributable to the ex-refinery pricing formula. Some savings could be achieved by improving supply efficiency if the market were deregulated; other savings might be made by changing product specifications and reference price. About one-third of the total excess charges could be saved in direct foreign exchange to the country through changes in

product specifications, financing, insurance, and RIM costs. The remainder represents excess charges in local currency for costs; these are attributed to the supplier but could be expected to be absorbed by the supplier under deregulation. The excess charges accrue to Petrojam as profit and flow through to PCJ for consolidation in overall government of Jamaica surplus accounts. Under IMF agreements, it would be necessary to increase the level of tax on petroleum to compensate for the loss in public sector revenue. As a result, consumers would pay the same final price.

Product Specifications and Acquisition Differential

3.36 The acquisition differential depends primarily on the product specifications for the Jamaica market compared with the quoted products in the USGC. Product specifications are presently established by the refinery in consultation with the marketing companies and major consumers such as JPS. Only in the case of unleaded gasoline has the specification been established with the involvement of the Jamaica Bureau of Standards. Unnecessary or excessive costs of petroleum products arise from specifying a higher quality product than is required to meet end-use needs in the Jamaican market. The import parity cost of petroleum would be minimized by supplying fully fungible products as available in the U.S. Gulf Coast market.⁸

3.37 The mission found that present specifications result in increased supply costs of about US\$5 million a year based on current volumes as compared with the cost of supplying products better suited to overall market requirements in Jamaica. The motor gasoline specification in particular is excessive, and a review by Petrojam (para. 3.39) confirmed that it can be reduced. In the case of heavy fuel oil, the acquisition differential is based on the lower-viscosity fuel oil used primarily by JPS rather than on the basis of a lower quality (and lower price) heavy fuel oil, as used by the bauxite companies.

3.38 The contributions that each of the quality changes discussed below could make to the yearly supply cost to Jamaica are estimated as follows:⁹

<u>Product</u>	<u>US\$ million</u>
Motor gasoline	1.90
Jet fuel/kerosene	0.4
Automotive diesel oil (ADO)	0.4
Marine diesel oil (MDO)	0 to 0.3
Heavy fuel oil (HFO)	<u>2.7</u>
Total	5.4 to 5.7

8. Fully fungible and therefore widely traded products are supplied according to Colonial Pipeline specifications. Because of a common specification, a product—say, gasoline—can be stored in common tankage regardless of source; hence, the product is fully fungible.

9. Petrojam is in basic agreement with the scope for savings based on the normalization of fuel specifications. Petrojam, however, estimates that HFO savings would be on the order of US\$1.4 million rather than US\$2.73 million and that no savings are possible for MDO, as the requirements for the Jamaican market do not permit a reduced specification. Overall savings related to product specifications would then be US\$4.1 million per annum based on 1990 volumes.

3.39 **Gasoline.** Consultants to Petrojam have analyzed the octane requirements of the vehicle fleet based on a data obtained from vehicle registrations, and, by all evidence, the octane rating and cost could be lowered. Petrojam blends 95 Research Octane Number (RON) gasoline is required by only a small percentage of cars, rather than a more suitable level of 92 or 93 RON octane.¹⁰

3.40 Midgrade unleaded gasoline is now being used as the basis for ex-refinery billing, since leaded gasoline prices are no longer quoted by *Platt's*. This is appropriate, as TEL additive can be blended to increase the octane to the required level for leaded gasoline; in practice, however, a cheaper low-octane gasoline would be used as the base fuel to which TEL would be added. With the lowering of the octane requirement to 92 RON about US\$1.9 million could be saved by Jamaican consumers. Surveys in the United States have found that the high-octane fuels promoted by marketing companies do not provide significant additional benefits to a large percentage of motorists because the higher octane is in fact not required.¹¹

3.41 **Fuel Quality Control.** As further protection against fuel adulteration, *it is recommended that JBS be given the responsibility for quality assurance for fuels* supplied in bulk whether locally refined or imported. Periodic testing of fuel from service stations should also be carried out to further protect consumers.¹² Stiff penalties under the Fuel Products Quality Act should be applied for infractions. A fuel testing laboratory, including an octane testing engine, is available at the refinery for operational quality control. This laboratory could be used to carry out all quality control testing, provided that satisfactory procedures could be established with JBS to ensure its independence and the integrity of its work.

3.42 **Automotive Diesel Oil.** With regard to the cetane specification for automotive diesel oil (ADO), the present specification is a 45 cetane index rather than 40 cetane index, which is the Colonial Pipeline specification for fully fungible fuel as supplied in the USGC region. Petrojam is concerned that the 45 cetane index fuel is needed to satisfy Jamaican fleet requirements with a high proportion of Japanese and European trucks. *Given the potential cost savings and the possibility of using fully fungible fuel, every effort should be made to lower the specification.*

3.43 The cetane index is of no consequence to JPS, which uses 20 to 40 percent of total Jamaican consumption of ADO in gas turbine power plants. An annual saving to consumers of about US\$0.4 million could be realized by reducing the cetane index to 40 from 45, thereby reducing the acquisition differential. No significant reduction in Petrojam's current cost would result, however, since the cetane index fuel cannot be adjusted effectively without modifying configuration of the refinery.

10. Gasoline is blended from Petrojam's own gasoline production and blending agents including tetraethyl lead as an octane booster. A rating of 92 RON corresponds to regular gasoline with 87 octane, as computed by the widely used (RON + Motor Octane Number)/2 method.

11. Consumer Research Reports, "Do You Need High Octane?" March 1991. Also, American Automobile Association Magazine, January/February 1991. These reports revealed that only about 10 percent of vehicles needed higher than regular grade gasoline.

12. By mid-1992, JBS was checking fuel quality at service stations every four months.

3.44 ***Jet fuel/kerosene.*** The present Jamaican specification for jet fuel/kerosene is based on the more stringent DERD specification required by only one international airline.¹³ It is recommended that the standard ASTM USA grade commercial jet fuel be adopted to avoid paying a premium of about US\$0.30/bbl. Under deregulation, any international carrier should be free to import fuel in bond for bunkering to meet whichever specification it requires.

3.45 ***Marine Diesel.*** The present price structure is based on reference USGC prices for a blend of 85 percent ADO and 15 percent HFO. A quality premium of US\$0.75/bbl is added to reflect the higher-quality atmospheric gasoil, which is supplied by Petrojam from the crude unit. Given a choice, and supported by technical advice, consumers might choose the lower-quality product, which would yield an annual saving (based on current volume) of up to US\$0.34 million.

3.46 ***Heavy fuel oil.*** The major users of Number 6 or heavy fuel oil (HFO) are the bauxite companies and JPS. The bauxite companies, however, do not buy higher-value straight-run HFO from Petrojam but rather low-quality cracked HFO. JPS, on the other hand, has not been consistently successful in the past in using the lower-quality, less-expensive cracked HFO because of boiler tube slugging and fuel-feed problems. The product specification should be changed to standard Bunker C with 3 percent sulfur and 250 viscosity without a quality premium in the acquisition price.

3.47 JPS will likely require consultant assistance and fuel supply modifications to adjust to a lower-quality fuel. The bauxite companies have been successful using such fuel, so there appears to be no insurmountable obstacle for JPS to do likewise. Under a deregulated market, JPS could also call for bids from fuel oil suppliers to provide the tankage, oil-handling equipment, and technical assistance necessary to burn cheaper fuel. A brief study carried out in early 1992 as an extension to ESSIPS concluded that there is potential for saving in Jamaican currency equivalent to about US\$3.5 million per year. Furthermore, a fuel-swap arrangement could have been made between Petrojam and the supplier of cracked fuel oil to backhaul straight-run fuel oil from the refinery to realize a net foreign exchange gain. A net gain of US\$4.00/bbl could have been realized in late 1991/early 1992 under such an arrangement (see Vol. III-A, Annex G, for Terms of Reference).

Other Ex-refinery Pricing Components

3.48 ***Other Acquisition Differentials.*** For all products, Petrojam receives a *credit adjustment* to allow for 30 days carrying cost instead of the normal 15 days, with a current interest rate of about 8 percent. The base case of 15 days built into the acquisition price is more than adequate to load and deliver products in a terminaling case. If an additional settlement period is required, the local currency funds should be held in Petrojam's account to earn an offsetting interest. No further credit allowance, therefore, is required, and a reduction of US\$0.06 to 0.11 per barrel is warranted.

13. This airline, however, uses ASTM specification fuel as supplied to all airlines at Miami International Airport.

3.49 The acquisition formula includes a small parcel size adjustment for HFO and LPG in the acquisition cost. Liberalization of imports and use of lower-quality fuel by JBS would encourage the joint importation with the bauxite companies in larger vessels, avoiding a small-ship premium.

3.50 For marine insurance, a base rate in excess of US\$0.07 per US\$100 valuation appears in the pricing formula, whereas a current rate of US\$0.03 to 0.04 per US\$100 valuation is more typical, and a reduction of 50 percent of the marine insurance allowance is proposed.

3.51 *Ocean Freight.* The ocean freight adjustment assumes two port loading points and certain ship sizes; however, in a deregulated market, actual shipping would not necessarily conform to the assumptions, and, combined with the product cost, this could result in lower total costs. In any event, a comparison of the World Scale Freight Points for one-port loading used in the present formula with rates currently applicable in the region suggest a reduction of about US\$0.50 to 0.60 on clean products and US\$0.14 on HFO. Because of continual price changes in the shipping market, a provision should be made for monthly adjustment under the price formula.

3.52 *Ocean Losses.* Well-run base loaded fleets are capable of achieving lower loss rates than used in the formula.¹⁴ Consequently, a reduction of US\$0.04/bbl is warranted for all products except LPG, for which 0.1 percent was allowed, since shipment is in a pressurized vessel. In this case, a saving of US\$0.13/bbl could be achieved.

3.53 *Terminal and Rack Fee.* The present formula for terminal fees overstates the cost of providing the service, and assigns an arbitrary 100 percent margin to total costs, which is intended to cover loss, insurance, and inventory carrying costs of product in the terminal. The smaller ESSO and Shell terminals in Montego Bay charge a total terminal and rack fee of US\$1.00 to 1.05 per bbl (excluding inventory carrying costs) for a volume roughly one-sixth of Petrojam's. Allowing for inventory carrying costs of about US\$0.35/bbl and based on an analysis of costs, a maximum terminal and rack fee of \$1.06 would be warranted, but it could be lower in a competitive situation, given experience elsewhere.

3.54 *Round Island Movement.* The Round Island Movement (RIM) charge should be removed entirely from all products in a fully deregulated market, as the intent of the pricing formula is to establish an ex-refinery price rather than provide a cross-subsidization mechanism for transportation to Montego Bay. Direct imports into Montego Bay may be the lowest-cost supply option; however, the present pricing formula assumes that all products locally refined or imported are supplied from Kingston. The matter is more fully discussed in connection with the common carrier terminal operation (para. 3.86).

14. This is confirmed by analyses of operations by multinationals.

Performance of Refinery

3.55 In recent years, the refinery has run (see Vol. II-A, Annex 6.1) at about half the officially quoted capacity of 35,500 BPCD, importing as finished products the balance of Jamaica's product requirements. An analysis of the utilization record revealed that the low throughput was attributable to a mix of physical, economic, and financial constraints. These constraints arose in part because the age of the refinery caused higher-than-normal forced outage rates and because of the need for periodic capital repairs that increased the downtime. Foreign exchange shortages (para. 3.61) caused crude runouts and further reduced refinery utilization. Table 3.1 provides a summary of the product imports, crude runs, and attendant refinery capacity utilization over the past five years.¹⁵

TABLE 3.1. Petrojam Refinery Operating Performance

Performance measure	'86-87	'87-88	'88-89	'89-90	'90-91	AVERAGE 5 YEARS
CRUDE RUN BPD	15,642	13,454	14,668	17,502	20,415	16,336
REFINERY UTILIZATION AS % OF						
- NOMINAL CAPACITY (35,500 BPCD)	44%	38%	41%	49%	58%	46%
- EFFECTIVE CAPACITY (24,600 BPCD)	64%	55%	60%	71%	83%	66%
TOTAL PRODUCT SUPPLY	26,587	24,789	27,160	29,526	30,211	27,709
PRODUCT IMPORTS AS % SUPPLY	12,292 46%	12,077 49%	13,268 49%	12,879 44%	10,674 35%	12,238 44%
REFINERY PRODUCTION AS % SUPPLY	54%	51%	51%	56%	65%	56%

3.56 Low nominal utilization, however, does not in itself mean that the available capacity is not being optimally used. The effective capacity was constrained by about 30 percent because of a bottleneck in the powerformer (para. 3.59). Taking this into account, the average utilization of effective capacity has been 66 percent over the years 1987-91 compared with 46 percent of nominal capacity. With debottlenecking of the powerformer and growing demand, optimal refinery utilization would still only reach 87 to 90 percent of capacity. With the addition of a catalytic cracker, however, refinery utilization could approach 100 percent.

15. See Vol. II-A, Annex 4.2 for details by product.

3.57 Average fixed and variable operating costs per barrel are about US\$1.57 (based on volume refined rather than total product sold, 35 percent of which is imported). The costs are about equal to the industry average for hydroskimming refineries.

Refinery Capacity and Availability

3.58 ***Capacity.*** The Petrojam refinery has a rated design capacity of some 38,000 barrels per stream day (BPSD). This level has been verified by test runs and represents the maximum amount of design (medium gravity) feedstock that the refinery can process through the atmospheric pipestill on a short-term uninterrupted run without encountering constraints in any of the downstream processing equipment, with the exception of the powerformer. After allowing for total plant downtime per year of 24 days for planned maintenance and unforeseen outages, the refinery currently rates its longer-term average processing capacity at 35,500 barrels per calendar day (BPCD).

3.59 The actual stream day capacity of the powerformer is some 3,500 barrels per day. Based on analysis of overall refinery performance, it is estimated that the powerformer capacity has constrained the refinery throughput capacity to some 29,000 barrels per stream day, which, with additional downtime requirements, resulted in an effective refinery capacity of 24,600 BPCD. This constraint has been known for several years, and Petrojam staff have made capital budget proposals to clear bottleneck. With the catalyst replacement and major maintenance repairs to the unit scheduled for late 1991, the overall throughput capacity for heavy crudes would reach 35,500 BPCD. Further debottlenecking of the powerformer, as assumed in the minimum refinery investment case, would allow the running of lighter crudes and would yield a higher percentage of gasoline.

3.60 ***Service Availability.*** Over the past five years, the Petrojam refinery experienced a total of 409 days of downtime in 37 separate shutdowns. This represents an average downtime of 82 days per year, or an overall service availability factor of some 78 percent. Assuming debottlenecking of the powerformer for FY 92/93 operations and efficient operation of the existing refinery, the full nominal capacity of 35,500 BPCD could be achieved with downtime limited to 24 days per year, to yield a service availability factor of 93 percent. This serviceability is achievable providing there are no external events beyond Petrojam's control, such as problems with letters of credit.

3.61 ***Foreign Exchange Constraints.*** As a result of chronic foreign exchange shortages, the Bank of Jamaica (BOJ) took over the responsibility for providing foreign exchange required for Petrojam's imports. Although the situation has improved in recent years, the underlying foreign exchange shortage has persisted, particularly during the Persian Gulf crisis. Letters of credit (LCs) could not always be opened as required because of BOJ's inability to maintain adequate foreign exchange deposits with credit houses in order to keep within agreed exposure limits. As a result, delays in liftings, crude run-outs, and demurrage charges have occurred.

3.62 Delays in opening LCs as long as 20 days have been experienced, leading to cutbacks in crude runs by Petrojam, the need to import small cargo lots of finished product to cover inventory, and

payments of demurrage charges on crude vessels waiting in load port (demurrage charges increased from US\$149,000 in 1988 to US\$655,000 in 1990). In addition, six runouts were caused by LC delays over the past five years, for a total average downtime of 14 days per year. A further 7 days of lost capacity utilization can be attributed to reduced throughput while stretching out available crude supplies to avoid a complete shutdown.

3.63 It is expected that with the projected lower and more stable oil prices and improvements in Jamaica's foreign exchange position, the LC delays and related inefficiency costs would be reduced considerably. *Nonetheless, it is recommended that improved coordination of foreign exchange requirements be developed between BOJ and Petrojam, including the use of hedging techniques through NYMEX to avoid unexpected price movements.* Commercial financial institutions offer a variety of risk management tools and strategies that can be used by refiners, product marketers, and consumers.

Product Demand

3.64 A product demand forecast was prepared on the basis of an overall GDP growth rate of 3 percent a year consistent with World Bank projections available at the time the forecast was prepared. Forecasts were made by end-use in each product category and then aggregated to give an overall total demand. Table 3.2 provides a summary by product class and key forecast years (details and assumptions are given in Vol. II-A).

3.65 Actual consumption of some 15.5 million barrels in 1989 is projected to increase to 19.6 million by the year 2000 and 23.2 million by 2010.¹⁶ The corresponding figures in KBD are 42.5, 53.8, and 63.7, respectively. These figures include a significant demand—primarily for heavy fuel oil—by the bauxite/alumina industry. Under the bauxite agreements, firms are not required to purchase from the Petrojam refinery and may import directly. The bauxite companies generally put their fuel requirements up for competitive bidding on a yearly basis. Petrojam generally does not win the bid because the bauxite companies specify the lowest quality cracked fuel oil, which can be imported at a lower cost than the higher quality straight run (uncracked) fuel oil produced by Petrojam.

16. *Reliable year-end data for 1990 was not available at the time the forecast was prepared.*

TABLE 3.2 Jamaica Petroleum Product Demand Forecast

Product	ACTUALS 1989	Thousands of Barrels -----FORECAST----->				
		1991	1995	2000	2005	2010
LPG	473	521	634	809	1,084	1,317
AVGAS	14	15	17	19	23	26
MOTOR GASOLINE	1,949	2,068	2,328	2,698	3,222	3,626
KERO/TURBO	1,571	1,675	1,906	2,248	2,752	3,157
AUTO DIESEL	1,789	1,513	1,856	1,862	2,471	2,838
MARINE DIESEL	503	496	569	619	694	754
HFO LOCAL	3,782	4,554	5,098	3,996	3,273	3,910
HFO BAUXITE	5,242	7,143	7,057	7,057	7,057	7,057
TOTAL FUEL PRODUCTS	15,322	17,985	19,464	19,309	20,576	22,685
LUBES	83	92	112	143	191	233
ASPHALT	97	109	138	185	262	331
TOTAL ALL PRODUCTS	15,503	18,186	19,714	19,637	21,030	23,249
EQUIVALENT KBD						
TOTAL ALL PRODUCTS	42.5	49.8	54.0	53.8	57.6	63.7
EXCLUDING BAUXITE	28.1	30.3	34.7	34.5	38.3	44.4

3.66 Table 3.3 illustrates Jamaica's actual and forecast product mix, based on the two (bauxite HFO, nonbauxite HFO) cases. As illustrated, the Jamaican demand mix with bauxite included is a relatively heavy one, with HFO accounting for more than half the total requirements on a volumetric basis. This HFO proportion drops to the 35 to 40 percent range without bauxite considered in the total mix.

TABLE 3.3 Jamaica Product Demand Mix

(Volumetric basis, Fuel Products Only)

Product	WITH BAUXITE			W/O BAUXITE		
	1989	1995	2000	1989	1995	2000
LPG	3.1%	3.3%	4.2%	4.7%	5.1%	6.6%
AVGAS	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%
MOTOR GASOLINE	12.7%	12.0%	14.0%	19.3%	18.8%	22.0%
KERO/TURBO	10.3%	9.8%	11.6%	15.6%	15.4%	18.3%
AUTO DIESEL	11.7%	9.5%	9.6%	17.7%	15.0%	15.2%
MARINE DIESEL	3.3%	2.9%	3.2%	5.0%	4.6%	5.1%
HFO	58.9%	62.4%	57.2%	37.5%	41.1%	32.6%
TOTAL FUEL PRODUCTS	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Least-cost Supply Options

3.67 Although the government intends to liberalize the petroleum market and divest itself of the refinery, it also wishes to assess the merits of options that would range from closing the refinery to modifying and expanding the refinery to varying degrees. The following analyses are intended to provide a framework for evaluating proposals from private sector operators, several of whom have already expressed interest in participating in the refinery. Each investor will have unique set of assumptions

concerning future prices and markets, so the present results must be regarded as indicative and intended to direct investment toward any one option. The analytical models that have been developed have been made available to MPUTE to assist in evaluating the proposals.

Supply Alternatives

3.68 Alternative product supply cases were selected and defined by reviewing earlier studies on investment and expansion options and through extensive discussions with Petrojam refinery technical staff. Five petroleum product supply cases were defined as follows:

- a. ***Base (Terminaling).*** Shut down the refinery process units and *import all products* using the existing port facilities, transfer lines, tankage, and other refinery offsites as required for the terminaling operation. It was anticipated that some minor investments would be required in tankage modification or conversion, product line tie-ins and crossovers, and environmental cleanup of existing problems and additional control facilities.
- b. ***Alternate (Refining) I.*** "Business-as-usual," *minimum investment* in the existing refinery in order to carry on business, but with enhanced efficiency and capability of meeting all anticipated product specifications and environmental standards. This case was projected to involve a reformer upgrade, a light naphtha isomerizer for 100 percent unleaded gasoline production capability, some tankage, and immediate pollution abatement. The refinery would remain a hydroskimmer with the same rated pipestill capacity as at present, 35,500 BPCD. There would be no cracking/conversion or investment in atmospheric pipestill debottlenecking.
- c. ***Alternate (Refining) II.*** *Intermediate investment* in a catalytic cracker with capacity balanced to the existing pipestill capacity, primarily to reduce the cost of product spikes or lighter whole crude feedstock to meet the given domestic product demand. No investment would be made in atmospheric pipestill debottlenecking, and capacity would remain at 35,500 barrels/day, but all the necessary product quality and pollution abatement investments would be included, as in Refining Case I.
- d. ***Alternate (Refining) III.*** *Maximum investment at existing site* in a larger catalytic cracker plus a major debottlenecking/expansion of crude running to the highest practical level with the existing pipestill. The expanded crude capacity would be 50,000 bbl/day, and the cat cracker capacity would be increased to the balanced level. The incremental investment above Refining Case II is primarily devoted to developing an export refining capability.
- e. ***Alternate (Refining) IV.*** *Site and facilities expansion* would incorporate all investments as in Refining Case III plus a new pipestill and processing unit. Because of space limitations at the existing site (some existing tanks would have to be relocated, and additional storage tanks would be built on a separate site, identified as land to be reclaimed near Portmore Causeway). The total capacity of the expanded refinery is assumed to be 100,000 bbl/day. This would be a major export refining case.

Crude and Product Price Forecast

3.69 The product—crude relationship implicitly embodies a gross refinery margin assumption; thus, it is a key determinant of the economics of refining compared with direct product importation. This forecast is based on the late 1990 World Bank petroleum price forecast of OPEC average prices. From this base forecast, the prices of OPEC and non-OPEC crudes, including common reference grades, were derived using historical price differentials, as summarized in Table 3.4 and shown in detail in Volume II, Annex 6.2.

TABLE 3.4: Crude Price Forecast

Crude Grade	1991	1995	2000	2005	2010
OPEC AVERAGE	22.49	17.76	22.84	22.49	22.49
BCF 17	16.94	13.62	17.54	16.74	17.33
BCF 24	19.74	15.70	20.22	19.67	19.95
MAYA	18.94	15.11	19.45	18.83	19.20

3.70 The absolute level of crude prices is only relevant to a refining project analysis in that it sets a general price and supply/demand environment for products in relation to crude (Table 3.4). Average crude prices are forecast to remain depressed for the next few years, and on the basis of low real prices of petroleum compared with other cost factors, a stimulation of product demand is expected. The anticipated strong growth in product demand would fully utilize the present level of international/regional refining capacity. Extreme measures were taken in the early 1980s to rationalize refining as a reaction to the collapse in petroleum demand. This action resulted in refinery shutdowns, decommissioning, and outright scrapping of plant on a massive scale worldwide. Total world refining capacity declined by about 10 million barrels per day or 20 percent of prerationalization levels.

3.71 Consistent with the "stimulated demand" scenario, it is expected that refining margins will be healthier in the future and could support further capacity expansion and upgrading investments in the region. Margins can reasonably be expected, based on the projected world refining situation (Vol. II), to increase to levels beyond the \$4.58 per barrel (based on USCG cracking BCF 17 crude) assumed in this analysis as an average over the 20-year forecast period.

3.72 In contrast, it is estimated that a gross margin of roughly \$7.00/barrel would have to be earned to amortize the capital and pay operating costs on a new grass roots cracking refinery, assuming a USGC location and 1991 cost levels. With the projected continuous expansion and upgrading required, in addition to capital replacement, it is expected that gross USGC margins will reach this level in 1991 dollars by the year 2010 at the latest, the end of the forecast period/project-life of this study.

Import and Export Product Prices

3.73 A base USGC spot product price forecast was developed in relation to the crude forecast by using the gross cracking refinery margin of \$4.58 per barrel for BCF 17 crude combined with typical product yields and interproduct price relationships. The refining margin was not used directly to derive product prices, since they were determined in reality by a number of factors. Refinery margins also vary according to the crude and its yield; however, the long-term average projection of refinery margins has been summarized in terms of BCF 17 at US\$4.58/bbl. A summary of the projected prices for main products for key forecast years is provided in Table 3.5.

TABLE 3.5: Forecast of USGC Spot Product Prices
US\$/BARREL (1990 CONSTANT PRICES)

Product	1991	1995	2000	2005	2010
PROPANE	16.01	12.88	16.58	15.82	16.38
BUTANE	19.92	16.02	20.63	19.69	20.38
ULR MOGAS	31.43	25.28	32.56	31.07	32.17
JET/KERO	31.63	25.44	32.77	31.26	32.37
NO.2 GASOIL	30.00	24.13	31.07	29.65	30.70
MDO	29.00	23.33	30.04	28.67	29.68
HSFO	15.60	12.55	16.16	15.42	15.96

3.74 Venezuela has traditionally supplied product "spikes" in whole crude grades, primarily to small simple refineries in the Caribbean area that were designed by the multinationals as satellites to their large crude supply/refining complexes in Venezuela. These spikes are semifinished products added at the Venezuelan refinery to whole crude grades such as BCF 24. Venezuela prices these products based on their opportunity values in other markets.

Import and Export Parity Prices

3.75 The USGC spot product prices, combined with freight assumptions from the most likely source (not necessarily the USGC) and minor quality adjustments to the current Jamaican standards, were used to derive import parity prices for each Jamaican product. Similarly, export parity prices were derived using the same base USGC Spot and freight data. For most of the products, however, it was assumed that significant export markets would be found at locations outside the USGC, such as the southern U.S. east coast.

Process Engineering and Economic Analysis

Case Comparisons

3.76 The base terminaling case and the alternate refining cases defined above were analyzed at the prefeasibility level of definition to arrive at required process configurations, capacities, capital, and operating costs, as shown in Table 3.6.

TABLE 3.6: Summary of Process Engineering Analysis

Factor	BASE	REFINING ALTERNATES			
	TERMINAL	I	II	III	IV
PROCESS UNIT CAPACITIES, KBCD					
CRUDE PIPESTILL(S)	NA	35.5	35.5	50.0	100.0
POWERFORMER(S)	NA	5.0	5.0	5.0	12.0
CATALYTIC CRACKER	NA	NA	11.5	17.5	18.5
LVN ISOMERIZER ^{1/}	NA	2.0	2.0	2.0	6.0
HYDROCRACKER	NA	NA	NA	NA	15.0
VISBREAKER	NA	NA	NA	NA	18.5
ALKYLATION	NA	NA	NA	NA	2.3
CAPITAL US\$ MILLION 1991					
PROJECT	2.6	15.5	130.5	175.7	737.0
SUSTAINING, YEARLY	0.4	2.5	3.3	3.7	5.0
OPERATING COSTS					
FIXED US\$ MILLION/YR	5.7	11.0	15.2	17.9	31.1
VARIABLE US\$/Bbl	0.06	0.22	0.32	0.38	0.36

^{1/} Light Virgin Naphtha

Source: Mission Estimates (Consultants' Report Vol. II)

3.77 Disbursements of project capital investment, ranging from US\$15.5 million in refining Alternate Case I, to US\$737 million in Case IV, would occur over a three- to four-year period from inception. The sustaining capital investment is an estimate of the annual renewal and rehabilitation expenditure required to maintain the operating capability of the plant.

Environmental Measures

3.78 Capital cost estimates include pollution abatement facilities to conform to present average North American standards in all cases. These investments include a sour water stripper; impermeation of tankage diked areas; improved oily water collection; additional new oily water separators, combined with downstream dissolved air flotation, and, in the FCC cases, recovery of sulfur from off-gases. About US\$1.0 million is required to complete the work on the existing refinery and would also be needed in the event the refinery were closed.

Linear Programming Analysis of Refinery Operations

3.79 A refinery linear programming (LP) model was used to determine the refinery crude selection, material balance, and equipment configuration for each year for the different refinery investment cases. The optimization objective was to supply the Jamaican petroleum product demand at minimum net cost on the basis of optimum crude processing and product import and export regardless of refinery ownership or responsibility for importation. Sensitivity analyses were carried out to determine the impact of reducing the demand on the refinery under the condition of liberalized product importation.

3.80 The LP analysis also shows that the refinery utilization is less than capacity in the business-as-usual (Case I), ranging between 82 and 90 percent over the forecast period, even assuming that all Jamaican demand would be supplied by the refinery. In the event that half of the gasoline and jet fuel markets, representing a major revenue loss, would be supplied by other importers in a liberalized market situation, refinery utilization would drop to between 50 percent in early years and rise to 87 percent in later years, as demand grows. With the present refinery configuration, the LP finds it optimal to reduce production (thereby lowering average utilization) and import a significant amount of product under the reduced-demand case.

3.81 Cases II and III, with the addition of the catalytic cracker, the LP finds the optimal solution is to run the refinery at 100 percent capacity throughout, even in the reduced local demand cases, and export the surplus in all years. The addition of the catalytic cracker gives greater production flexibility and makes the optimal solution less sensitive to variations in local demand.

Cash Flow Modeling Results—EIRR and NPV

3.82 A detailed economic cash flow model was prepared to integrate all refinery production, import and export balances, and cost and revenue data for each investment case based on the crude and product price forecast. Economic Internal Rate of Return (EIRR) and net present value (NPV) were calculated for each of the refining cases, incremental to a base all-products-imported case. The EIRR and NPV results were analyzed for sensitivity to lower Jamaican demand on the refinery and to lower refining margins than in the base-product/crude- price relationship.

3.83 Each refining case was compared with the base case alternative of importing all products in a terminaling operation. The net present value of the difference in cash flows between the refining case and terminaling case was then discounted at 15 percent, and the associated EIRR was computed. The 15 percent discount rate was used to reflect real minimum returns required in the petroleum industry in view of the risks and uncertainty.¹⁷

¹⁷ An opportunity cost of capital discount rate of 12 percent is normally used in the economic evaluation of public sector projects in Jamaica.

3.84 Analytical results, discussed in detail in Vol. II-A, indicate that continued operation of the refinery with minor upgrades could be a lower-cost option than importing all products but could be risky in a liberalized local market. Upgrading the refinery with the addition of catalytic cracking facilities would also be viable and would be more competitive in export markets and less reliant on local markets. Refinery expansion for export would not be viable based on projected refinery margins. Of course, these results are based on the assumptions and price projections that reflect the situation of independent refining and importing, as determined by spot market price projections. The price expectations of private sector operators may differ from the projections used as the basis of this analysis.

3.85 In its comments on the draft report (Annex 2.1), Petrojam pointed out that about 45 percent of refining costs are incurred in local currency, resulting in a saving of about US\$6 million (at the exchange rate of September 1991). With the liberalization of the foreign exchange market and with the macroeconomic policy of market pricing, shadow pricing of local costs at a rate other than the market rate would not be warranted in the economic evaluation. In the event that importing and local refining would be equal in economic value, local employment would be an additional benefit of refining.

Common Carrier Terminal Operation

3.86 *The operation of the Kingston and Montego Bay terminals as common carrier facilities is recommended to increase competition under a liberalized importation regime.* This system is used to reduce monopoly control of elements of the oil and gas industry through ownership control of key transport and storage systems. Government authorities in several countries, notably the United States and Canada, regulate these facilities as common carriers, approving and publishing tariffs for the facility and approving the system of administration of capacity allocation. Common carrier regulation is designed to allow smaller independent operators the use of facilities owned by others, the duplication of which would be too costly for their own use because of economies of scale. It effectively reduces the entry fee and permits an increase in competition.

3.87 The degree of regulation of open access may vary. In major interstate/interprovincial facilities, both the tariff and method of apportionment of capacity are explicitly and directly controlled by a central regulatory authority. This approach is recommended in Jamaica for the Petrojam terminal at Kingston and the marine terminals owned by the marketing companies at Montego Bay. In the case of smaller terminals, however, a more laissez-faire approach is warranted, whereby shippers and users are left to make their own arrangements for access with the owner/operator of the facility. The regulatory authority would intervene only in the event of a complaint of denial of access or excessive charges.

3.88 A portion of the Petrojam terminal would need to be reserved for refinery operations, with the remaining capacity brought under common carrier status.

Privatization of the Refinery

3.89 Concerns have been expressed to MPUTE by PCJ, Petrojam, and others regarding the viability of the refinery as a privatized business in a free market. Essentially the arguments relate to the need for protection for the refinery because of the risk that international marketing companies would engage in predatory practices to force the closure of the refinery and the need for Jamaica to have a refinery ensure the security of the national energy supply.

3.90 Although the existence of the refinery in Jamaica gives flexibility of supply, it is not essential for security of supply, since Jamaica is situated within the highly competitive U.S. Gulf Coast and Caribbean petroleum supply region. Jamaica's total petroleum requirements (bauxite plus nonbauxite sectors) amount to about 19 million bbl/yr (1990) and are small relative to total regional supply, which, for island refineries alone, amounts to more than 400 million bbl/yr. Almost 60 percent (11 million of 19 million barrels) of total requirements are already met by offshore supply. In addition to the major multinational petroleum companies, a number of independent traders are operating in the region. PCJ and Petrojam already benefit from this competitive situation by dealing both with trading companies and directly with refineries. Concerning the possibility of predatory practices the following points can be made:

- a.** A potential purchaser of the refinery will undoubtedly assess his ability to negotiate term contracts for as much of the refinery output as possible to reduce business risk before making an offer to purchase.
- b.** The bidder will recognize the risks of operating the refinery in its present configuration as a simple hydroskimmer and will seek to cover this risk by either demanding protection or by planning to upgrade the refinery. Granting protection to the refinery as is presently enjoyed by Petrojam would run counter to the government's general policy of market liberalization and would reduce the incentive for the purchaser to upgrade the refinery should the purchaser deem it viable. Upgrading the refinery would make it more competitive in the regional market and less dependent on the domestic market. Both the NIBJ and the World Bank, however, have advised that upgrading should be carried out by the private sector because of the inherent business risks involved. At best net revenue gains to the government from upgrading would be zero. It is more likely, however, that they would be negative, since investments to be undertaken by the government would not have the same value for a prospective buyer. The government of Jamaica should not itself make the investments in view of its stated policy to disengage from business enterprises.
- c.** Market liberalization in product importation and distribution, by definition, should permit the refinery operator the freedom to import products, refine, negotiate term sales contracts, and acquire distribution outlets according to the operator's own business judgment.

- d. The multinational marketing companies presently operating in Jamaica are no longer vertically integrated with refineries. American petroleum companies are under a U.S. Government Consent Decree against collusion in domestic and international markets. This injunction covers not only collusion among the international corporations but also their affiliates. Of course it is recognized that the existence of legislation has not fully prevented (and cannot prevent) market manipulation and that government oversight is also required.
- e. The introduction of common-carrier/common-access terminaling would permit large consumers such as JPS and independent retail associations to bypass the marketing companies or the refinery to obtain lower-cost products. The tankage requirements for refinery operations would not be designated as part of the common carrier capacity (para. 3.79). The implementation of such a regime is one of the essential means of reducing the potential for market manipulation. The ability of consumers to bring in products at a lower cost than otherwise obtainable in the domestic market would reduce the possibility of monopolistic pricing.

3.91 Notwithstanding the existence of adequate legislation and the physical measures indicated above, an effective regulatory framework is required. *As the availability of price information is an essential requirement for the efficient functioning of a market, it is recommended that the government monitor and make public the quantities, price, and origin of petroleum products being imported under the liberalized regime.* An independent body with a qualified staff and adequate budget is needed to provide the necessary oversight.

Export-Oriented Options

Grass Roots Refinery

3.92 A review of the present and projected regional refining situation revealed that sufficient capacity exists, could be upgraded or could be added to existing facilities at lower cost than grass roots construction, rendering such a new facility uneconomic in the medium term (Vol. II). Jamaica would offer no logistical advantage to an independent refiner, since it is neither close to the crude source or to product markets. Other locations, such as the Bahamas, appear more attractive. Direct access to crude or markets may well change the economics, but in that case Jamaica would merely be leasing the site.

Transshipment Terminal

3.93 A proposal for a 200,000 BPD transshipment terminal has been put forward to the government of Jamaica; however, this would be a high-risk project. *It is recommended that any such proposal be subject to the most careful scrutiny, particularly with regard to the environmental risk, and that the government of Jamaica not invest or accept any risk in the project.*

B. ETHANOL

3.94 The production of fuel-grade ethanol in Jamaica is peripheral to the energy sector, as the export value is greater than the cost of gasoline it would replace in Jamaica. Nonetheless, Petrojam Ethanol, as the producer of anhydrous ethanol, is a profitable venture because of the availability of cheap wine alcohol from the European Community and the duty exemption on exports to the United States under the CBI. The extension of the tax exemption under the CBI until the year 2000 has removed the previous uncertainty concerning the product market. A minimum of 35 percent of total f.o.b. price must be attributable to local value added, including the cost of feedstocks produced or qualifying under the CBI. As a result, wet alcohol from other CBI countries is eligible for processing in Jamaica. Details of the evaluation of the PCJ ethanol operations are presented in Vol. II-B and summarized below.

3.95 The Petronol fermentation and wet alcohol facility, with 15 million USG annual capacity located at Bernard Lodge sugar factory, was constructed in 1986 to provide CBI-qualifying feedstock to Petrojam Ethanol's anhydrous distillery, having a nominal 50 million USG capacity.¹⁸ Contrary to the original plan, Petronol has had to rely on imported feedstocks rather than using molasses from Bernard Lodge. Petronol variable production costs at US\$1.39/USG are higher than the US\$1.25/USG c.i.f. price of Caribbean wet alcohol; hence, it is more profitable for Petrojam Ethanol to use Caribbean wet alcohol than feedstock from Petronol to blend with the cheaper European feedstock currently landed in Jamaica at US\$0.57/USG. Because of the high cost of Petronol production, the plant has never been operated at capacity, and in 1990 it produced only 1.1 million USG or 7 percent of capacity.

3.96 It appears unlikely that Petronol could become a profitable venture, particularly if the capital cost of waste treatment (roughly US\$4 million) must be taken into account as a pollution abatement measure. The waste products are presently discharged without treatment and place a high biological oxygen demand on the surface and ground waters.

3.97 Assuming that the selling price for fuel-grade ethanol would follow the price projection for gasoline in the USGC market, the Petrojam Ethanol operation would remain profitable for price increases of up to 50 percent over the present farmgate level of US\$0.27/USG. The cost of CBI-qualifying feedstock is not critical, provided that the CBI qualification continues to be based on percentage of value added rather than in volume terms.

Recommended Strategy

3.98 As part of the government of Jamaica privatization program, *it is recommended that PCJ request offers simultaneously for the purchase of both Petronol and Petrojam Ethanol facilities.* Bidders should be given the option of offering for both plants individually or together. It is quite possible that the Petronol plant would be bought for relocation; however, the Petrojam Ethanol facility could be

18. The total capacity is in two units; the newer unit has a capacity 40 million USG, while the second unit of 10 million USG capacity is reaching the end of its useful life. For study purposes 40 million USG capacity has been assumed.

operated in its present location under a service agreement with the refinery operator. Care must be taken to ensure that the sale and operation of the ethanol distillery at the refinery should not become prejudicial to the sale of the refinery.

3.99 So that the government can maximize its revenues from the sale of both ethanol and petroleum refining assets, the timing and modality of both divestitures and attendant requests for proposals would have to be coordinated closely to ensure that the presence of the Petrojam ethanol facility on the refinery site is not an encumbrance to a sale of refinery assets to an operator not wishing to be involved with ethanol. The present PCJ ethanol production assets should be available for purchase along with the refinery, however, in the event that a potential buyer of the refinery saw the ethanol business as an attractive add-on to the petroleum refining.

IV. ELECTRIC POWER

Introduction

4.1 The Jamaica Public Service Company (JPS), like other power utilities in the region, faces many challenges, including fast-growing demand, capital constraints, and continual public demands for improved services without tariff increases. As a parastatal corporation, JPS also may be called upon to support government policy objectives that would not be included within the mandate or contractual obligations of a private utility. The primary policy issues confronting the government of Jamaica are how to meet growing demand for electricity while improving efficiency both in operations and in the use of capital. Improvements in the levels of training, experience, and productivity of staff will be essential for increased efficiency in both public and private power-sector operations.

4.2 This chapter summarizes the main findings and conclusions of the Consultants' Report (Vol. III-A), which was prepared in collaboration with JPS; the Ministry of Mining and Energy; SWECO, which has prepared a Least Cost Expansion Plan (LCEP); CIDA, on environmental matters; and others. The mission worked with JPS staff using the WASP generation-planning software to make an independent assessment of the LCEP (para. 4.42).

Policy Issues and Strategies

Operational Efficiency

4.3 JPS is currently making progress in key areas to improve operational efficiency through increases in generating efficiency, transmission, and mitigation of distribution losses. Accounts receivable are being reduced; however, nontechnical losses continue to remain unacceptably high.

4.4 **Cost Reductions.** Reductions in fuel costs can be achieved by economic despatch, by lower fuel-quality specifications, and by improving the thermal efficiency of generating plants through rehabilitation (para. 4.20). Reduction in capital cost (i.e., improvement in the use of capital) can be achieved by increasing system reliability, thereby reducing the reserve margin requirements, by improving the system load factor through Demand Side Management (DSM), and by optimizing the size of plant additions to meet growth.

4.5 **Outage Costs.** Outages are not only an inconvenience to JPS customers but are also a source of economic losses estimated by JPS at an average cost of about US\$1.50 per kWh for unplanned

outages, far greater than the value of revenue lost to JPS.¹ An analysis of outages, however, shows that a significant percentage of them are attributable to transmission and distribution faults, and a lesser percentage are assignable to generation problems.

4.6 The Loss of Load Probability (LOLP) is the summary measure used for planning purposes to reflect the economic trade-off that must be made between the costs of reducing outages and the costs incurred by the outages themselves.² In the case of Jamaica, an LOLP criterion of two days per year has been retained for generation planning and is appropriate for the composition of JPS's load and the level of economic development.

Environmental Impact

4.7 Environmental impacts from JPS generating plants occur primarily in the form of atmospheric emissions, waterborne effluents, and thermal plumes discharging into Kingston Harbor and the sea. Existing international guidelines can be used as a starting point in setting appropriate national standards but ultimately should be set on the basis of local conditions under the leadership of the National Resource Conservation Authority.

4.8 Environmental impact assessments are now required for new plants and must be carried out as part of project preparation. Additional attention is also required for existing plants (para. 5).

Pricing and Tariffs

4.9 The 37 percent average tariff increase implemented in April 1990 was an important step to improving the financial situation of JPS. Of equal significance, the tariff adjustment included the restructuring of rates to reflect better the cost of capacity in addition to the energy-related fuel costs. A fuel cost adjustment clause reflects changes in the cost of fuel brought about not only by international oil price changes but also by changes in the exchange rate.³ Although the existence of the fuel price adjustment clause is important in protecting JPS from events outside its control, it must be remembered that tariff setting is based primarily on the cost-plus principle. As a result, JPS staff has little direct incentive to pursue efficiency improvements vigorously.

4.10 A detailed marginal cost study was completed by JPS in 1989 and updated in 1991. A further update of these studies is planned in 1992, since JPS's future capital investment program and

1. Estimating Cost of Outages to the Jamaican Economy, *System Planning Division, JPS; November 1990, draft report.*

2. LOLP is expressed as a percentage (in this case $2/365 = 0.548$ percent) that the generating plant would be unable to meet demand (i.e., that there will be load shedding because of the unavailability of generating capacity).

3. The fuel cost adjustment clause has been in effect since 1928. Some efficiency incentive is provided, inasmuch as the fuel component of losses above 15 percent of net generation can not be recovered.

operations are currently undergoing major structural changes reflecting the impact of liberalization of foreign exchange as well as the changing role of the utility in the sector, particularly in generation.

Unaccounted/Administrative Losses

4.11 JPS's financial performance has improved with the increase in rates and with the efficiency improvements now being implemented. A major problem of unaccounted for and administrative losses continues to thwart JPS, however, as it is often dangerous for JPS staff to enter certain neighborhoods without the support of security forces to read meters—let alone collect bills. Of total losses of 17.1 percent in 1990, roughly 10 percent were estimated as technical and the remainder unaccounted or attributed to theft.⁴

Electricity Demand

Historical Demand

4.12 The historical growth of energy sales in the 1970s was at the modest rate of about 3.3 percent per year, followed by 2.2 percent per year to 1985, and then increasing to 6.1 per year to 1990, despite the setback caused by Hurricane Gilbert in September 1988. The production and sales since 1979 are shown in Table 4.1. The sales comprise about 32 percent to residential customers, 48 percent to

TABLE 4.1: JPS Historical Generation and Sales

Year	Net Generation and purchases (GWh)	Sales (GWh)	Company use (GWh)	Losses and unaccounted	
				GWh	%
1985	1,437	1,147	9	281	19.5
1986	1,525	1,227	7	291	19.1
1987/88(Apr/Mar)	1,722	1,370	7	273	16.5
1988/89(Apr/Mar)	1,651	1,271	7	372	22.5
1989/90(Apr/Mar)	1,944	1,569	8	375	19.3
1990/91	2,005	1,632	8	343	17.1
1991/92 est.	2,100	1,697			

small commercial and industrial, 11 percent to large commercial and industrial, and 9 percent to others. Technical and unaccounted for losses are split about 50/50. By year-end 1989 there were about 285,000 consumers with a total consumption of 533.9 GWh or 1,870 kWh per customer a year. Most

⁴ The available estimates regarding technical losses vary from 10 to 14 percent but are judged by the mission to be nearer 10 percent.

significantly, about 92 percent (264,100) of residential consumers had an annual consumption greater than 900 kWh, indicating significant opportunities for DSM.

Demand Forecast

4.13 Three demand forecasts based on underlying economic growth assumptions of 3 percent a year were prepared during 1990, reviewed by the World Bank, and used as the basis for the analysis of the least-cost expansion program (paras. 4.33-4.47).⁵ A comparison of these forecasts revealed that the difference between them was small and that the SWECO forecast would provide a realistic and acceptable basis for supply expansion planning. The forecast given in SWECO's March 1991 draft LCEP Report therefore was retained for planning purposes. The growth of electrical demand on the base case SWECO forecast (of December 1990) is summarized in Table 4.2; Table 4.3 shows average growth rates over five-year intervals (details are given in Vol. III).

Loss Reduction and Demand Side Management

4.14 The demand figures cited are before adjusting for the effects of projected loss reduction and demand-side management (DSM) measures. The effect of loss reduction is a saving of 4 percent on energy and 5 percent on maximum demand by 1995 and thereafter. The effect of DSM has been taken as the mean of the low and high scenarios estimated by the mission. This reduction is substantial and amounts to some 500 GWh and 84 MW by 2005. The reductions in load stemming from loss reduction measures and DSM are also shown in Table 4.2.

TABLE 4.2: Basic Load Forecasts

Year	Basic forecast by SWECO						Forecast reduced after loss reduction and DSM					
	Energy (GWh)	Max. Demand (MW)	Growth Rate (%)	Load Factor (%)	Ded'n for loss red'n		Ded'n for DSM		Energy (GWh)	Max. Demand (MW)	Yearly	
					(GWh)	(MW)	(GWh)	(MW)			Growth Rate (%)	Load Factor (%)
1989	1,944	309		72			0	0	1,944	309		72
1990	2,041	325	5.2	72			0	0	2,041	325	5.2	72
1991	2,167	345	6.0	72			0	0	2,167	345	6.0	72
1995	2,764	435		73	111	22	107	21	2,547	392	2.5	74
2000	3,288	516	3.3	73	132	26	269	52	2,887	439	2.8	75
2005	3,808	596	2.7	73	152	30	350	64	3,306	502	2.8	75
2010	4,419	688	2.8	73	177	34	405	71	3,837	583	2.8	75

Note: DSM = demand side management
Source: SWECO, Mission estimates.

5. Energy Demand Forecasts for Jamaica: A Review, Dr. A. Markandya, *Metroeconomica Ltd., Economic Consultants, January 1991*; Energy Demand Forecast, Part I: Summary and Conclusions, W.R. Ashby for Planning Institute of Jamaica, February 1990; Power Market Survey and Load Demand Forecast Study, Jamaica Public Services Corp., December 1990. See also JPS Electric System Load Forecast given to World Bank mission November 1990.

TABLE 4.3: SWECO Basic Forecast - Average Growth Rates

Year	Demand (MW)	Energy (GWh)	MD Growth %/year	Load Factor %
1991	345	2,167		72
1995	435	2,764	6.0	72
2000	516	3,288	3.5	73
2005	596	3,808	2.9	73

Source: Jamaica Power Market Survey and Load Forecast Study, Final Report, December 1990; SWECO.

Existing Facilities

Generating Plant

4.15 The sent-out capacity of JPS thermal generating stations will amount to some 499 MW comprising 297 MW of oil-fired steam plant, 40 MW of low-speed diesel plant, and 162 MW of gas turbines, after rehabilitation, by the end of 1993. Vol. III-A, Table 3.1 gives details of the plant, which is in four stations at Old Harbour (all steam), Hunt's Bay (steam and gas turbines), Rockfort (diesels), and Bogue (all gas turbines). Some of the plant, especially the steam plant, is undergoing rehabilitation at a cost of some US\$25 million; further rehabilitation is planned for the Hunt's Bay gas turbines in about 1994; two gas turbines at Hunt's Bay were rehabilitated in 1991.

4.16 JPS also has nine hydroelectric stations with a total capacity of 24 MW and an output of an average of about 140 GWh a year. All are small, the largest at Magotty Falls having a capacity of 6.3 MW (Vol. III-B, para. 0.03). The older schemes, dating from 1945, are to be rehabilitated under an IDB loan following a feasibility study in June 1989. The work will comprise general modernization and replacement of wood-stave pipelines.

Efficiency Improvements

4.17 Significant technical efficiency improvements can be achieved in JPS generating, transmission, and distribution systems. A number of programs are already in hand including economic load dispatch, plant-performance monitoring, and transmission and distribution loss reduction.

Economic Load Dispatch

4.18 An upgraded off-line computer-based economic load despatching system has recently been introduced and is estimated to have reduced fuel consumption by about 4 percent; the cost of this system has probably already paid for itself in fuel savings.⁶ A further computer-based plant monitoring system is being introduced to warn of deterioration in plant performance and will identify incipient faults.

Generating Plant Rehabilitation

4.19 Power plant rehabilitation is required to improve operating performance and extend the life of the existing steam generation plants in particular. This work is being financed by IDB. The benefits of rehabilitation do not last indefinitely, and it is expected that further rehabilitation or plant replacement would be required again in about 5 to 7 years. Initially after rehabilitation, plant availability will be improved, and forced outage rates will be reduced; however, both these indicators will deteriorate over time. The provision of adequate maintenance resources should be given high priority to ensure maximum ongoing benefit from the investment in plant rehabilitation and life extension. Apart from undertaking the planned maintenance requirements, the maintenance resources should also be capable of responding quickly to faults identified by the planned performance-monitoring system (para. 4.19).

4.20 Retirement of existing plant amounting to 230 MW by the end of 2000 is an important aspect of the Least Cost Expansion Program (LCEP). The total new capacity required by the end of 2000 is about 440 MW, over half of which is required to replace retired plant. By 2006, the retirements total 360 MW of the total of 760 MW of new plant to be added in the period beginning in 1991. It is very important, therefore, to examine the retirement policy with a view to further rehabilitation and life extension as part of future expansion planning. Any further investment resulting in reliable life extension will be highly economic.

Fuel Specifications

4.21 The steam and diesel plants all burn Number 6 heavy fuel oil (HFO) supplied from the Petrojam refinery near the Hunt's Bay station. The oil is about 2.8 to 3 percent sulfur. It is of a quality suitable for use as a feedstock for catalytic cracking and is about US\$1.50 per barrel more costly than Bunker C oil bought on the open market. The bauxite companies by and large are successfully using the lower-quality Bunker C oil. An analysis of the potential cost savings of using lower-quality fuel oil was carried out as an extension to this study.⁷

6. *The original system was introduced in the 1970s.*

7. *"Analysis of High Sulfur Fuel Oil Prices in Jamaica," the Energy Futures Group, March 1992.*

Generation Augmentation Program

4.22 Captive installed capacity of approximately 265 MW is owned by bauxite companies (168 MW), sugar factories (30 MW), the cement plant (27 MW), and other industries (40 MW). About one-third of this total capacity operates at 60 Hz and is thus incompatible with JPS's system. About half the bauxite companies' capacity, which operates at 50 Hz, is connected to the JPS's grid, as is a small portion of the sugar factory capacity. Although JPS has purchased electricity from these sources over the past 10 years, the volume has been insignificant—7.9 Gwh, or 0.4 percent of JPS sales in 1991. The feasibility of connecting the cement company to the grid is under investigation; however, for the purposes of long-term planning, the effective supply of power from captive plants has been taken as zero.

Interruptible Loads

4.23 Up to 70 MW in irrigation and municipal water supply pumping loads could possibly be transferred to off-peak or be designated as interruptible loads, thereby reducing demand on JPS if required. Studies are under way by consultants to JPS, and investments will be financed under existing loans from IDB. Further interruptible loads may be found as part of ongoing DSM work.

Transmission and Distribution

4.24 The upgrading of the system to reduce losses and cater for load growth is under way, with IDB and World Bank financing. Over the past two years, JPS has reconductored 11 km of trunk lines; installed or rehabilitated 36 MVAR of capacitors, resulting in an improvement of the day peak power factor from 0.81 to 0.90; and converted about 311 circuit km (out of 7,290 km) to 24 kV as part of the voltage improvement program. Improvements brought about by these measures (and the completion of the program) have been taken into account in the load forecasts (Table 4.2) used in the LCEP analysis.

Environmental Issues

Audit of Existing Power Plants

4.25 The existing power stations affect the environment in two main ways. The first is chimney emissions containing sulfur dioxide (SO₂) and nitrogen oxides (NO_x). Little can be done about SO₂ without spending excessively on low-sulfur fuel to reduce emissions or on plant to remove the SO₂, especially in the context of the limited life of the plant. NO_x may be reduced at the steam stations if it proves necessary and feasible to modify the burners. It would be possible to reduce ground-level concentrations of emissions by increasing stack heights on existing plants. Again, these measures would be costly, particularly in view of the planned retirement of the Hunt's Bay steam plants over the next 10

years. In the longer term, environmental improvements in Kingston can be more cost-effectively achieved by relocating the replacement generating plant.

4.26 The abatement of particulate emissions is being achieved and can be increased through the installation of equipment for continuously monitoring burner performance and the overall operational state of the generating plant. Improved staff training in boiler operations will reduce the emission of the dense black smoke frequently visible in Kingston and will improve energy efficiency.

4.27 The second main environmental impact of the power plants is in the release of effluents including dirty water, oil, chemicals, and boiler blowdown into the station drains and hence into the sea. Improvements are possible by rearranging the station drainage system with a view to catching the waste and treating it before discharging it to the sea. An environmental audit of the existing Hunt's Bay facilities has been conducted by consultants financed by IDB. An action plan will be prepared under the ESDP project to define mitigative measures, implement the recommendations of the environmental audit, and remove all hazardous material from the site.

Environmental Impact of New Plants

4.28 For a full assessment of environmental impact of the various stations in the LCEP, it is necessary to have baseline measurements of existing air and water quality and to identify the main sources of pollution. Modeling of the effects of existing pollutants, to which can be added the emissions of proposed projects of all types, not just power stations, is needed. Required grant financing for this work will be provided by CIDA.

Coal Plant Siting Studies

4.29 CIDA also intends to finance the preliminary engineering and baseline environmental studies of the Salt River site for a coal-fired plant. Earlier studies had identified a total of 18 sites. TORs for a detailed FIA were to have been prepared following a review by the Energy/Environment Steering Committee (Annex 4.1). The studies are expected to begin in 1992 following finalization of funding arrangements and would require at least a year to complete to permit the investigation of a full seasonal cycle.

Power Plant Site Inventory

4.30 It is necessary to identify the possible sites for other new plants such as gas turbines and additional low-speed diesels. Some of this plant will be installed at existing power station sites, but it is desirable to have a number of optional sites identified as reserve, particularly because environmental concerns in the Kingston metropolitan area are growing. CIDA has also agreed to finance an island-wide

emissions study that would quantify all pollution patterns caused by existing bauxite and power plants and other sources.

Least Cost Expansion Program

Previous Studies

4.31 Several least-cost expansion studies have been carried out over the past decade. These include Monenco (1985), Beck (1989), and SWECO (1991). During the periods of high petroleum prices, particular attention was given to the possibility of developing the peat resources in western Jamaica as well as other nontraditional energy sources. Of all the options, coal has consistently emerged as the most economic alternative to petroleum and is being examined closely not only because of its lower fuel cost but also because of the opportunity to diversify from petroleum.

Expansion Options

4.32 The options for the future comprise a coal/oil-fired steam station at Rocky Point (Salt River), low-speed diesels and gas turbines at existing power stations, or sites yet to be identified. Selection and proving of sites should also be undertaken as soon as possible, particularly with regard to environmental impact. (Details of the capital and operating costs of each option are given in Vol. III-A, Table 5.3.)

4.33 Medium-speed diesels were considered by SWECO, but it has been agreed that they are unsuitable for use with the high-vanadium heavy fuel available in Jamaica. Indeed, the Caribbean Cement Co. has some 27 MW of medium-speed diesel generating plant and has attempted to use heavy fuel oil but found that exhaust valves were wearing out faster than they could be replaced. The problem is due to vanadium and sodium in the fuel. The diesels now can burn heavy fuel oil only when it is mixed with the same quantity of diesel oil No. 2. *Experience elsewhere in the Caribbean confirms the serious problems caused by burning high vanadium heavy fuels (derived from Venezuelan crude) in medium-speed diesels, and it is recommended that medium-speed diesel generators should not be an option for JPS in Jamaica.*

4.34 The coal station should be pursued urgently, since it is a significant long-term project whose earliest availability is estimated to be early 1997; however, the on-line date could be advanced if preparation work is carried out expeditiously. Proving of the site by physical investigations should be done quickly so that a reserve site can be brought forward if necessary. This work should be done before site-specific environmental assessments are made.

4.35 A design study will be required to take the project to the stage where specifications can be prepared for private sector financing as a BOO project. This study should include consideration of Circulating Fluidized-Bed boilers, to minimize the SO₂ and NO_x emissions, particularly if it proves

feasible to burn heavy fuel oil. In that case, Orimulsion may prove to be an attractive new fuel, though its commercial acceptability has not yet been fully proven by experience. The size of the generating units should also be reviewed.

4.36 The Back Rio Grande hydro scheme, at 50 MW, is the largest of the hydro resources but was not found to be part of the LCEP in any of the sequences tested under the WASP model or by SWECO in the planning period.

Industrial Cogeneration

4.37 Cogeneration, particularly in the bauxite industries could be feasible at the time of replacement of boilers (many are more than 20 years old) or of major plant expansions. Cogeneration at existing installations is not viable because plants have been designed to balance the process steam and power generation requirements. In addition, some plants operate at 60 Hz, whereas JPS operates at 50 Hz, and additional expenditures for frequency conversion would be required. The interest of the bauxite and other industries, including sugar factories, in cogeneration can best be determined by establishing a buy-back tariff based on avoided costs or inviting industries to bid as independent power producers. Development of a cogeneration scheme should be left to the new owners.⁸

Results of LCEP Analysis

4.38 Detailed discussions on the SWECO Draft LCEP Report identified certain differences in costs and availability but were satisfactorily resolved.⁹ Apparent differences in the SWECO and WASP computer modeling however, do not lead to different conclusions. The joint Aide Mémoire (Volume III-A, Annex H) recommended the sequence of plants shown in Table 4.6 as the agreed LCEP.

4.39 Preliminary ranking studies of various plant combinations showed that most of the options are close in economic merit. Through detailed analysis both by SWECO and with WASP, however, the addition of steam turbines to gas turbines to make a combined-cycle plant ultimately was found to be one of the least economic options. Its high efficiency would not offset the high fuel cost, which would cause it to be despatched on peak load, further raising the average cost per kWh produced.

4.40 The program shown in Table 4.6 is the LCEP as selected by WASP and confirmed by SWECO. As there is reasonable doubt concerning the rate at which DSM measures will become

8. Feasibility Study of the Frome Cogeneration Project, *Jamaica Energy Team (JET)*, September 1991. The project was also reviewed by a Working Group constituted by MPUTE, JPS, and Jamaica Sugar Holdings (Frome) that reached the same conclusion as the ESSIPS review.

9. Meetings were held in Jamaica (March 1991) and in Washington (April 1991) among the SWECO Study Manager, JPS, the World Bank, and IDB Staff, to arrive at an agreed LCEP.

effective, the program was established on the basis of the SWECO base forecast without any load reductions.

TABLE 4.6: Least Cost Expansion Program without DSM Load Reduction

1993	Low-speed diesels	2 x 20 MW
1994	Low-speed diesel	1 x 20 MW
1995	Gas turbine	1 x 33 MW
1996	Gas turbine	1 x 33 MW
1997	Coal-fired steam station, Unit 1	1 x 61 MW
1998	2 & 3	2 x 61 MW
1999	4	1 x 61 MW
2000	5	1 x 61 MW

4.41 Based on the above plant sequence, it is important to proceed expeditiously with the implementation of the 3 x 20 MW low-speed diesel BOO project with the first two units to be on line in 1993 and with an option on the third machine for 1994 or 1995, depending on annual reviews of load growth and progress with DSM. A decision on the timing of the gas turbine(s) can be deferred for about two years.¹⁰

4.42 The operational advantage that the coal/oil station and possibly Orimulsion would introduce—in terms of the diversity of fuels available, protection against volatility of oil prices, and the ability burn the lowest-priced fuel available at any time—cannot be fully quantified. For these reasons, however, the coal/oil station is to be preferred. This conclusion also confirms previous studies.

Sensitivity Analyses

4.43 Sensitivity studies on WASP show that the plan including coal is reasonably robust as a long-term source of electricity, and although all options are fairly close in economic merit, from time to time both gas turbines and low-speed diesels find a place in the LCEP. The coal-fired station becomes even more attractive if oil and coal prices are assumed to stay at their present relative level, instead of coal prices increasing more rapidly than oil prices in real terms, as currently projected by the World Bank.

10. Because of slippage in the preparation of the BCO project to install the low-speed diesels, it was found necessary to advance the gas turbine unit from 1995 to 1993. As a result, the plant sequence incorporated in the ESPD project has become 1 x 30 MW GT 1995; 3 x 20 MWS low-speed diesel 1995; 1x30 MW GT, 1996.

4.44 Combined-cycle plant was not selected by WASP under any sets of data tried. Even when combined cycle was forced into the plant program, it was found to be uneconomic, and coal-fired steam was selected to follow, although somewhat delayed given the availability of the combined-cycle capacity.

4.45 Loss Reduction and Demand-Side Management measures are potentially very economic and should both be implemented with vigor. The recommended LCEP to 2000, on the basis of the forecast reduced by loss reduction and DSM, is shown in Table 4.7 and could eliminate the need for a 33 MW gas turbine in 1995. The longer-term development of coal-fired plants would delay the third unit by one year.

TABLE 4.7. Recommended LCEP to 2000 Including Loss Reduction and DSM

1993	Low-speed diesel	20 MW
1994	Low-speed diesel	20 MW
1995	Low-speed diesel	20 MW
1996	Gas Turbine	33 MW
1997	Coal-fired steam station, Unit 1	61 MW
1998	Coal-fired steam station, Unit 2	61 MW
1999	Coal-fired steam station, Unit 3	61 MW
2000	Coal-fired steam station, Unit 4	61 MW

JPS Investment Program

4.46 JPS's capital expenditure program for FY93 to FY97 assumes that all future generation investments, except hydroelectric power plants, would be undertaken by the private sector and that the expansion and improvement of the transmission and distribution systems as well as rehabilitation of existing plants and implementation of ongoing projects would be carried out by JPS. The program, based on the projected exchange rates, is within the overall public investment program agreed between the government of Jamaica and the IMF for 1992-93 to 1994-95 as of March 1992.

4.47 The investment program for the five years is estimated at J\$7,090 million, or US\$236.3 million in constant terms, and J\$7,717 million (US\$257.6 million) in nominal terms. Of this, the foreign component is US\$150 million, or about 63 percent. The investment program, which includes apportioned costs such as administration overheads and interest during construction, is detailed in Table 4.8 and has been reviewed by the World Bank and found acceptable.

TABLE 4.8: Investment Program FY93-FY97

Category	Total Cost US\$m equivalent	Total Cost J\$m equivalent	%	Foreign Exchange (%)
Production	45.4	1,361	19	74
Generation	31.2	934	13	94
Transmission	30.8	925	13	63
Substation	31.6	947	13	73
Distribution	33.9	1,017	15	45
Property	26.3	789	11	24
Energy conservation	2.7	81	1	74
Other	34	1,036	15	61
Total: (Constant)	236.3	7,090	100	63
(Nominal)	257.6	7,717		

4.48 Production (i.e., rehabilitation, improvement, and replacement of major parts) represents the largest share of the investment program with 19 percent of total investment, followed by distribution and general projects with 15 percent each. Generation investments, which include the already signed contract for two gas turbines at Bogue, amount to US\$31.2 million, or 13 percent of total investment.

Conclusions and Strategies

4.49 The conclusions drawn from the above analysis can be summarized in the following recommended strategies for the power sector.

Existing Plant

- a. The plant retirement policy should be reviewed periodically as is being done under the Plant Audit, with a view to possible further life extension in due course, since the current rehabilitation is shown by SWECO to be very attractive.
- b. The environmental issues at existing stations should be examined as outlined in the Terms of Reference in Vol. II-A, Annex G.

New Coal-fired Station

- c. Apart from its prime position in the LCEP, a coal/oil-fired plant would introduce diversity of fuels available for generation and give protection against the volatility of oil prices. The base load can be supplied by oil- or coal-firing, according to the cheapest fuel available at any time.

- d. **The coal station should be designed at least to be convertible to heavy oil firing, and possibly for dual firing from the outset. Orimulsion is also a possibility. Although Orimulsion is being proven in commercial operations in several power stations, more time is required to establish a strong track record. Jamaica should not commit itself until more extensive commercial experience has been gained elsewhere. On the present program, the design of the station need not be finalized for about two years so there is time for further assessment of Orimulsion; in any case Orimulsion could be used in the later units, if not in the first units.**
- e. **The use of circulating fluidized-bed (CFB) boilers to minimize SO₂ and NO_x emissions should be considered for the station, though the ability of a fluidized-bed boiler to burn solid and liquid fuels should be checked. Although CFB boilers are a recent development, considerable commercial experience with such boilers in the size range suitable for Jamaica has accumulated. Should CFB boilers be incapable of burning liquid fuels, a decision would have to be made on whether it would be economically preferable to use conventional boilers to retain the dual-fuel capability or to stay with CFB boilers to burn higher-sulfur and lower-price coals.**
- f. **The proposed coal/oil station appears as the preferred long-term option in the LCEP and is sufficiently attractive to warrant proceeding as quickly as possible with completing the siting studies and implementing the environmental impact assessment. Delays in this work may be costly.**
- g. **It is also important that at least preliminary physical site investigations (boreholes, test pits, etc.) be made quickly at Salt River to confirm its suitability and to avoid the possibility of having to abort the baseline environmental studies. If the site investigations prove Salt River to be unsuitable, a second site should be immediately investigated based on the siting studies already carried out by consultants to JPS (Wallace-Evans, financed by CIDA).**
- h. **A final design report should be commissioned at the end of 1992, as soon as the siting and baseline environmental studies show the site to be acceptable, with a view to commissioning the first unit for service in 1997. The report should include layout, harbor facilities, size of generating units, type of boiler, dual- or triple-fuel facilities, ash disposal, and so on.**

Other New Plant

- i. **The Back Rio Grande hydroelectric scheme (50 MW) was not selected by WASP, and estimates of its benefit-cost ratio show it to be about 0.8 at a 12 percent discount rate. This estimate corresponds closely with the SWECO/CIPS Report, which shows an internal rate of return of 7.8 percent. Nevertheless, it is possible that the project may be attractive to countries that are willing to offer concessionary finance on environmental grounds in exchange for limiting CO₂ emissions.**
- j. **A buy-back tariff should be established by JPS on the basis of avoided costs to solicit supplies from industrial cogeneration sources such as the sugar factories and bauxite industries.**

Loss Reduction

- k. The unaccounted losses are variously given as 5 percent or 10 percent. They represent uncollected revenue, and efforts should continue to identify and reduce them. Investigations should be made into the feasibility of putting billing and collection operations out for contract.

Demand Side Management

- l. The reduction and spreading of load by Demand-Side Management and energy efficiency measures should be pursued vigorously; it is potentially very profitable both to consumers and to JPS. The viability of some of the measures will need to be checked as part of the continuing development of DSM.
- m. The avoided system costs as a basis for assessing DSM measures may need to be studied further to provide an adequate breakdown of the costs for the whole range of DSM characteristics. This matter should be reviewed when the results of the demonstration and pilot projects become available. In the interim, the avoided cost estimates (para. 5.34) should be used as a benchmark.

Environment

- n. Environmental standards should be set according to international guidelines, but higher standards are not recommended, since, for example, the fitting of flue-gas desulfurizing equipment is very costly and likely unwarranted. Other means of reducing sulfur dioxide emissions, if required, may be more cost effective (e.g. using low-sulfur coal, even if at a premium price) or using circulating fluidized-bed boilers.
- o. Improvements can be and are being implemented to reduce emissions—for example, through the constant monitoring of burner performance and of the state operation of the plant. Such monitoring, however, can have no effect on emission of sulfur dioxide. Retirement of existing plant solely for environmental reasons would be prohibitive. For example, retirement in 1993 of one of the 60 MW units at Hunt's Bay or at Old Harbour would require replacement investment of US\$60 to 80 million and increase the Net Present Value of the LCEP by some US\$30 to 40 million.
- p. The use of Orimulsion will further exacerbate emission problems, since it is high in sulfur (3 percent) and is equivalent to a high-sulfur coal and worse than the typical heavy fuel oil now used.
- q. The existing stations contribute to the discharge of dirty water, oil, and some chemicals into the sea. This problem could be virtually eliminated by reconstructing the station drainage system and

collecting and treating effluents before discharge to the sea. Such a system should be a design feature for all new stations. The rehabilitation of the plant should result in combustion improvements and reduction in the emission of smoke caused by incomplete combustion.

- r. The discharge of NO_x can be reduced somewhat by careful burner management, but substantial reduction at existing stations would require new low-NO_x burners on both steam and gas turbine plants; the extent to which this would be possible requires detailed examination. The discharge of NO_x can be minimized in new plant by specifying low-NO_x burners to meet the required standards.
- s. For the assessment of environmental impact of the various stations in the LCEP, it is necessary to have measurements of existing (base) air and water quality and to identify the main sources of pollution. Modeling of the effects of existing pollution—to which can be added the effluents and emissions of proposed projects of all types, not just power stations—should be undertaken in the study.

Private Sector Participation

- t. There are no significant technical problems with private BOO power stations. However, it is essential that JPS thoroughly examine the design of all proposals to assure that they will be designed and built to a reliable technical and environmental standard. JPS will not be excused by the public if a private station causes or environmental pollution.
- u. JPS should assess proposals for private power stations with regard to their impact on LCEP. The interaction of a proposed plant with existing and future plants as an integrated system may reveal a proposed plant to be less attractive than it would be if analyzed in isolation.
- v. The contract terms for purchasing the output of a private power station will require special and careful attention to protect JPS from poor availability, to ensure that the cost of energy reflects the best fuel prices, and to allow JPS to purchase power as and when it requires so as to minimize total system running costs.
- w. The contract will be particularly important for the coal/oil station, where the benefits of using the cheapest fuel should also accrue to JPS and their consumers and not entirely to the private owner. The possibility that the owner of the first stage of the coal/oil station will not wish to continue with later stages also should be covered.

V. ENERGY CONSERVATION AND EFFICIENCY

Introduction

5.1 The terms *energy conservation* and *energy efficiency* are used interchangeably to describe the supply of energy at lower cost without changing the end-use benefit of the service provided. In this regard, fuel substitution is also considered as being a form of energy conservation/efficiency, as the end-use benefit is the same regardless of the fuel used.

5.2 As Jamaica places greater reliance on market pricing for the allocation of resources within the economy, it is important to ensure a consistency of pricing policy and expectations regarding consumer behavior. Consumers should be free to make consumption decisions based on prices that reflect costs. The choice of adopting energy-saving equipment should similarly be left to the consumers, based on their valuation of the costs and benefits of both the end-use service provided and the cost of acquiring and installing the energy conservation equipment. Consumers can be expected to adopt energy efficiency measures that clearly result in a net cost saving, provided they have sufficient information to make rational choices. The government should focus on acting as a catalyst to ensure that consumers and potential suppliers of energy efficiency equipment and services are well informed concerning energy conservation opportunities and to assist in overcoming barriers and constraints.

Barriers and Constraints to Energy Conservation

5.3 One of the biggest barriers to energy conservation is the lack of information regarding energy conservation techniques, energy savings, equipment costs, and their payback period. Many energy conservation measures are achievable at low cost or no cost with almost instantaneous paybacks but are not implemented because consumers are unaware of the opportunities. The lack of information also extends to lack of skills, data, and tools to assess either current expenditures or the benefits of conservation.

5.4 Institutional impediments within the building professions frequently inhibit the introduction of cost-effective energy efficiency measures at the architect's conceptual design stage, since lighting and air conditioning engineers are normally employed later in the design process.

5.5 Like consumers in other countries, Jamaican consumers recognize the long-term benefits of energy conservation both for themselves and as a desirable national goal. For many industries and commercial firms, however, energy costs are a relatively small percentage of total costs, often on the order of 5 to 10 percent. As a result, a 10 percent saving in energy cost does not have a major impact on overall profitability, and consequently managers direct their attention to other priorities. Moreover, even for firms that recognize the potential net benefits, the high first cost of energy efficient equipment and the cost of audits and retrofits and the associated disruption to business operations have consistently been cited as the principal barrier to implementing energy conservation measures. The high transaction

costs and high implicit discount rate applied by industrialists to energy conservation projects are frequent barriers despite the advantage of energy conservation to the economy.

5.6 Previously, the high rates of import duties and taxes on energy efficient equipment ranging from 10 percent on construction materials to more than 100 percent for electrical goods were major contributors to the high first cost of energy conservation measures. These rates will be reduced under the CET (45 percent) and GCT (12.5 percent) revisions, except for fluorescent lamps and solar water heaters, which have been zero rated. These new tax rates, however, still contrast sharply with the virtual tax free status (5 percent import duty and 0 percent general consumption tax) on power supply equipment. In effect, there is a general financial bias against energy conservation and a comparative bias in favor of expanding electricity supply. The lower taxes and duties on generating equipment and access to foreign exchange at lower interest rates than obtainable by local industries (for conservation equipment) act to keep power tariffs lower than otherwise would obtain. The cost to the consumer of saving energy is thus artificially higher than the cost of purchasing electricity at what is effectively a subsidized rate. Consistency in macro pricing policies is required to put supply and demand side prices on an equal basis.

5.7 In addition, industrialists and building owners who are ready to install energy conservation equipment often face difficulties in obtaining financing for equipment that is not seen by banks and other financing agencies as directly productive. If paybacks are less than one year, conservation measures could be financed out of cash flow, but, in other cases, loans would likely be required.

5.8 Last, in many cases, the energy efficiency infrastructure is inadequate. Experienced engineers, auditors, and reliable equipment suppliers and contractors are needed as part of the delivery mechanism to identify and implement DSM measures. Although a small core of expertise exists in Jamaica, it must be expanded.

5.9 The availability of information, technical services, and finance, however, may not be sufficient in themselves to sustain an energy efficiency program, a problem experienced with previous programs in Jamaica. Policy options that can help overcome these barriers are discussed below, and recommended strategies are more fully developed in later sections of this report.

Previous and Ongoing Energy Conservation Programs

USAID Program

5.10 Since the oil price shocks of the 1970s, the government of Jamaica has stressed energy conservation as a major component of its national energy policy but has had difficulty in achieving lasting results. The largest program, supported by USAID in the period 1983-87, had four main elements:

- a. Institution building in the Ministry of Mining, Energy, and Tourism, including the training of staff and energy auditors, development of information and monitoring systems, publication of technical documents, and policy development

- b. **Energy conservation in the public sector, including energy audits and 52 demonstration retrofits in public sector buildings in government-owned industries and hotels**
- c. **Alternative energy in the public sector, including the installation of 27 solar water heaters in government hospitals and health centers, and assessment of other renewable technologies**
- d. **Establishment of a US\$10 million energy credit fund through the National Development Bank of Jamaica and the commercial banking system to support private sector investment.**

5.11 Overall, success was mixed because the project was too large (US\$30 million) and was perceived as a stand-alone project out of the mainstream of government. Much of the infrastructure and momentum was quickly lost upon completion, particularly because of lack of government budgetary support. The Energy Credit Fund was canceled after disbursing only about US\$0.4 million for about 50 audits and 20 projects. The Fund failed primarily because of unattractive financing terms, excessive bureaucratic requirements by loan officers who were not sufficiently familiar with energy conservation, and undue restrictions on equipment sourcing.

5.12 The final report of the USAID program made a number of recommendations supported by other international agencies, particularly regarding the need to raise energy prices. Recommendations for offering energy efficiency incentives through tax credits and technical support systems, however, were not taken up because of lack of government resources, lack of commitment to the recommendations, or both. Likewise, recommendations to achieve energy savings in transportation through the establishment of efficiency standards, infrastructure improvements, and emissions testing were not adopted.

Energy Sector Management Assistance Programme

5.13 Following on from recommendations in the World Bank Energy Assessment report (1985), ESMAP launched an energy efficiency project in mid-1987 with CIDA funding. Two components are directly concerned with energy conservation activities and one with an institution-building component for an energy management information system in MME (now MPUTE) in addition to this ESSIP Study.

5.14 The ESMAP energy conservation activities were designed to work closely with the private sector primarily through committees established with the Jamaica Bureau of Standards (JBS). An Energy Efficiency Building Code (EEBC) has been developed for new construction and retrofits in commercial and institutional buildings and is now mandatory for public buildings. The technology transfer phase is ongoing, and engineers and architects are being trained in the application of the code through a series of workshops. Several architects and engineers have reported making significant design changes in current projects compared with normal practice in order to comply with the code. Design handbooks incorporating Jamaican construction practice are being prepared by teams of Jamaican architects and engineers with inputs from international specialists.

5.15 JBS with about J\$640,000 (US\$80,000) in funding from MPUTE is providing ongoing support for EEBC implementation over the next year. The work program includes design workshops,

energy audits for about six government buildings, and compliance reviews of about five buildings. This level of support indicates the commitment of the Jamaican government to a rapid implementation of the EEBC and the early realization of benefits.

5.16 Total energy savings of about 30 percent (compared with existing energy use) in new construction of office buildings over the next 10 years would be cost-effective under the standards of the EEBC. These energy savings have a net present value of US\$18 million; a further net saving in avoided capital expenditure of roughly US\$4 million on generating plant capacity is possible. An additional saving of capital and recurrent expenditures from retrofits over the next 10 years with an NPV of about US\$15 million would also be achievable under the DSM program through the application of the EEBC.

5.17 The Appliance Testing and Labeling Program has been established to provide information to consumers on energy consumption in major appliances. An energy efficiency test laboratory for refrigerators and freezers has been installed at JBS.¹ A public information and labeling program will be undertaken later in 1992, on completion of the initial round of appliance testing. Additional appliances recommended for addition to subsequent phases will include air conditioners, gas ranges, and water heaters.

JPS Energy Conservation Unit

5.18 Major work is now under way in the area of Demand Side Management (DSM) in the power sector. An Energy Conservation Unit (ECU) has been established in JPS with additional support from Rockefeller Foundation and is carrying out pilot and demonstration projects in commercial and residential premises with a total budget of US\$3.5 to 7.0 million, depending on the feasibility of certain cogeneration technologies. These activities aim to quantify and demonstrate to consumers the possible savings and help to design and test the effectiveness of institutional arrangements that will be effective in DSM program implementation. The program is expected to be cofinanced as a project under the Global Environment Facility (GEF).

5.19 The ECU has been supported by international and local consultants in carrying out a study (Power by Efficiency) to estimate the potential savings from DSM.² This study has been used as the basis of the ESSIP team's assessment of priorities and implementation plans for DSM programs (described in detail in Vol. III, Part B).

¹ *Electricity consumption by refrigerators alone in 1990 is estimated to be 152 GWh. Energy savings on the order of 10 to 15 percent could be achieved with more efficient units.*

² *Power by Efficiency—An Assessment of Improving Electrical Efficiency to Meet Jamaica's Power Needs, June 1990, Conservation Law Foundation of New England, supported by Biomass Users' Network and Resource Development Fund.*

Energy Conservation Issues and Strategies

5.20 Although the technologies, magnitude of savings, costs, and benefits are readily identifiable, particularly for energy conservation opportunities in the commercial and industrial sectors, the mechanisms for program delivery are less apparent. *The recommended strategy presented below emphasizes the development of programs that can be implemented as much as possible through the private sector and can be financed out of the savings that will accrue to consumers.* To the greatest extent possible, energy conservation as an industry should be motivated by an entrepreneurial desire to develop a business opportunity.

Energy Pricing

5.21 The government has already taken the most important first steps in overcoming the barriers and constraints to energy conservation by setting a sound macroeconomic framework to give correct price signals to consumers. Petroleum prices are based on import parity and have been deregulated at the retail level. Electricity tariffs largely reflect long-run marginal costs in structure and level following an increase of 37 percent on average in April 1990. Previously, tariffs were based on a declining block structure and had low maximum-demand charges that did not reflect the cost of expanding generating capacity. Tariffs are now adjusted monthly to reflect fluctuations in the price of fuel and foreign exchange.

5.22 However, because of the low taxes and duties applied to electrical supply equipment as opposed to appliances and end-use equipment, the cost of supply is artificially low relative to the cost of consumption, which effectively underprices electricity. This is a policy issue best handled on a macro basis by reducing price distortions caused by uneven duties and taxes.

Regulation

5.23 Despite the incentives given to consumers through the operation of the market system, some forms of regulation will be required to ensure minimum standards of product safety, as in the case of kerosene stoves, or to ensure the application of best industry practice, as in the case of building design. As a general rule, however, regulations and standards, unless vital to the public interest, as with consumer safety, should be imposed judiciously, as they diminish the functioning of the market system and reduce the opportunity of consumers to make their own purchasing decisions.

Private Sector Involvement

5.24 As a corollary to preferring more information and less regulation as a means of promoting energy efficiency, encouragement should be given to the private sector as the delivery mechanism for achieving energy savings. The opportunity for the development of a specialized energy conservation service industry has become apparent, particularly with the increase in electricity tariffs in Jamaica. Fortunately, one of the most enduring benefits of the USAID-sponsored energy conservation program has

been the development of a cadre of energy auditors and efficiency specialists, many of whom continue to operate electromechanical equipment service firms. In early 1991, about 40 engineers attended a two-week series of seminars sponsored by the Jamaica Institute of Engineers on energy conservation, and considerable interest was expressed in the concept of developing energy efficiency service companies.

Cost Recovery

5.25 Much consumer reluctance to adopt energy efficient measures, however, arises from a difficulty in their financing rather than a lack of appreciation of the economic benefits. Consumer financing is often provided by supplier for a number of goods including electrical appliances through lease options and hire-purchase arrangements. To overcome financing problem for DSM programs, power utilities in the United States in many cases have been permitted by their regulating authorities to finance such measures on behalf of customers as a power company investment to be included in the fixed-asset rate base for tariff setting purposes.

5.26 As with other power sector investments, investments in DSM measures should first be economically justified as part of the overall least-cost end-use strategy. The financing and cost recovery then become the key issues to be resolved. Recovery through general tariffs of the costs of DSM programs that directly benefit individual customers would not be justified on either economic or social grounds. Low-income customers would most certainly and quite rightly object to paying for measures that provide the greatest savings to high-income consumers. It is important, therefore, to link the cost recovery mechanism as directly as possible to the beneficiary to avoid objections from nonbeneficiaries. The ability of JPS to identify potential customers for DSM programs through its billing records, the availability of a credit history, and the direct means of cost recovery through monthly bills, provides a major opportunity for devising the financing programs best suited to the DSM measure and the consumer category.

Energy Conservation Priorities

5.27 Based on their technical and economic potential, priority programs in energy conservation should focus on demand side management in electric power, combustion efficiency improvements in industry, and road transportation. Each area offers potential savings on the order of 20 percent, but they differ markedly in the degree of difficulty in realizing these savings. Experience elsewhere with DSM and industrial efficiency projects is encouraging; however, programs for road transportation efficiency improvements have been less successful. Strategies for DSM and industrial energy conservation are discussed in detail in Vol. III-B.

Demand Side Management

Concept

5.28 Until recently, attention in the power sector in general has focused on the expansion of power supply with little attention to the net benefits of reducing consumption on the demand side. Through regulatory reform in North America, in particular, public utilities are recognizing that it is often cheaper to invest in energy conservation equipment on the demand side rather than to expand supply to meet the same end-use need. To this end, they have established demand side management programs. Similarly, energy service companies have been created to carry out energy audits, install equipment, and pay the investment costs out of the savings, which are shared with the consumer. Given the relatively small and untried market in Jamaica for DSM programs and the experience to date (paras. 5.10-5.11) with energy conservation projects, it is apparent that JPS will need to play a major role in implementing and demonstrating the feasibility and benefits of DSM. It is unlikely that a purely private venture could be established until the energy service company and shared savings concepts have been adequately demonstrated and proven.

DSM Potential

5.29 Benefits to be attained from DSM measures include energy savings through an absolute reduction in energy consumption through improved efficiency, energy savings through shifting to off-peak periods when fuel costs of generation are lower, and generating capacity savings through load reduction or peak shifting. Some measures provide both energy and capacity benefits (e.g. substituting compact fluorescent lamps for incandescent lights used during the peak period, whereas other measures provide energy savings alone, such as air-conditioner efficiency improvements used only in off-peak periods.

5.30 Eight programs were proposed and initial estimates of savings potential were made in the CLF report, *Power by Efficiency*. The ESSIP study has examined each of the CLF programs in terms of energy savings potential, delivery mechanism, costs and benefits, and cost recovery. CLF has proposed the direct payments and rebates be provided by JPS, the government, or both to consumers to promote energy conservation. In the ESSIP analysis, however, it has been assumed that incentives would be limited and that costs should be recovered (para. 5.35).

Cost-Benefit Analysis of DSM Programs

5.31 To provide an initial screening of potential programs, cost benefit analyses of DSM programs were carried excluding duties and taxes on both supply and demand sides. In this manner, the effect of price distortions has been removed to assess the economic potential. If price distortions caused by differentials in taxes and duties included in the power tariff and the purchase price of appliances is not reduced, the pay-back periods to consumers would be increased and the adoption of DSM measures could be reduced by about one-third with a corresponding reduction in power and energy savings.

Benefits

5.32 Potential DSM benefits were analyzed in terms of energy and capacity cost savings as part of the power sector least-cost expansion program analysis (paras. 3.3-3.4). Capacity benefits were determined as the avoided costs between the LCEP with and without DSM, based on the long-term expansion program to 2010. Energy costs on-peak and off-peak were assessed on an annual basis. Estimated avoided capacity and energy costs associated with DSM are shown in Table 5.1. The difference in energy costs post-1997 is caused by the introduction of base-load coal-fired plant.

TABLE 5.1: Avoided Costs with Demand Side Management

Year	Capacity Cost U.S. cts/kWh	On-peak Energy U.S. cts/kWh	Off-peak Energy U.S. cts/kWh
1991-97	157	7.0	4.0
1998-2010	157	6.0	1.8

Note: Capacity and energy costs are measured at the high-voltage level on an as-sent basis, allowing for 1 percent loss at HV. Further losses of 2 percent and 8 percent increase the avoided capacity costs to US\$175 and US\$200/kW-yr at the HV and LV levels, respectively.

5.33 **DSM Program Costs.** Cost estimates for each DSM program were prepared for each technology for the level of savings to be achieved. In the absence of more detailed information, pending the results of pilot programs now under way in Jamaica, the costs and benefits associated with retrofit programs were based on the assumption that consumers would adopt conservation measures with a maximum two-year payback. With marketing through JPS and with greater acceptance of DSM measures as an investment, it may be possible to include programs with paybacks in the 3 to 5 year range, as done in other countries.

Aggregate DSM Savings

5.34 The two DSM programs, both high- and low-implementation rate cases, yield energy (GWh) and peak capacity (MW) savings. The average of the high and low, the "mid case, was used in analyzing the power sector LCEP. The energy and peak load capacity benefits of the DSM programs are summarized in Table 5.2.

Table 5.2: Potential DSM Power and Energy Savings

Year	High case		Low case		Mid case	
	Saving	% of Fcst ¹	Saving	% of Fcst ¹	Saving	% of Fcst ¹
1995						
Energy (GWh)	156	6%	56	2%	106	4%
Peak (MW) ²	28	6%	12	3%	20	5%
2000						
Energy	418	13%	140	4%	279	8%
Peak (MW) ²	67	13%	26	5%	47	9%
2010						
Energy	631	14%	224	5%	428	10%
Peak (MW) ²	93	14%	36	5%	65	9%

Note: 1. Percentage reduction from SNECO base demand forecast Table 7.2.
 2. Based on an assumed evening peak, 6-10 P.M.

5.35 Details of the DSM costs and benefits are presented in Vol. III-B and summarized in Table 5.2. Both the high and low cases indicate a strong economic justification for DSM individual programs having a range of 12 to 70 percent for the high case (overall average 35 percent) and 9 to 45 percent for the low case (overall IERR 31 percent) and benefit-cost ratios of 1.4 and 1.3, respectively. The internal rates of return are significant in comparison with the 12 percent discount rate (opportunity cost of capital; OCC), which is used to assess the economic feasibility of public sector investment programs in Jamaica. The economic merit of a DSM program in comparison to a supply project is thus apparent, having a rate of return nearly three times that of the public sector OCC.

DSM Priorities

5.36 Because the pilot programs for DSM are in their early stages, and JPS has not yet geared up to implement more extensive projects, it is difficult to set firm priorities for the various components of the overall DSM program. However, based on the results of the initial cost-benefit analysis, the potential IERR and benefit-cost ratio, and experience with DSM projects elsewhere, *it is recommended that DSM program priorities be placed as follows:*

- a. New commercial and industrial buildings with a benefit-cost ratio of about 1.8, since the EEBC is in place, and benefits from initial design will be long lasting
- b. Residential lighting programs, since the benefit-cost ratio is on the order of 2, and various marketing strategies can be used to increase penetration
- c. Commercial and industrial lighting programs with benefit-cost ratio comparable to, if not better than, that for residential lighting
- d. Commercial and industrial retrofit programs other than lighting, requiring detailed energy audits, engineering design, and financial intermediation (benefit-cost ratio about 2)

- e. Solar water heating, which requires further cost reduction and financial intermediation to make it sufficiently attractive to most consumers.

Residential DSM Program

5.37 In the residential sector, where individual savings opportunities may be high in percentage terms but relatively small in absolute terms per household, it may be necessary to promote DSM programs heavily. Taken as a whole, the residential sector offers a large potential for energy savings, particularly in lighting and the recent zero rating of the GCT for fluorescent lamps will improve the attractiveness of lighting programs. Some power companies in the United States offer rebates for the installation of compact fluorescent lamps or undertake direct installation programs at nominal cost to consumers to increase the rate of penetration and ensure the most effective installation of the lamps. This approach is not recommended for JPS unless costs can be recovered from the consumer through monthly billing. Refrigeration and air-conditioning programs are to be covered primarily through public information campaigns as part of the appliance testing and labeling program.

5.38 Following a review of the various options for involving the private sector, it was recognized that it was necessary to build and strengthen the capabilities of JPS and government agencies to implement a long-term DSM program. GEF funding totaling US\$3.8 million is expected in addition to funds from Rockefeller Fund (US\$1.5 million), IDB (US\$2.0 million) and JPS (US\$0.3 million equivalent) to carry out a DSM Demonstration Project (a) to develop institutions and mechanisms to assess end-use efficiency potential, (b) design specific programs to capture this potential, (c) evaluate the effectiveness of these programs, and (d) develop capabilities to implement these programs on a larger scale.

5.39 In addition to the institution building component, the project would provide (a) technical assistance in evaluation of DSM potential, program design, and evaluation; (b) energy audits and retrofit investments in proven technologies for lighting, air-conditioning, energy management systems, and water heating in offices, industries, hotels, and residences; and (c) technology transfer relating to policy development from experienced power utilities and DSM specialists.³ An investigation would also be carried out through field installations of absorption air-conditioning systems in solar-driven, engine-driven, or cogeneration-driven modes.

5.40 The project would be implemented by JPS with technical services provided by Jamaican private sector energy efficiency specialists trained during previous projects.

3. A twinning arrangement with New England Electric System, a leader in DSM programs, has been established during the preparation of the Power by Efficiency study.

Industrial Energy Conservation

5.41 Oil-fired boilers are used in heavy industry (particularly bauxite) to generate electricity and process steam. In lighter industry (particularly food processing plants), boilers are used to generate process steam, and in the institutional sector (hotels, hospitals, etc.) to provide steam and domestic hot water. The boilers are fired by heavy fuel oil (especially in large industry), and by kerosene and diesel oil in smaller installations. LPG may also be used for domestic water heating.

5.42 Under the USAID program in the mid-1980s, more than 100 energy audits were undertaken in public and private sector facilities. Many of these involved boiler efficiency testing and the identification of a range of corrections, including tuning for maximum combustion efficiency; no-cost/low-cost measures involving boiler cleaning and maintenance, steam trap and steam line repair; fuel switching from diesel to heavy fuel oil; and higher-cost measures such as insulation, combustion air preheating, heat recovery, and boiler replacement.

5.43 Overall, it was found that efficiency testing, tuning, and no-cost/low-cost measures alone could reduce fuel use by about 10 percent at very little cost, and a considerable amount of this was performed during the program. The higher-cost retrofit measures were also financially attractive but relatively few were carried out, because of the high first cost and poor financing. Energy auditors report little follow-up activity.

5.44 Currently, in Jamaica, all boiler owners are required to have annual safety inspections on their equipment in order to satisfy the licensing regulations of the Factories Inspectorate, Ministry of Labour. In addition, such safety inspections may be required for insurance purposes and by food industry inspectors. These annual inspections, which do not include an efficiency component, are carried out by private sector boiler inspectors, who each have a clientele and are paid directly by the boiler owners for this inspection service.

5.45 There is an opportunity to "piggyback" a renewed boiler efficiency testing service on the annual safety inspection program through closer coordination of MPUTE with the Ministry of Labour. This service would involve training the boiler inspectors, where necessary, to carry out a combustion efficiency test, combustion tuning for optimum efficiency, and a maintenance review and identification of no cost/low cost measures.

Energy Conservation in the Transport Sector

Introduction

5.46 The transport sector is the major consumer of oil in Jamaica, projected to consume about 5.2 million bbl of fuel in 1995, which represents about 27 percent of total petroleum products. Within the transport sector, about two-thirds is consumed by the road subsector, and the remaining one-third is consumed mostly by air and marine domestic and international transport. The focus of the energy strategy should be on road transport, since it is the major consumer of transport fuels.

Major Characteristics of Road Transport

5.47 A recent survey of vehicle registrations in Jamaica indicates that there are about 144,000 vehicles; the motorization rate of about 65 cars per 1,000 population (Annex 5.1).⁴ Motorcars make up about 55 percent of the fleet; trucks, 18 percent; motorcycles, 16 percent; and the remaining 11 percent consists of vans, buses, tractors, and trailers. About 84 percent of the fleet consumes gasoline; the remainder consumes automotive diesel. Typical of developing countries are the large number of old vehicles—about 53 percent of the fleet is more than 10 years old. The slow rate of scrapping of vehicles is caused by low disposable incomes and the high cost of new vehicles with duty and taxes that can add 100 percent to the import price. The large number of older vehicles that still require leaded gasoline will also slow the pace at which unleaded fuels can be introduced.

5.48 Most vehicles are fairly small because of government restrictions on imports of cars over 2.6 litre engine displacement and the higher duties on cars over 2.0 litre engine displacement. Many vehicles are poorly maintained and badly tuned because preventive maintenance is not carried out; the high cost of spare parts resulting from high duties and taxes also deters regular preventive maintenance. The standard of maintenance is often inadequate because of poorly trained mechanics and the lack of a certification program; however, GTZ is currently supporting a training program for auto mechanics.

5.49 Although detailed figures are not available, the majority of vehicle-miles are by private car, about half of them in urban areas.⁵ The public transit system consists of a large number of old minibuses and a smaller number of new, larger diesel buses. Most buses are owned, operated (and poorly maintained) by individuals licensed by the government for specific routes.

Transport Energy Conservation Options and Strategy

Options

5.50 In theory, many measures could be taken to conserve energy in road transport. In practice, however, these measures are difficult to implement, not only in developing countries but also in developed countries. Two of the generally successful strategies for conserving energy in the transport sector are to improve the fuel efficiency of the vehicle fleet, and to improve the use of the transport fleet through urban traffic management.

Improving Fleet Fuel Efficiency

5.51 Vehicle fleet fuel efficiency will increase as newer, more efficient vehicles are brought into the fleet. Reductions in the tax structure as expected under macro policy adjustments (para. 2.1) and

4. The survey was carried out by Petrojam to assess motor octane requirements.

5. These estimates are based on a 1983 study, since current figures are not available.

maintenance of high tax levels on transport fuels will encourage vehicle maintenance. MPUTE should continue to provide consumer information on possibilities for energy savings.

5.52 The Jamaican government has introduced a policy to permit the importation of second-hand vehicles. Given the high depreciation rates for vehicles during the first two to three years of their lives, such a policy will result in substantially lower costs for imported vehicles, and, over time, it will help to improve the average fleet fuel efficiency, since newer vehicles are more fuel efficient. It is not expected that the scrapping rate for old vehicles will decrease significantly, since there is a high unsatisfied demand for vehicles.

Urban Traffic Management

5.53 Given the high level of traffic congestion in Kingston (and to a lesser extent, Montego Bay), substantial energy savings in the 5 to 20 percent range can be achieved through a traffic management program. Such measures as one-way street systems, coordination of traffic signals, widening of busy intersections, bus bays, turning movement restrictions, and greater enforcement of parking restrictions and traffic regulation could significantly reduce fuel consumption by reducing idling time and increasing the average speed of traffic. The overall economic rate of return on such programs is usually quite high because of the substantial time savings in addition to the fuel savings. Road widening also may be economically justified for some routes, but there will generally be lower returns because of the high capital costs involved.

5.54 Although of significant economic and social worth, improved public transport will generally not result in fuel savings given the great difficulties in persuading people to switch from cars to buses, no matter how much the bus service is improved. Improvements in public transport, however, are needed in their own right for general transport and busing of school children.

5.55 A traffic management program would require detailed traffic surveys in peak and off-peak hours to identify the most heavily congested road sections and intersections in Kingston. The design of the program obviously will have to take into account the capacity of the local government to implement such programs. Many such programs have failed in other countries because of weak local institutions, lack of experienced staff, and lack of political support. Even with the assistance of external lending agencies, the local government will still have to raise additional local resources to finance traffic management programs, involving an increase in both capital and recurrent budgets. *It is recommended that these are legitimate user costs that should be recovered through general fuel taxes or as identified road user charges.*

5.56 The implementation of a traffic management program will therefore depend on (a) the political support, both central and local, for such a program; (b) the financial situation of Kingston local council and the scope for revising the taxation system; and (c) the institutional capacity to design, implement, and monitor programs. The first phase of a traffic management program should concentrate on development of measures that can be designed and implemented by consultants without putting a heavy burden on local manpower resources. Such measures would include the development of one-way traffic systems and widening of busy intersections, both of which should give high returns. Other measures such

as coordination of traffic signals and traffic regulation enforcement will require the development of local institutions over a longer period. *It is recommended that MPUTE, the Ministry of Transport and Kingston/St. Anne's Parish Council collaborate in studying the potential for traffic management.*

VI. HOUSEHOLD, BIOMASS, AND RENEWABLE ENERGIES

Overview of the Household Energy Sector

6.1 As in most developing countries, the primary household energy requirement in Jamaica is for cooking. Fuel use for cooking is not confined to a single energy source, however, as revealed by an ongoing socioeconomic survey of charcoal.¹ This survey shows that 46 percent of households already use substitution fuels (of which 56 percent use LPG in addition to charcoal, 31 percent use kerosene, and 16 percent also use wood). These results thus indicate that almost half the households have invested in the equipment to use either LPG or kerosene but prefer to use charcoal as their main cooking fuel. Substitution fuels are used when speed is required (such as for breakfast), but charcoal is preferred because of the taste it imparts to food. The fuel use distribution among households was estimated as shown in Table 6.1, based on the Survey of Living Conditions (1989). Electricity and LPG are the principal fuels for roughly one-half of the population who make up the middle- and upper-class households, and the remaining predominantly lower-income households use woodfuels and kerosene as as primary fuels.

TABLE 6.1: Overview of Energy Use in the Residential Sector (1990)

Primary cooking fuel	Primary energy used		End-use energy		Total value		Population	
	PJ	%	PJ	%	million J\$	%	'000	%
Charcoal	7.7	56	1.5	21	103.0	22	268	12
Firewood collected	2.0	15	2.0	29	0	0	280	13
LPG	1.7	12	1.7	24	225.3	47	939	43
Kerosene	1.6	12	1.6	22	74.5	16	558	25
Electricity	0.6	5	0.2	3	71.9	15	131	6
Firewood purchased	0.08	1	0.1	1	2	0	14.3	1
Total	13.7	100	7.1	100	474.6	100	2,190	100

6.2 In rank order of primary energy use, woodfuels (wood used for charcoal making plus wood burned directly) account for approximately 75 percent of total, petroleum fuels for 21 percent, and electricity for 4 percent.² In terms of monetary value, LPG accounts for 47 percent of the total worth of J\$475 million, charcoal for 22 percent, kerosene for 16 percent, and electricity for 15 percent. In terms of end-use

1. *Improved Charcoal and Kerosene Stoves Project (ICKSP, 1991, MMET/UNDP/ESMAP), a survey of 240 households in four Jamaican parishes.*

2. *The conversion efficiency of charcoal production is 15 percent and of electricity generation 35 percent.*

energy, wood (collected free of charge) accounts for 29 percent, LPG for 24 percent, kerosene for 22 percent, charcoal for 21 percent, and electricity for 3 percent.³

Fuel Pricing

6.3 For consumers, kerosene is the most attractive fuel at subsidized prices, as shown in Table 6.2, with a cost 0.13 J\$/MJ of end-use energy compared with 0.23 J\$/MJ for charcoal, 0.30 J\$/MJ for LPG, and 0.50 J\$/MJ for electricity, including annualized costs of stoves. Electricity is delivered at its approximate economic cost, but deregulated LPG retail prices are high compared with markets of similar size in other countries. The LPG price is high in large measure because of wholesale and retail margins that account for about 40 percent of retail price. Kerosene is cross-subsidized within the ex-refinery pricing structure by approximately 35 percent of economic cost. In the medium term, this subsidy is justifiable on environmental grounds, as it provides an incentive not to switch to charcoal for the 25 percent of the population using kerosene as a primary cooking fuel. Initial indications in ongoing survey work show that kerosene is used inefficiently. Removal of the kerosene subsidy would encourage the use of more fuel-efficient stoves so that there would be some offsetting of the higher kerosene prices. On the other hand, consumers could switch to charcoal as a primary cooking fuel.⁴

TABLE 6.2: Comparative Costs of Household Fuels (March 1991)

Fuel	Cost of Fuel J\$/MJ	Cost of Delivered Energy, incl. Annualized Stove Costs, J\$/MJ _{eff}
Wood	0	-
Kerosene	0.05	0.13
Charcoal	0.08	0.23
LPG	0.13	0.30
Electricity	0.33	0.50

Note: By March 1992 retail prices of all fuels had increased substantially in nominal terms but only the price of electricity had increased in real terms. Retail prices for fuels increased in the period March 1991-March 1992 as follows: LPG, 110 percent; kerosene, 9 percent; charcoal, 60 percent; electricity, 154 percent. The consumer price indexes increased by 110 percent. In real terms, price changes for the same period were: LPG, no change; kerosene, -48 percent; charcoal, -24 percent, electricity, +19 percent. Relative price changes would then encourage a switch to lower-cost fuels, particularly since real household incomes declined in the period.

Sources: MME, mission estimates

3. This does not take into account the thermal efficiency of conversion from petroleum and wood fuel to electricity and charcoal, respectively.

4. Trials are under way to introduce kerosene stoves that would be 10 to 20 percent more efficient than those presently in use.

Woodfuels

Wood Use and Resources

6.4 Despite the fact that woodfuels account for roughly three-quarters of the primary energy use, half of energy end-use, and one-fifth of household expenditures on energy, they have largely been neglected both for energy accounting and planning purposes. Their importance in the economy is thus clear, and woodfuels should figure more prominently in energy sector policy. At the same time, it is equally clear that the woodfuels sector is considerably more difficult to manage than the petroleum or power sectors because of the large number of independent operators working in an unregulated market.

6.5 Commercial woodcutting for all uses takes place on government lands, whereas woodcutting for charcoal production takes place on either government or private lands, mainly in dry woodland areas on the fringes of remaining productive forest areas. As a result of the growth in charcoal consumption—estimated by the Department of Forests to have increased 2.6 times in the last decade—serious degradation of soils is now occurring where cutting is concentrated, often in fragile watershed areas, and the additional environmental pressure caused by charcoaling is apparent.⁵

6.6 The total volume of wood harvested for all purposes can only be estimated, as no reliable data are available. The two current estimates show the order of magnitude, which is approximately 750,000 m³ per year.⁶ Of the total amount, some 64 percent is used to make charcoal, 16 percent for construction purposes and in commerce, and the remainder for firewood⁷.

6.7 The actual extent of woody biomass resources also remains largely unknown. Several estimates have been made, mostly based on a 1971 aerial survey.⁸ In terms of area, a total of 2,280 km² of forest now remains, of which 17 percent is well stocked and the remainder ruinate. The total standing stock was estimated at 21 million tonnes, of which 25 percent is well-stocked areas.⁹ The NFAP estimated that 3,000 to 5,500 km² with tree cover exist, with less than 700 km² undisturbed forest and 2,670 km² of forest with commercial potential. Although these latter figures are much higher, the total annual increment is the same order of magnitude as estimated by Agrocan: 1.06 million tonnes. ESMAP,

5. From 19,000 tonnes in 1980 to 49,000 tonnes in 1990 for residential use. Commercial use in restaurants accounts is estimated at an additional 20 to 30 percent.

6. The National Forestry Action Plan (1990) estimates that the total annual wood harvested in 1989 was 725,000 m³, 84 percent of which was used for energy purposes and the remainder for construction etc. Based on data obtained from the Survey of Living Conditions (1988) it was estimated that the total 1989 amount of woodfuel used for all purposes is about 780,000 m³, or 665,000 MT.

7. Collected by households free of charge.

8. Forestry Inventory of Jamaica, Kingston, Jamaica, UNDP/FAO Project Jam 5, Technical Report 8.

9. USAID/government of Jamaica "Forestry Resources Assessment Project," Agrocan Ltd., Kingston, Sept. 1983.

based on field data obtained from FIDCO, estimated the annual increment more conservatively at 0.7 million tonnes.¹⁰ Although the annual increment is equal or larger than the total demand, deforestation problems occur regionally. Thus, the likelihood that wood can be a sustainable source of energy is high if these regional problems can be solved, particularly if trees outside the forest (i.e., on farmers' lands) are taken into account. This would include a total of approximately 8,000 km² of scattered trees that could yield an additional 1.2 million tons annually.

6.8 A National Forestry Action Plan (NFAP) was designed to highlight priority activities in the forestry sector. Potential funding agencies have expressed concern that the plan should be more tightly focused and that institutional strengthening is required before the NFAP could be effective. The matter has not yet been resolved, however, and, at minimum, an inventory of forest resources should be carried out immediately.

Charcoal

6.9 Charcoal is not the cheapest fuel available to Jamaican households, as it is in many countries (Table 6.2). For urban households, charcoal thus appears to be a fuel of choice instead of the fuel by default. Both wood (which is collected freely and has no real negative environmental impact)¹¹ and kerosene (which is subsidized) are considerably cheaper to consumers on the basis of delivered cost per MJ of end-use energy.¹² The preference for charcoal has quite evident environmental implications, as charcoaling accounts for approximately 64 percent of total wood use.

6.10 Charcoal users pay little if at all for the resource value of the wood component in the cost of charcoal produced from wood harvested on public lands, and they do not pay for a provision to alleviate the environmental damage caused by clear cutting in fragile areas for the production of charcoal. Even though, in monetary terms, the charcoal market is larger than that of kerosene or electricity, there is neither government intervention nor regulation to capture the economic resource cost including the cost of environmental protection.

6.11 Stumpage fees are frequently levied on woodcutting in other countries and are designed capture the resource cost on behalf of the state. For example, if a tax equivalent to 20 percent of the retail value of charcoal were levied and fully collected in Jamaica, the proceeds would be in excess of J\$20 million per year. This level of taxation would make charcoal equally expensive as LPG, the next-best fuel. Experience in other countries with the collection of stumpage fees or other forms of taxation, however, has been mixed, and it is uncertain that the government would have any greater success in collecting stumpage fees directly.

10. *Jamaica: Charcoal Production Project, September 1988, Report No. 090/88.*

11. *Fuel wood is mainly collected as dead wood or by trimming branches rather than cutting down the whole tree.*

12. *Wood: J\$0/MJ; Kerosene: J\$0.13/MJ; Charcoal: J\$0.23/MJ; LPG: J\$0.30/MJ; Electricity: J\$0.50/MJ.*

6.12 Perhaps more important than capturing the economic value of the harvested wood is the need to ensure that replanting occurs. As an alternative to attempting to collect stumpage fees from individual woodcutters, it is recommended that a study be carried out to assess the options to improve forest management, including replanting. The feasibility of auctioning timber rights on public lands should be considered for investigation with incentives and penalties for performance for replanting.¹³ In this manner, the concessionaire would be responsible for managing the forest and would ensure the collection of stumpage fees from woodcutters; this cost then would be passed on to final consumers. Stumpage fees are preferable to a tax on charcoal because they encourage higher efficiency in kiln operation.

Petroleum Fuels

6.13 Both LPG and kerosene are used by households for cooking. LPG is used by 43 percent and kerosene by 25 percent of the population. LPG is economically a more expensive fuel than kerosene when costs of fuel supply, distribution, and appliances are taken into account. To the consumer, LPG costs are disproportionately high compared with kerosene, even if the subsidy on kerosene is abolished (Table 6.2), as the margins for LPG distribution and retail are unusually high. Economically, and to the consumer, kerosene is the cheapest household energy source (apart from wood, which is little used). The recommended energy strategy, therefore, focuses on kerosene as the primary fuel of choice for lower-income groups, not only because of economic priorities but also because of its social and environmental implications.

LPG

6.14 LPG at the retail level is more expensive than it should be. It is not subsidized and is within 10 percent of the ex-refinery cost of kerosene. The LPG price structure shows an unusually high component for marketing, distribution, and retail margins.¹⁴ Ex-refinery, LPG costs J\$0.054/MJ (including refinery margins and costs, taxes), and retail/distribution adds J\$0.82/MJ. For comparison, for kerosene, these figures are respectively J\$0.049 and J\$0.014 per MJ. The distribution and retail of LPG requires more specialized and expensive equipment than kerosene; however, even if one assumes that distribution/retail costs of LPG are limited to twice those of kerosene, the approximate economic LPG price would be J\$0.083/MJ (J\$1.68/IG), compared with J\$0.058/MJ (J\$9.22/IG) for kerosene. From an economic view-point, kerosene would still remain a more attractive fuel than LPG.

Kerosene

6.15 Household kerosene is retailed at a controlled price J\$7.5/IG, compared with the deregulated retail industrial kerosene price of J\$11.3/IG. The subsidy reduces the incentive for lower

13. Tighter control of charcoaling on public lands may be possible; however, trespass and theft is a chronic problem in Jamaica for private land owners.

14. The source is MME data, which, unfortunately, cannot be broken down into costs and margins.

income households to use charcoal by virtue of a price differential. Indeed, if all kerosene-using households opted for charcoal as a result of a diminished price differential, the total wood consumption would roughly double. It is clear that such charcoal use could even further aggravate regional environmental degradation and would not be sustainable on a long-term basis.

6.16 Until April 1990, domestic kerosene was distributed in bulk through service stations and by kerosene peddlars. The large price differential created a strong incentive for adulteration of gasoline and diesel fuels for transportation. Indeed, it was estimated that total consumption of kerosene decreased by 38 percent over the same period in 1989, when kerosene sales through service stations were suspended to discourage adulteration of gasoline and diesel fuel. The kerosene consumption was estimated at 1.441 million barrels per year (1989-90, of which 28 percent was attributed to residential use, or 405,000 barrels); projections for 1990-91 show a total consumption of 1.491 million barrels (with 15 percent for the residential sector, or 220,000 barrels). The present solution of controlling the supply of kerosene by distribution in small drums and through small retailers rather in bulk through service stations has been effective in reducing the apparent amount of adulteration although at considerable cost in management time and transportation inefficiencies.

6.17 Introducing kerosene stamps and efficient kerosene stoves are alternatives to maintaining the present household kerosene subsidy. The use of kerosene stamps as a means of targeting the subsidy to low-income groups would permit the setting of the refinery billing price (ex-refinery price plus consumption taxes) for both industrial and domestic kerosene. It would be less costly to distribute stamps than to package and distribute kerosene in small drums. The essential difficulty lies in identifying the target beneficiaries; however, the existing food stamp program managed by the Ministry of Labor, Welfare, and Sport covers about 15 to 20 percent of the total population, comprising low-income households.¹⁵ Coverage of the program is being broadened and the administration strengthened through the addition of about one hundred additional staff. Further studies are to determine the feasibility of removing the kero subsidy and replacing it with a kero stamp program.

6.18 Pressurized kerosene stoves, which are about 10 to 20 percent more efficient and considerably safer than existing stoves, are readily available on the world market. Testing of kerosene stoves is under way, and preliminary results indicate that models currently available in Jamaica are low power (i.e., slow in heating) or higher power but cumbersome to use. As with other household appliances, it is important to provide both consumer protection and to ensure energy efficiency in the national interest. *It is recommended, therefore, that an ongoing program for certifying the safety and efficiency of kerosene stoves should also be incorporated in the appliance labeling and testing program that has been established at the Jamaica Bureau of Standards for electric and LPG appliances.*

15. Households with children under five years, pregnant or lactating mothers, and households qualifying on the basis of a means test are eligible for food stamps. Coverage of the program has been assessed through the Living Conditions Survey.

Renewable Energy

6.19 MPUTE, with GTZ support, has recently completed an evaluation of all renewable energy options, assessing their potential in the medium and long term. Options of obvious economic interest include solar water heaters; micro-hydro in some locations; solar drying; and, for limited applications, photovoltaics. Options not of economic interest from the energy point of view, but possibly justifiable on other grounds, are windpower (small-scale applications) and biogas. Options not likely to have an immediate economic justification such as solar cooking, geothermal, and peat (not strictly a renewable energy source), will be addressed also. In addition to evaluating the different options and determining their relevance to Jamaica, the MPUTE/GTZ study will also propose an action plan for implementation and commercialization of the most interesting options.

6.20 A demonstration project now under way at the Bernard Lodge sugar factory has shown the technical feasibility of producing charcoal briquettes (biocoal) from bagasse using retorts that also provide fuel gas for sugar processing. It is estimated that with this process in multiple plants, conversion of 10 percent of total bagasse could supply 10 to 15 percent of the total charcoal demand. The plant is about to go into commercial production. Further evaluation of economic feasibility is required after about 12 months of actual production and considering the transport cost to market.¹⁶

6.21 Investigations are currently under way to establish a 20 MW windpower generating facility as a private BOO scheme and study results are expected in mid 1992. The feasibility of the project will be determined on the basis of the buy-back tariff to be established by JPS. The avoided costs associated applicable to the DSM program (Table 5.1) are relevant as well for wind power and other renewable energy conversion projects.

Policy Options and Strategies

6.22 On the basis of the foregoing analysis, the recommended strategy in the household fuel area is as follows:

- a. Carry out a wood resources inventory as quickly as possible under the NFAP; estimated cost, US\$250,000.
- b. Use the inventory project as an institution-building vehicle for the Forest Department with further data collection in wood use (commercial lumber, land clearing, charcoaling); estimated cost, US\$125,000.¹⁷

16. In mid-1992, *Natural Cane Products Ltd.* expects to enter the market to sell carbonized bagasse briquettes at a price competitive with wood charcoal.

17. CIDA has financed aerial photography, which was undertaken in late 1991.

- c. **Conduct household energy surveys every three to five years, to be carried out by consultants for MPUTE as the basis for reviewing pricing (including taxation policies) on household fuels; estimated cost, US\$85,000 per survey.**
- d. **Investigate options for collecting stumpage, such as the auctioning of timber rights on public lands with a condition that replanting must be carried out; estimated cost, US\$150,000.**
- e. **Test and certify kerosene and LPG stoves for safety and fuel consumption as part of the JBS appliance testing and labeling program; estimated cost, US\$50,000 for laboratory and initial tests.**
- f. **Carry out a study to seek means of reducing the cost of LPG to consumers covering all aspects of c.i.f. cost, and bulk and retail distribution; estimated cost, US\$35,000.**
- g. **Carry out a feasibility study to apply consumption taxes to domestic kerosene to raise the refinery billing price to that of industrial kerosene and provide an equivalent subsidy through the food stamp program.**

VII. ENERGY AND THE ENVIRONMENT

Introduction

7.1 The government of Jamaica is fully aware of the importance of the environment to Jamaica's economic and social development and is taking essential steps to address these issues. In addition to the obvious need to maintain the quality of the environment in support of key economic sectors such as agriculture and tourism, popular concern is strong and growing for environmental protection and clean-up as the basis for sustainable development, and many people are aware that without proper management, Jamaica could suffer irreversible environmental degradation, as has already occurred on other Caribbean islands.

7.2 Inevitably, however, trade-offs must be made between environmental protection and economic growth. Where the costs of environmental damage and protection can be quantified, they can be internalized in the economic evaluation of projects, thereby influencing the technology choices and ultimately the prices charged for petroleum and electricity. Where it is not possible to quantify and internalize environmental costs, it is necessary to set standards for emissions and effluents to reduce the impacts to tolerable and consistent levels. International organizations such as UNEP and the World Bank have developed guidelines that continue to evolve. Countries may themselves wish to apply more stringent environmental standards; however, World Bank guidelines have been accepted by many development agencies as a minimum requirement for project design and are recommended as interim standards for Jamaica (applicable standards for energy projects are shown in Annex 7.1).

Environmental Institutions

Ministry of Finance, Development and Planning

7.3 The Ministry of Finance, Development and Planning (MFDP) was responsible for environmental affairs and was instrumental in setting up a secretariat for the development of a National Conservation Strategy (NCS). The Secretariat, with support from UNDP and CIDA, organized a consultation workshop in April 1990 to guide the process of developing a national conservation strategy with the goal of establishing "a framework for sustainable development." This workshop involved government, the private sector, NGOs, and international agencies concerned with environmental issues. Recommendations were made by the conference for the continued involvement of public and private organizations at all levels in the process of developing the NCS and an action plan for its implementation.

National Resources Conservation Authority

7.4 The government of Jamaica, through the Ministry of Tourism and Environment, is setting up the National Resources Conservation Authority (NRCA) as the principal agency responsible for "the effective management of the physical environment" following passage of the enabling legislation, the National Resource Conservation Authority Act, in early 1991. Of particular relevance to the energy sector, NRCA has the responsibility to (a) develop, implement, and monitor environmental protection programs; (b) formulate standards and codes of practice including those relating to emissions and effluents; (c) investigate the effect on the environment of polluting activities and take appropriate action; (d) undertake studies and promote relevant research; (e) carry out training programs of a general nature; and (f) do anything that in the opinion of NRCA is necessary to perform its functions.

7.5 Under section 10 of the Act, NRCA has the authority to request Environmental Impact Assessments (EIAs) and construction permits for new projects, although they are not mandatory. *It is recommended that a schedule of project types should be drawn up by NRCA with the assistance of the Energy/Environment Steering Committee (para. 7.9) to determine the nature and size of energy projects for which EIAs and permits would be mandatory and the timetable for rulings by NRCA.* At a minimum, power generation projects over, say, 10 MW; petroleum refining and bulk storage, and mining and mineral processing projects should be subject to environmental assessments before construction. It is essential that a firm timetable be followed by NRCA so that private sector investors would not face uncertainty or incur undue expense in fulfilling environmental requirements.

7.6 NRCA also has the power to require industries to monitor the pollutants they discharge and to impose fines and imprisonment on offenders. As part of its broad power for natural resource protection, NRCA can order cessation of harmful activities and require restoration to original condition. Its powers also could presumably include forest management and regulation of the charcoal industry.

Other Government Agencies

7.7 The Natural Resource Conservation Division (NRCD), under the Ministry of Agriculture, has been responsible for much of Jamaica's environmental management work until now. Its functions cover management and policy aspects relating to wildlife, watersheds, coastal zone protection, and national parks, including survey and investigative work. Its present resources are inadequate, and it will become part of the newly created NRCA.

7.8 The Environmental Control Division of the Ministry of Health is responsible for monitoring pollution sources, setting standards, and carrying out assessments of water quality, effluents, and emissions. A recent ECD paper has identified the principal sources of air pollution in the Kingston area (para. 7.20).¹

1. *Air Pollution, Silvero; 1990. Paper presented at the NCS Consultation Workshop.*

Energy/Environment Steering Committee

7.9 The recently established Energy/Environment Steering Committee is headed by the Permanent Secretary and includes representatives from NRCA, JPS, and MPUTE. This committee is an outgrowth of the committee established to guide the work of the siting studies and environmental impact assessment of the proposed coal-fired power station. It has now been recognized, however, that the committee should address energy and environment issues more broadly rather than focusing narrowly on a single power project site and technology. Under the Act, NRCA would retain final authority to give rulings.

Other Agencies

7.10 Various nongovernmental organizations (NGOs) have been formed or have become involved in environmental issues as activists and focal points for public concern. Institutions such as the University of the West Indies (UWI) are undertaking environmental research, and the Environmental Control Division of the Ministry of Health has carried out some air-quality monitoring studies. It is understood that one community service club is using moral suasion to encourage its members, many of whom are industry and business executives, to deal with pollution problems created by their firms. Petroleum Corporation of Jamaica and the Petrojam refinery have established a monitoring program and are now making budget provisions to clean up oil leaks and cut emissions (para. 7.14).

Energy and Environmental Issues

General

7.11 Two key issues hinder environmental protection and cleanup: the weakness of institutions to deal with the problems and the lack of baseline data concerning water and air quality. A major step has been taken by establishing NRCA as the focal point for these issues and by giving it broad powers to deal with the complex interdisciplinary problems. Progress has been slow, however, in finalizing the national conservation policy, physically setting up and staffing the NRCA, and providing the funds needed to carry out the work program that has been identified so far. A proposal for a technical assistance project has been prepared, but funding has not been fully obtained.

7.12 Environmental issues by fuel type are readily apparent in Jamaica and are summarized below. Details are provided in the subsector chapters together with recommendations for specific actions.

Issues By Fuel Type

7.13 ***Charcoal.*** The clearcutting of forests for land clearing, charcoal production, and other uses is estimated at about 37 acres per day and is a significant contributor to soil erosion and water runoff in river basin catchments.²

7.14 ***Petroleum.*** Petroleum supplies 90 percent of the commercial energy in Jamaica. In the supply, refining, and distribution of petroleum the principal problems relate to oil spills, deliberate discharge into harbors, and seepage from storage tanks into groundwater as well as atmospheric emissions from combustion. The possibility of major oil spills from ships off the coast of Jamaica also exists. Such spills may not necessarily be related to national energy use, but provision must be made to deal with them. The refinery itself is a source of pollution and steps can be taken quickly and at relatively low cost to reduce effluents and oil leakage from entering Kingston Harbor or seeping into the ground water (para. 3.59).

7.15 The cleanup of Kingston Harbor is a priority, and action is being taken under the direction of an Interministerial Steering Committee. Provision for cleanup of effluent discharges into Kingston Harbor from power plants and the refinery have been made in subsector planning (paras. 3.71 and 4.26, respectively).

7.16 The combustion of petroleum is the main source of pollution in the form of SO_x, NO_x, and particulates. The control of SO_x at the point of combustion is expensive, however, involving the use of flue gas desulfurization equipment that is not cost-effective for existing equipment and expensive for new plant. The present sulfur specification in heavy fuel oil as used by JPS and the bauxite companies is 3 percent by weight. Although it is well known that SO_x is the primary cause of acid rain, the extent to which acid rain is a significant problem in Jamaica is not known. CIDA intends to fund an emissions inventory and impact assessment to determine in particular if the sulfur specification for HFO should be reduced. The study will be based on the Draft Terms of Reference given in Annex 7.2. The most cost-effective means of control will be through the restriction on the crudes processed by the Petrojam refinery. A requirement for lower-sulfur fuels would raise the cost of all petroleum products refined locally because lower cost, high-sulfur Venezuelan crude provides the cheapest petroleum products.

7.17 Control at source is the primary means of dealing with NO_x and particulate emissions. The major sources are power production, industrial boilers, and vehicles. The recent introduction of lead-free gasoline and a phase-out of leaded gasoline recommended by the year 2000 would eliminate the health hazard associated with leaded gasoline.³

2. *Forestry and Watershed Management, L. Alan Eyre, UWI; 1990; paper presented at the National Conservation Strategy Consultation Workshop.*

3. *Lead is used as an octane enhancer; however, emissions from leaded gasoline are toxic and can retard the mental development of young children.*

7.18 *Power and Industrial Sectors.* The principal emissions are NO_x and particulates in addition to SO_x. Particulate emissions are a result of incomplete combustion resulting from poor boiler tuning and maintenance. Effluents and boiler blowdown contaminants will enter the sea or groundwater unless collected and treated. In the case of electric power production, a thermal plume will be created by seawater cooling that will affect the ecology of the surrounding body of water. These problems can and should be handled through proper design in conjunction with environmental impact assessments of proposed projects.

7.19 *Road Transport Vehicles.* Vehicles are responsible for emission of NO_x, particulates (mainly from diesel engines), and lead (from leaded gasoline). Old design and badly tuned vehicles are the primary sources. A phase-out to unleaded gasoline by 2000 is recommended and can be achieved by importing increasing quantities of unleaded gasoline or by upgrading the refinery (para.). Vehicle tuneups and fleet upgrading will be the principal means of reducing NO_x and particulates but will be achieved only in the longer term.

7.20 *Other Sources.* Other sources of particulate emissions, notably the cement plant and the burning of garbage at dump sites and throughout Kingston, are major contributors to the smoke haze problem, which develops particularly during temperature inversions. There is an obvious need to improve waste management and reduce or eliminate these emissions. Treatment of the municipal waste problem will have an immediate and greater impact and be more cost-effective per unit reduction of pollution than placing stringent controls on power plants and industries.

Energy/Environmental Strategy and Action Plan

7.21 The recommended environmental strategy and action plan for the energy sector consists of six elements:

- a. Carrying out Environmental Impact Assessments for new energy supply projects
- b. Cleaning up existing sources of pollution
- c. Pollution abatement through conservation and energy efficiency improvements
- d. Strengthening institutions responsible for environmental management notably NRCA
- e. Establishing baseline data for air quality and forest coverage
- f. Identifying environmental zones and setting standards according to the particular requirements of the zone (e.g., Kingston metropolitan area, tourist areas, bauxite mining areas, etc.).

7.22 *Environmental Impact Assessments.* EIAs are now mandatory for all energy projects beginning with the 3 x 20 MW low-speed diesels to be financed under the PSED project. The baseline

Environmental studies are expected to be started by late 1992 or early 1993 for the proposed coal-fired power plant at the Salt River site to verify the suitability of the site before calling for proposals from private sector developers. This study is on the critical path for project preparation. The Energy/Environment Steering Committee is responsible for approving the terms of reference and for supervising the execution of the EIA according to authority delegated from NRCA.

7.23 The private sector developer would be responsible for submitting an EIA for the technology and plant layout, infrastructure and waste disposal proposed and should be assured of a ruling from the EESC within a specified time period—say, 8 to 10 weeks. TORs for the EIA would form part of the RFP package.

7.24 *Cleanup of Existing Sources of Pollution.* Environmental improvements should be carried out at JPS power stations and the refinery as soon as possible to reduce effluents to Kingston Harbor and atmospheric emissions.⁴ Capital expenditures to clean up the refinery should be carried out before selling it to a private operator to remove any concern for liability the buyer may have. Provision has been made in the government of Jamaica's Public Sector Investment Program, which includes funds for meeting environmental standards at the refinery based on an environmental audit being carried out as part of the privatization studies.

7.25 Further baseline studies are required to set appropriate standards for other industries, including the mining sector (para. 7.29).

7.26 *Pollution Abatement through Conservation.* Energy conservation and efficiency improvements are necessary components of an environmental protection program and should be pursued on both economic and environmental grounds as a matter of national concern. At a macro level, energy pricing including the setting of taxes must reflect economic costs including environmental costs. This policy will be most difficult to implement with respect to charcoal, both socially and administratively; however, pricing is a key element in promoting energy efficiency improvements and reducing demand.

7.27 At the international level, energy conservation and efficiency improvements are among the principal means of reducing emissions of NO_x and CO₂, which are associated with the greenhouse effect and global warming. To that end, the Global Environment Facility is expected to provide financing for JPS's Demand Side Management Demonstration Project.

7.28 *Institutional Strengthening.* As quickly as possible, NRCA should be staffed with sufficient experienced personnel to carry out its mandate. CIDA is presently planning an environmental program that will include assistance to NRCA for training and the development of regulations. A recommended work program to gather the necessary baseline data for the energy sector and serve as a vehicle for institutional development is set out below.

4. Preparation of an environmental mitigation study is a condition of effectiveness for the World Bank ESDP loan.

7.29 ***Baseline Data Collection.*** In addition to the need for specific environmental impact assessments (para. 7.22), there is an immediate requirement for the following studies:

- a. Mapping of emissions sources and assessment of effects of acid rain on an island-wide basis (Annex 7.2).
- b. Monitoring of ambient air quality in the Kingston area
- c. Mapping of forest resources under the National Forest Action Plan.

7.30 ***Setting Environmental Standards.*** *Where environmental standards have not yet been established, it is recommended that World Bank guidelines be accepted as the basis for energy sector planning.* Based on costs and benefit evaluations using the baseline data to be collected, the need for revising the interim standards should be assessed according to the requirement of each environmental zone.

7.31 ***Ongoing Monitoring.*** Provision must be made in staffing and budgeting for NRCA for ongoing monitoring of air and water quality throughout the island. The need for monitoring will be greatest in the Kingston metropolitan area, where population and industrial concentrations are the highest. The benefits of establishing the NRCA and giving it authority under the Act will be realized only if an ongoing monitoring and enforcement process can be put in place.

Jamaica Energy Balance, 1990
('000 barrels of fuel oil equivalent)

	Petroleum	Coal	Gas	Hydro	Wind	Other	Losses	Total	Sub-Total	Sub-Total	Total
	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990
Production	1,250.0							1,250.0			1,250.0
Imports											
Exports											
Stock (increasing/decreasing)											
Supplies	1,250.0							1,250.0			1,250.0
Losses											
Change in Inventory											
Open Line (+/-)											
Losses (-)											
Revised Products											
Statistical Adjustments											
Power Generation by											
Coal											
Oil											
Gas											
Hydro											
Wind											
Other											
Losses											
Sub-Total											
Transportation											
Losses											
Sub-Total											
Final Consumption											
Transportation											
Industrial											
Commercial											
Residential											
Losses											
Sub-Total											
Total											

of production only.
of Jamaica Public Services Company only.



Office of the Minister

MINISTRY OF PUBLIC UTILITIES, TRANSPORT & ENERGY
~~Ministry of Mining and Energy~~
36 Trafalgar Road, Kingston 5, Jamaica
Telephone: 92-69170-9

January 15, 1992

Mr. Joseph Gilling,
ESMAP Strategy and Programs Division
The World Bank
1818 H Street N.W.
Washington DC 20433

Dear Mr. Gilling:

Jamaica: Energy Sector Strategy and
Investment Study - Review and Comments

I thank you for the signed version of the Aide Memoire, a draft of which was distributed at the wrap-up meeting held on September 27, 1991. I take this opportunity to commend you and your team for good work on the preparation of the ESSIPS report which should serve as a background document in drafting our energy sector policy and strategy.

2. The analyses and suggestions contained in the draft report and discussed at the wrap-up meeting on all but the refining sub-sector were accepted as presented. However, PCJ and Petrojam had raised queries with regard to the accuracy of information and disagreed with some of the recommendations contained in the petroleum and refining sections of the report.

3. My Ministry has now received a formal response from Petrojam to your draft Aide Memoire of September 27, 1991. I am enclosing these comments and ask that you review them and wherever there are errors of facts or figures, you make the necessary corrections in the report.

4. Further, regarding the petroleum and refining sector, your report concludes that the continued operation of the refinery forms a part of the least cost petroleum supply option for Jamaica. However, in the past the refinery has not run at optimum operational capacity. Within the context of the general privatization and liberalization policy of the Government of Jamaica, we need a short to medium term strategy to deal with the issue of bringing the refinery to its optimum operational capacity (irrespective of its ownership status) while ensuring its continued operation during the transition period.

Mr. Joseph Gilling
The World Bank

January 15, 1992

5. I suggest that your report outline such a strategy and that you recommend a course of action which may be considered under the proposed refinery privatization study to be commissioned by the World Bank.

6. With these amendments to the petroleum/refining section, I suggest that you finalize the report and submit 500 copies to my Ministry.

Thank you and best regards.

Yours sincerely,


Robert Pickersgill, M.P.
Minister

Encl.

c.c. Messrs. Graham Smith (LA3IE);
Ibrahim Elwan (CFSPS); &
Denis Benn (UNDP)



PETROJAM LIMITED

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Cable Address: Petrojam 2119, Tel: (809) 923-8611-5/923-4740-9/923-8814-18, Fax: (809) 923-5698

September 27, 1991.

The Hon. Horace Clarke
Minister of Mining and Energy
36 Trafalgar Road
Kingston 10

Dear Minister,

We have received a copy of the September 23 letter sent to you by Mr. Gilling of the World Bank, and would like to add the following comments to his letter (a copy of which is attached).

- 1) The Table indicating the net TOTAL cost to Jamaica, wherein some US\$5 million per year in additional costs has been incurred due to underutilization of the Refinery over the past five years, underscores the importance of Refining versus finished product importation.

The recommendations as presented in the report for carte blanche import liberalization can only lead to decreased Refinery utilization, and attendant increased cost to the Country. We are in principle in agreement with deregulation. However, in this particular circumstance, we clearly see the mechanism (import liberalization), and the cost, but cannot see what gain or objective is to be accomplished by it.

- 2) Refinery utilization, particularly over the last five years, has been less than desirable for a variety of reasons detailed in our original response to the Bank's Working Draft.

However, presenting the average only is misleading. Attached is the historical utilization abstracted from the Bank's own report, and updated for the first five months of fiscal 1991. The data shows a continuous and consistent increase in utilization from a nadir of 38% in 1987 to a current utilization of 68%. This compares to the average of 48%, and the ideal situation of 83%.

Additionally, the Bank had confirmed the identification of one of the Refinery processing units, the Reformer, as being the major bottleneck in utilization. Our Reformer Upgrade Project, to eliminate this handicap, will be completed by year end.

- 3) The letter suggests that since the US\$3-4 million San Jose Accord benefits are applicable to finished products, this savings is immaterial to total petroleum costs.

However, this saving accrues to the GOJ only. Under the recommended import liberalization, there is no incentive for importers to source product from Venezuela versus other supply options. It is therefore probable that the bulk of this saving would be lost to the country.

- 4) We note that neither the Letter nor the Report disputes the significant foreign exchange savings incurred by Petrojam.

The World Bank letter characteristically omits to mention that - even at the underutilized level indicated in the Letter, the 45% of the US\$13.9 million that is local costs, or approximately US\$6 million per year, in addition to the Accord benefits of US\$3-4 million, still add up to a significant US\$9-10 million per year of foreign exchange savings.

- 5) It also ought to be pointed out that the World Bank in this latest aspect of its study and report is using current prices of feedstock and products at a time when margins are much lower than they would be on a year average basis. However, despite this, as mentioned in 4) above, there are appreciable savings involved, as even US\$9-10 million per year of foreign exchange savings is substantial for our country.

As a final note, we wish to state that we have no dispute with deregulation or the Bank. Our only interests are that whatever Report is finally issued should be totally accurate, and that the recommendations therein should pragmatically be in the best interests of the nation.


H. J. Fenton
Managing Director

Copy to:	Hon. Eli Matalon	Petroleum Corporation of Jamaica
	Mr. Godfrey Perkins	Ministry of Mining & Energy
	Mr. Arthur Geddes	" " " " "
	Mrs. Andree Nembhard	Petroleum Corporation of Jamaica
	Mr. C. Chin Fatt	Petrojam
	Dr. K. C. Peart	"
	Mr. M. A. Hewett	"
	Mr. R. S. Jones	"
	Mr. Tony Hylton	Prime Minister's Office

Handwritten signature/initials

June 7, 1991

Hon. Horace Clarke
Minister of Mining & Energy
Ministry of Mining & Energy
36 Trafalgar Road
Kingston 10

Dear Minister:

**RE INITIAL DRAFT OF WORLD BANK/UNDP ENERGY SECTOR ASSISTANCE
PROGRAMME - JAMAICA ENERGY SECTOR STRATEGY AND INVESTMENT
PLANNING STUDY - VOLUME II, PETROLEUM SECTOR**

=====

Enclosed please find a copy of the PCJ/Petrojam comments on the referenced document.

The report needs to clearly distinguish between matters of national policy and matters related to the business operations of the oil refinery. Appendix I provides comments mainly on matters related to Government Financial Regulatory and Fiscal Policies and the need for understanding of their effect on the nation. The Petrojam critique, attached as Appendix II, specifically addresses matters related to the operation of the oil refinery. You may notice that some comments may be duplicated, however in the interest of time, we will not be able to fully eliminate their occurrence.

These comments are being made in the context that any assumptions and conclusions of this study should not necessarily be regarded as binding on the Government of Jamaica but should be treated as a basis for an informed decision by the Government of Jamaica. We feel that it is imperative that this point is fully understood in order to ensure that the Government of Jamaica will not be bound by the findings of the Report in further discussions with the bank. I would recommend that you immediately make this known to the bank.

Yours faithfully
PETROLEUM CORPORATION OF JAMAICA


DR. VINCENT LAWRENCE
DEPUTY CHAIRMAN

Attch. (Appendix 1 & 2)



PETROLEUM CORPORATION
OF JAMAICA
36 TRAFALGAR ROAD,
BOX 579, KINGSTON 10, JAMAICA.

Appendix I

**COMMENTS ON THE WORLD BANK/UNDP ENERGY SECTOR
ASSISTANCE PROGRAMME**

PETROLEUM SECTOR REPORT INITIAL DRAFT - VOLUME II
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1. **SAN JOSE ACCORD AND CRUDE SELECTION - PAGE ii**
PARAGRAPHS 12 & 14
-

WOULD THE CONCLUSION ARRIVED AT BE TRUE EVEN IN AN UPGRADED REFINERY ?

2. **RECOMMENDATIONS - PAGE iii (PARAGRAPH 19)**

THE STUDY RECOGNIZES A NUMBER OF CRITICAL POSITIONS :

1. **WE WILL OPERATE IN A DEREGULATED ENVIRONMENT. (SEE PAGE (iv)
PARAGRAPHS 22 (a) & (b).**
2. **THE DEMAND FOR THE LOCAL ECONOMY INCLUDING BAUXITE
REQUIREMENT IS 43KBD AT PRESENT, 54 KBD IN THE YEAR 2000 PLUS
64 KBD IN THE YEAR 2010. (PAGE i, PARAGRAPH 1)**
3. **EXPANSION AND UPGRADING TO 50 KBD IS ECONOMICALLY VIABLE AT
AN EIRR OF (25%) A SLIGHT DECLINE FROM 27% IN A 35 KBD. (PAGE ii,
PARAGRAPH 8)**

YET THE STUDY RECOMMENDED THAT THE INVESTMENT IN THE REFINERY SHOULD BE ON THE BASIS OF UPGRADING AND MAINTAINING THE EXISTING CAPACITY OF 35,500 BPCP. (PAGE iii. PARAGRAPH 19)

3. THE EX-REFINERY PRICING

THE STUDY INDICATES THAT A TOTAL SAVING OF US\$15 MILLION COULD BE AVAILABLE BY ADJUSTMENT TO THE EX-REFINERY PRICING FORMULA. (PAGE 7 - SECTION 4.6) GOES ON TO POINT TO A SAVING OF US\$5.7 MILLION RESULTING FROM ADJUSTMENT IN PRODUCT QUALITY.

ALL OTHER ADJUSTMENTS IN THE PRICING FORMULA TO ACHIEVE THE US\$15 MILLION SAVINGS WILL BE ACHIEVED BY 'REDUCING CHARGES TO THE CONSUMER'. NEW CHARGES BY PETROJAM WILL NOT RESULT IN ANY COST REDUCTION TO PETROJAM NOR THE COUNTRY (US\$9.3 MILLION).

DOES THIS HAVE IMPLICATION FOR OIL REFINERY VIABILITY ? NEEDS CLARIFICATION AND COMMENTS.

2

4. DEREGULATION OF PRODUCT IMPORTS:

[PAGE 11 (SECTION 4.27/4.28)]

- (a) WHAT IS THE IMPLICATION FOR THE REFINERY ? VIABILITY BEFORE UPGRADE - AS A RESULT OF THE RECOMMENDATION IN 4.28 (a) TO DEREGULATE PRODUCT IMPORTS FOR WHICH THE REFINERY CANNOT MEET FULL DEMAND BASED ON OPTIMAL USE OF EXISTING REFINERY CAPACITY SHOULD BE INTRODUCED AS SOON AS PRACTICABLE ?
- (b) THE NEED FOR UNDERSTANDING THE IMPLICATION IS EVEN MORE CRITICAL IN LIGHT OF THE RECOMMENDATIONS REGARDING 'PRICING FORMULA' ABOVE.

5. CRUDE AND PRODUCT PRICE FORECAST

THE FORECAST TRENDS IN MARGINS (FIGURE 6.2. TO 6.4 INCLUSIVE) ARE SOMEWHAT DIFFICULT TO UNDERSTAND. FIGURE 6.4 SHOWS THE TREND LINE WHICH LEVELS AT \$5.37. YET STILL \$4.59 IS USED IN THE ANALYSIS AT THE "SINGLE MOST IMPORTANT BODY OF INPUT DATA".

EVEN THOUGH IT IS STATED THAT A SENSITIVITY ANALYSIS BE DONE BASED ON FIGURE 6.5 THE TREND IS NEVERTHELESS VERY CLEAR. TREND LINES SHOULD POSSIBLY BE INCLUDED IN FIGURE 6.5 SHOWING

AVERAGE (BASE), HIGH AND LOW MARGINS. ADDITIONALLY, PLEASE GIVE LOW MARGIN VALUES USED IN THE ANALYSIS.

6. FINANCIAL EVALUATION RESULTS

SECTION 7.6 TO 7.12 (PAGES 43 - 47)

THE CONCLUSIONS ARE :

- (i) NET FOREIGN EXCHANGE COST PER BARREL FOR TOTAL JAMAICAN DEMAND IS LOWER FOR REFINERY THAN FOR TERMINALLY.
- (ii) THE CRACKING CASE IS THE LOWEST COST TO THE COUNTRY.
- (iii) 75% FOREIGN PARTNER OWNERSHIP IS REQUIRED IN ORDER TO ATTRACT INVESTORS.
- (iv) 100% GOVERNMENT OF JAMAICA OWNERSHIP WITH CRACKING IS THE BEST FROM A LEAST COST SUPPLY STANDPOINT.

THESE ARE ARRIVED AT BY ANALYSIS OF THE KEY PARAMETERS IN SECTION 7.6. PLEASE DISCUSS IN MORE DETAIL THE POSITION OF NET FOREIGN EXCHANGE FLOWS. THE PER BARREL FOREIGN EXCHANGE COST, THE PRESENT VALUE OF MINISTRY OF FINANCE FISCAL FLOWS, FOR EACH OF THE BUSINESS AT USUAL AND THE CRACKING CASES ASSUMING SEPARATELY -

- (i) 100% GOVERNMENT OF JAMAICA OWNERSHIP AND,
- (ii) 75% FOREIGN PARTNER OWNERSHIP.

THIS ANALYSIS AND DISCUSSION SHOULD BE FOR PERIODS OF 5 YEARS, 10 YEARS, 15 YEARS AND 20 YEARS, ESPECIALLY IF PAY-BACK OF 6.2 YEARS FOR FOREIGN PARTNER IS BEING RECOMMENDED.

7. RE : ANALYSIS OF FISCAL CASH FLOWS - (PAGE 2 OF ANNEX 7.1

THE ASSUMPTION IN THE MODEL THAT THE ELIMINATION OF IMPORT DUTIES ON IMPORTED PRODUCTS WOULD APPLY IN DEREGULATION SHOULD NOT BE CONFUSED AS NECESSARILY BEING A POLICY POSITION OF THE GOVERNMENT. IN FACT THE ALTERNATIVE OF A BALANCING DUTY IMPOSITION ON THE REFINERY SIDE IS A POSITION THAT THE GOVERNMENT OF JAMAICA WOULD MOST LIKELY WANT TO GIVE DUE CONSIDERATION.

8. THE ANNEXES PROVIDED ARE INADEQUATE AS ONLY THE BUSINESS AS USUAL FINANCIAL ANALYSIS DATE IS GIVEN. THE DATA FOR CRACKING IS REQUIRED.

Response to

Energy Sector Strategy and Investment Planning Study

A. EXECUTIVE SUMMARY

1. Introduction

In October 1990 the Government of Jamaica (GOJ) requested 'Energy Sector Management Assistance Program' (ESMAP) assistance in carrying out an Energy Sector Strategy and Investment Program Study (ESSIPS). The terms of reference of this study were jointly agreed to following extensive discussions between representatives of World Bank, Ministry of Mining & Energy (MME) and a joint committee comprising representatives of GOJ, Petroleum Corporation of Jamaica and the Jamaica Public Service.

The GOJ macro objectives for the sector were identified and discussed with the Bank's representatives and included in the Bank's final terms of reference as follows:

- o to maximize the net economic benefit to the national economy by meeting end use energy needs at least cost and by optimizing the participation of Jamaica in the international energy trade;
- o to further deregulate the power and petroleum sectors in order to encourage greater private sector participation in the operation and financing of sector facilities;

The identification and prioritization of these macro-economic objectives by the GOJ are easily rationalized in the context of the fundamental weakness of the Jamaican economy; the deficit between foreign currency demand and supply. It is therefore of paramount importance to the GOJ that any assessment of the energy sector has a bias to the fundamental issues of:

- a) minimizing the foreign currency requirements of this sector,
- b) ensuring that maximum efficiency levels in the refining, distribution and end usage of petroleum in the Jamaican economy is achieved.

2. ³ESIPS Working Draft - May 1991

Since the completion of the World Bank's working activities in Jamaica, two reports have been circulated for comments; a working draft released in May 1991 and the 'Green'-second draft report.

The 'working draft' concluded as its main findings :

- the under-utilization of refinery capacity due to a complex mix of factors including powerformer capacity and technology limitations, planned and unforeseen outages and foreign exchange limitations;
- adjustments to the existing ex-refinery pricing formulae through market efficiency improvements, changes in product specifications could yield significant savings;
- refining of crude oil is the most economic supply option for petroleum supplies to the Jamaican economy;
- the implementation of the Fluid Catalytic Cracking project was an extremely attractive investment.

The report went on to highlight as its main conclusion that the GOJ should proceed with plans to attract private sector participation in the ownership and operation of the refinery. In addition, the report recommended a two-phase approach to deregulation of petroleum imports as a mechanism to improving the efficiency of the sector:

Short term: Maintain the present structure of import parity pricing for products where there is a surplus refining capacity, until upgrading of the refinery is complete. Revision of product specs. and reductions in the price build up components should be initiated. Deregulation of product imports for which the refinery cannot meet full demand based on optimal use of existing refinery capacity should be introduced.

Medium Term: After completion of upgrading, complete deregulation of product imports and pricing.

2.1 Brief Summary of GOJ's Response To Working Draft Report

Following the release of the 'working draft' a comprehensive response was made on the various studies, issues and recommendations of this draft report.

A number of inaccuracies and mis-conceptions were identified for correction however in essence the GOJ was of the opinion that the majority of the recommendations; except for some of the proposals relating to the price formulae and aspects of the product importation liberalization, were reasonable and could be easily accommodated provided certain key provisos' were included in the development of the detailed implementation plan.

3. ESIPS 'Green' - Second Draft Report

3.1 Overview

Since the initial release of the draft report a second 'Green' - draft report has been released. A detailed reading of this second document indicates no significant changes in the database and analyses contained in the first draft document however the recommendations now being proposed have shifted in 'emphasis and effect' and are predicated on the 'Macro Policy Issue' of 'trade liberalization'. No attempt appears to have been made to justify this change of emphasis in the report away from the guidelines which were agreed to with the World Bank representatives and which have been summarized in Section 1. of this response.

3.2 Response to Second Draft Report

The net effect of the shift in emphasis of the 'Green' or draft report is to arrive at recommendations that are conflicting with the basic policy objectives of the GOJ and paradoxically the World Bank's own detailed technical studies. In some instances, the Bank's recommendations can be expected to result in the inefficient use of scarce foreign exchange and capital assets and more critically result in increased foreign currency costs for petroleum supplies.

A reliable supply of petroleum products to the Jamaican economy is critical to the smooth functioning of the economy as this fuel provides over 94% of the energy needs of Jamaica. In essence this sector is important to the national economic security of the country. This requires that any proposed changes have to be consistent with maintaining reliable supplies and of necessity be evolutionary rather than be revolutionary in nature.

It is the GOJ's considered opinion that the first draft report emphasis on the maximization of crude oil refining (least cost supply) was more consistent with a balanced approach to the many issues involved and GOJ's concerns. However, the Bank needs to give more consideration to any schemes for import liberalization, ensuring adequate safeguards against unfair trading practices such as are discussed later in this response.

4. Macro Policy - Trade Regime

4.1 Product Importation

The draft report now recommends the liberalization of petroleum imports to induce competition to lower supply costs. This recommendation is compared to the removal of JCTC monopolies on traded goods. This is at best an unfortunate comparison as goods imported by JCTC are not in the category of commodities as crude oil and petroleum fuels. Imports of petroleum involves two categories of

commodities; crude oil and petroleum fuels. These can be considered as mutually exclusive substitutable commodities; in a fixed demand market an increase in supply of one reduces the need for the other.

The second aspect of the duality nature of crude oil and petroleum product in the Jamaican economy is there is no requirement for crude oil imports if there were no refinery. Consequently, the merit of importing and refining crude oil is intimately connected with product imports and cannot be easily separated as the World Bank appears to make out in its trade liberalization scenario. The only reasonable and logical course of action in economically evaluating crude oil refining and petroleum imports activities is an analysis based on a least cost linear programming model; as the World Bank has extensively studied. The results of that study would then be heavily weighted in determining any future course of action.

The Bank's own analysis indicates that the maximum benefit to the Jamaican economy is realized when crude oil processing to petroleum fuels is maximized. The foreign currency savings being of the order of US\$ 1.40/barrel. The implication of product import liberalization, if only 25% on non-bauxite petroleum volumes were diverted from crude oil refining would be an increase in foreign currency costs to the country of US\$ 4,700,000/year.

Other issues that the Bank's report ought to place more emphasis on is the role that the smooth operation of the petroleum sector plays in the national economic security of the country. Any proposed changes should not result in any reduction of the security of supply or reduce the real benefits that Jamaica realizes under the San Jose Accord.

4.2 Petroleum Pricing to Reflect Least Cost Supply Option.

The Bank recommends action on petroleum product standards to meet Jamaican requirements and which may have a positive spin-off in reducing petroleum product prices. The GOJ has no problem in going along with this specific recommendation except to indicate that the effects of any proposed change in specifications has to be properly evaluated with agreement between the various marketing companies and major end users.

In regards however to other World Bank proposals relating to the import parity price formulae, our own evaluation is that they are a number of inaccuracies as outlined in our detailed response to the 'working draft' report.

5. Conclusions

5.1 The draft report adequately covers the various study objectives outlined in the 'Terms of Reference' for the ESSIPS and

contains enough pertinent information to allow for long term strategies to be adopted by the GOJ for this sector. However, based on the presentations in the 'working draft', Zia Mian's Back to Office Report and the 'draft' reports we have a concern that some of the principal recommendations in the final 'draft' report are inconsistent and often contradictory with the Bank's own analyses and recommendations in previous Bank draft reports.

Specifically, the recommendation for an open import policy for petroleum products is inconsistent with the results of the least cost study. In addition, the implicit assumption made by the Bank that petroleum product imports can be divorced from crude oil purchases and refining cannot be supported by technical or economic criteria.

- 5.2 The GOJ notes the Bank's analysis support the conclusion that the refinery remains the least cost source of supply for the country (of the order of US\$ 14 million/year) in addition to earning additional foreign currency cash flow benefits under the San Jose Accord.
- 5.3 The GOJ also concurs with the Bank's recommendation on examination of product quality specification changes to bring them in line with Jamaican requirements. The GOJ notes however the necessity that consensus on the proposed changes will be required of the principal parties involved in the sector; marketing companies and consumers.
- 5.4 The GOJ will pursue its plans for enacting a Competition and Fair Trade Practices Act as noted by the Bank.
- 5.5 The issues raised by the Bank for adjustments to the import parity price formulae are not conclusive and need to be further discussed between the relevant Government agencies and the World Bank consultants.

**B. IMPLICATIONS OF WORLD BANK PROPOSED
PRODUCT IMPORT LIBERALIZATION PLAN**

6. Product Import Liberalization

The Bank has recommended the immediate liberalization of petroleum finished product imports as the primary mechanism to achieve the petroleum sector objectives of the GOJ.

While the GOJ is committed to the principle of deregulation to achieve its objectives, we are concerned that this recommendation, as presented, would not meet the particular objectives set for the petroleum sector. These objectives, as included in the ESSIP Terms of Reference, are:

- "a) to maximize the net economic benefit to the national economy by meeting end use energy needs at the least cost, and by optimizing the participation of Jamaica in the international energy trade.
- b) to further deregulate the power and petroleum sector to encourage greater private sector participation in the operation and financing of sector facilities."

Our concerns are as follows:

6.1.1 Least Cost Implications

The Report has concluded that refining of crude oil is the least cost petroleum procurement mode for the country, earning a NPV of US\$34 million versus importing finished products (even using the questionably low product import cost developed by the Bank).

The Green Draft Report's recommendation, as presented, would result in finished product imports at the expense of crude oil refining. Product importation would therefore lead to an increase in the overall cost of petroleum to the country. This directly contradicts the original objectives of least cost petroleum procurement to the country. ht

The Report also finds that refining results in a foreign exchange savings of US\$1.40/Bbl (approx. US\$11 million per year), since some 45% of the refining costs are Jamaican inputs. We note these savings do not include any benefits derived from the San Jose Accord, estimated in the Report to be worth an additional US\$0.30 per Bbl., or approximately US\$3 million per year. ht

The current recommendation therefore is counter to the original objectives of maximizing the net economic benefit to the national economy via least cost procurement of its energy needs.

6.1.2 Potential Refinery Closure

In the May 30 Bank/Zia Mian meeting, it was suggested that GOJ should be prepared for the possibility that the Refinery could be closed as a result of this recommended policy.

In light of the Report's findings on the viability of the Refinery, we would regard closure of the Refinery as a regressive move, as:-

- I) Closure of the Refinery would shift the sector from a viable manufacturing one, saving scarce foreign exchange, to an import oriented one.
- II) A closed Refinery would severely impact the GOJ's ability to divest it, or to divest it at the best possible price.
- III) Closure of the Refinery would handicap the country in its meeting its objective of participating in the international energy trade.
- IV) The Refinery does generate significant direct and indirect employment, with associated social and political benefits. All other things being equal, the objective of maximizing net benefits to the country would be better met using local labour and inputs than, in effect, using U.S. Gulf Coast labour and inputs to provide the same product.

6.2 Other Implications

The above concerns are predicated on the Report's conclusion that refining is the least cost supply option. However, if unrestricted finished product imports were the philosophically desired objective, regardless of the original objectives of the Study, there are some additional concerns with the import liberalization mechanism as recommended in the Report. These concerns are as follows:

6.2.1 Dumping / Unfair Trade Practice

Petrojam has expressed concern that the proposed import liberalization would allow the marketing companies to drive it out of business through unfair trade practices.

The GOJ has followed a policy of restricting Petrojam from direct marketing (GOJ segregated the marketing arm, Petcom, from Petrojam in 1989), except in a few special areas. Petrojam therefore currently has virtually no market outlets of its own to dispose of its production. The marketing companies however, have the market outlets, and under the import liberalization policy, would also have unrestricted access to supplies.

Under an immediate liberalization of imports, the marketing companies could bankrupt the refinery by intentionally importing finished products for a few months, irrespective of whether the Refinery prices are competitive with the import prices. The products would not necessarily have to be imported at less than fair market value, i.e. dumped. Also, as the marketing companies would be purchasing from their overseas affiliates, they would have flexibility in setting the transfer price at which the product enters Jamaica. Under these circumstances, a fledgling Anti-Trust unit would have great difficulty in proving unfair trade practices. In any event, in as complex a case as this hypothetical one, by the time any finding could be determined, the result would be purely academic to the, by then defunct, Refinery.

For the sake of providing a level playing field, it may be more appropriate to provide an interim period during which Petrojam could attempt to develop alternative marketing outlets.

A real situation incidentally currently exists which highlights the potential for intrinsically unfair practices. The marketing companies have long shown their propensity for acting as a cartel in the Jamaican market. Since decontrol of prices, they have virtually quadrupled their marketing margins, going from J\$0.53/IG to about J\$2.00/IG. Such a large (and remittable in foreign exchange) margin, and which the Bank's Study has ignored, could certainly support a low transfer price from the marketing company's overseas affiliate, thus masking the true foreign exchange cost to Jamaica.

6.2.2 Competition at Product Import Level

We are concerned that, under the import liberalization policy as proposed by the Report, there would be insufficient competition at the import level to ensure that the maximum benefits of this deregulation accrues to the country.

If the petroleum marketing companies were totally local companies purchasing products from an unaffiliated seller, market forces would dictate that they import at the lowest achievable price in order to maximize their local profits.

In Jamaica, the petroleum market is almost entirely dominated by Shell, Esso, and Texaco. These companies are integrated refining and marketing companies, and would in all probability purchase product from their overseas affiliates. Their corporate profit is determined by this purchase price and the final sales price, in this case, at the retail level in Jamaica. The transfer price imputed upon entry into the country does not affect their overall profit, but only affects the distribution of the profit between the overseas affiliate and the local marketing arm. Unlike a purely local marketing company, the integrated company's corporate interests do not necessarily coincide with the country's national interest.

To achieve the objective of maximizing benefits to the economy, a more competitive arena would be required

6.2.3 Security of Supplies

The Report fails to address the issue of ensuring reliable petroleum supplies. As product runouts would wreak havoc on most sections of the economy, this objective must be addressed before any new petroleum regime can be considered.

It should be noted there currently exists an arrangement with the Venezuelan national petroleum company, PDVSA, where deficit products can be accessed as necessary at competitive prices, and, additionally, with the full benefits of the San Jose Accord.

C. ADDITIONAL COMMENTS - PRICING FORMULA

7. Summary

Petrojam strongly disagrees with some of the comments made in the Report on the elements in the pricing formula. Their previous detailed response addresses those included in the original working draft. Following is a summary of some of these responses as well as responses to additional comments made in the Green Draft Report. The numbers refer to the paragraph in which they appear in Vol. 1 of the Report

- 2.5 "... the formula pricing arrangement should be based on Platt's spot price quotes for U.S. Gulf Coast or Caribbean market whichever is lower."

The Report contradicts itself as it also states: "The Caribbean spot market, though quoted in Platts, is presently too thin to serve as a reliable price reference; It is seldom used .. "

- 4.5 "The ex-refinery pricing formula was established in November 1988....."

The Pricing formula was established in 1962 when Esso built the refinery and has been modified periodically, the last review being November, 1988.

- 4.9 "Some of the current specifications have been established to compensate for inadequate quality control outside the refinery as in the case of octane rating for gasoline."

Not true.

- 4.11 "Petrojam produces a 95 RON gasoline, required by only a small percentage of cars"

While this is true in N. America, we are unsure the same is true in Jamaica where a significant proportion of cars are older models or European, both of which require higher octane. This is why Petrojam initiated a motor car population survey prior to the ESSIP study to determine the optimum octane for Jamaica.

- 4.14 Automotive diesel quality: "the present specification is 45 cetane index for which no justification can be found."

The 45 cetane specification has been in place since the Refinery inception and was an Esso specification. The Jamaican fleet contains a high proportion of older, European and Japanese diesel engines, which require higher cetane. See comment on motor vehicle survey above.

- 4.18 Jet fuel quality: "... one Int'l airline requires the stringent DERD specification costs about US\$0.30/Bbl more than the standard ASTM USA grade recommended that the standard ASTM grade be adopted ... "

The previous World Bank Consultant insisted on DERD. If the marketing companies agree, Petrojam will supply this grade only.

- 4.18 Heavy fuel oil "... the price of the fuel is determined by its value as a catalytic cracker feedstock ... "

Not true. Price is based on U.S. Gulf Coast price adjusted from the 300-350 viscosity U.S.G, quality to the 200 viscosity req'd by JPS.

- 4.21 "The acquisition differential includes a parcel size adjustment for all products in the acquisition cost. On a planned import basis of fully fungible material readily obtainable in the USGC market, mixed cargo vessels of 200-300Kbbl would be used and should not incur a premium."

NO parcel size adjustment is made for HFO or LPG. The FREIGHT RATE (NOT the parcel size adjustment) for gasoline, kerosene, and diesel was based on 250Kbbl vessels, and two port loading because the products are currently not fungible. The parcel size adjustment is intended to reflect the premium charged by suppliers for small (70-75KBbls) instead of the more normal 200-300Kbbls single product sale.

- 4.23-6 Ocean Freight: "These (formula freight rates) are \$12.25 per long ton for clean products and \$7.15 for dirty products. These (freight) rates are equivalent to some 390% of WORLDSALE (WS) for clean and 230% WS for dirty (products), using a 1991 WS rate of \$3.10 per MT for USAC to Kingston."

"An analysis of the average dirty vessel market rates during 1989 and 1990 ... the average SPOT rate for 30,000 DWT size was 220 WS ... a maximum clean vessel rate of 250 WS would have applied ... "

The 1991 WS rate for USAC to Kingston is \$3.56 per metric ton. The assessed freight rates as computed by the Bank is not consistent with the ACTUAL freight fixtures experience of the various charterers in the region, as reported in various shipping publications.

The freight rate for clean products in the formula contains an adjustment as previously noted for two port loading, because the Jamaica quality is currently not fungible.

This has been addressed at length in the original response. However, the Green Draft additionally contains a comparison of the ESSO/Shell Mobay terminal charges.

"The total charge in the present price structure for the terminal/rack combination is US\$1.12/Bbl The much smaller ESSO and Shell operation in Montego Bay charge US\$1.00 to US\$1.05/Bbl for total terminal and rack fees."

The ESSO/Shell charges cited cover tankage facilities only, i.e. the user procures his own product, shipping, accepts product losses, risk of contamination, insurance, inventory carrying costs etc. The Petrojam fee includes includes these factors. For the service comparable to that provided by Petrojam, Shell charges US\$2.50/Bbl.

Ministry of Mining and Energy

36 Trafalgar Road
Kingston 10
Jamaica W.I.

Telephone: (809) 926-9170-9
Fax: (809) 929-6005

FACSIMILE

Date : 8th November, 1991
To : Hon. Eli Matalon
Company : Petroleum Corporation of Jamaica
Fax no. : 929-2685
From : Hon. Horace Clarke

Brief Message : Re: Aide Memoir - Against the background response,
carefully draft a response to the Aide Memoir,
indicating the changes needed based on inaccuracies a
"Lease Cost" acceptance of the Refinery.

This message consists of _____ page(s) including this sheet.

Do it now! Energy Conservation Can't Wait.



PETROJAM LIMITED

96 MARCUS GARVEY DRIVE, P.O. BOX 241, KINGSTON, JAMAICA
Cable Address: Petrojam 2119, Tel: (809) 923-8611-5/923-4740-9/923-8814-13 Fax: (809) 923-5698



November 5, 1991

Hon. Horace Clarke
Ministry of Mining and Energy
36 Trafalgar Road
Kingston 10

Please note attached draft of the petroleum section of the World Bank's draft Aide Memoir that includes responses by Petrojam. For easy reference, the relevant sections of the draft by the World Bank is also attached.


H. J. Fenton
Managing Director

CCF:mp

Copy to:

Hon. Eli Matalon	-	Petroleum Corporation of Jamaica
Mr. Noel DaCosta	-	Desnoes & Geddes
Mr. Arthur Geddes	-	Ministry of Mining & Energy
Mr. C. Chin Fatt	-	Petrojam
Dr. K. C. Peart	-	"
Mr. M. Hewett	-	"
Mr. R. S. Jones	-	"
Mrs. A. Nembhard	-	Petroleum Corporation of Jamaica
Mr. Tony Hylton	-	Prime Minister's Office

Petroleum Sector

5. PCJ/Petrojam presented written comments to the Mission which were discussed at both the Sept. -17 meeting and subsequently. Factual technical points were noted for correction in the final report. The fundamental policy issue, concerning the apparent contradiction between least cost petroleum procurement (refining) and liberalization of petroleum imports, could not be resolved during discussions. The analysis in the ESSIPS report shows refining in Jamaica under conditions of maximum efficiency and optimum utilization of capacity to be part of the least cost solution but vulnerable to loss of domestic market. Upgrading through the addition of a catalytic cracking unit would make it competitive in export markets.

6. PCJ/Petrojam contends that immediate removal of the protection to the refinery would permit international petroleum companies to engage in predatory imports (regardless of whether refinery prices were competitive), that could not be detected under the Anti-Dumping Act or the forthcoming Competition and Fair Trade Practices legislation because of vertical integration of the marketing companies and could lead to the closure of the refinery. Petrojam contends that structural deficiencies in the Jamaican petroleum marketplace, eg., oligopolistic tendencies and small size need to be addressed in any recommendations seeking to further liberalize petroleum imports. Specific proposals were made by Petrojam including a 'phase-in' period of 36 months to allow Petrojam time to develop local market outlets and thus be able to compete on an even footing with the international petroleum marketing companies. The idea of a decreased protective tariff on product imports during the phase-in period was also discussed.

7. The introduction of the legislated common carrier terminaling was also considered by PCJ/Petrojam to be prejudicial to the refinery, and would require yet another Governmental intervention, and institution, in the marketplace. PCJ/Petrojam felt that such arrangements should be left to negotiation between the marketing companies and themselves. The Mission responded that based on growing worldwide experience, the Bank has found the common carrier approach as a viable means of increasing competition. Terminaling fees would be set to recover investment costs including a return on capital.

8. In response to points raised by PCJ/Petrojam (i) that the refinery has been very efficient in its operations and (ii) that savings of US\$20 million would be lost if the refinery were closed, the Mission prepared a letter to the Minister MME (dated September 23, 1991) which presented the results of an analysis of the refinery operation in the business as usual case (minor upgrading, no new investments) at optimum and historical levels

of capacity utilization. Based on current volumes and prices, there would be little savings in the (in the order of 2.5% of total product supply cost or US\$4.7 million) between optimum refining (at 83% capacity utilization) and 100% product imports. More significantly, refining in the business as usual case, if based on the average historical level of utilization (48%) would be more expensive by US\$1.1 million than full product importation. Benefits under the San Jose Accord would be US\$3-4 million in each case and would accrue to GOJ regardless of refinery ownership or product importer. Furthermore it should be noted that with liberalization of the petroleum sector, Petrojam would be free to expand into downstream distribution particularly in transportation fuels. At present it has access to over half the non-bauxite market to JPS and bulk supply customers other than the marketing companies for which no retail network is required.

PCJ/Petrojam subsequently responded to the Mission's letter by writing to the Minister of Mining and Energy indicating:

- (i) A steadily increasing historical trend in refinery utilization to a current 68%;
- (ii) that under liberalized importation, importers would not necessarily import from Venezuela and therefore the bulk of the San Jose Accord benefits would be lost. Nor is it certain that Venezuela could supply the full finished products requirements given that country's other commitments;
- (iii) emphasizing the additional foreign exchange saved due to the local content in the oil refining process, and indicating a total foreign exchange savings in the region of US\$9-10 million even under the underutilized (48%) capacity scenario.
- (iv) The only significant bulk customer apart from JPS is Kaiser Bauxite using a small amount of fuel oil.

9. PCJ/Petrojam undertook to prepare a paper to MME concerning the issue of liberalization of petroleum imports. MME, on behalf of GOJ, will inform the Bank concerning the GOJ's position. The Bank agreed to be guided by these comments in the final report following review within the Bank.

**WORLD BANK/UNDP
ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)**

ENERGY SECTOR STRATEGY AND INVESTMENT PLANNING STUDY MISSION

September 16 - 27, 1991

AIDE MEMOIRE

1. A World Bank mission consisting of Messrs. Joseph Gilling, Sr. Energy Economist and William Matthews, Petroleum Specialist, (consultant) visited Kingston during the period September 16-20, 1991 to present the green cover draft ESMAP report of the ESSIP Study and to receive the comments from GOJ officials. During the week of 23-27 September, Mr. Gilling worked with MME and JBS staff concerning ongoing and proposed energy efficiency projects to be included in future ESMAP assistance. The mission wishes to express its gratitude for the close collaboration and assistance provided by officials of GOJ and the sector entities.
2. A Minister's Steering Committee (MSC) meeting chaired by the Minister Mining and Energy was held September 17, 1991 to present the report to officials of GOJ and subsector entities (MME, BOJ, NIBJ, PIOJ, PCJ, Petrojam) and UNDP. Additional meetings were held to discuss specific subsectors and clarify factual points. Messrs. Abderramane Megateli, Sr. Financial Analyst PSED project (LA3IE) and Graeme Thompson, Country Officer (LA3C2) of the Bank's Regional Operations Department attended the MSC meeting and participated in several meetings of the mission. A list of MSC meeting participants is attached.
3. The Mission pointed out that the report had been prepared as an ESMAP report and reviewed in the working draft stage in Washington with the Bank's Regional staff and the Energy Advisor MME following circulation for comment by GOJ and sector officials. This procedure had been established at the request of GOJ in the Terms of Reference for the study but was not the norm for the preparation of Bank reports which, as a general rule, are not presented to Government until they have been reviewed internally by the Bank and reach the green cover stage. Shifts in recommendations, particularly regarding the pace of liberalization of importation in the petroleum sector, were therefore evident in moving from the working draft to the green cover report. The emphasis on liberalization reflects the thrust of the phased program of economic reforms which has been established between GOJ, IMF, and World Bank.
4. Key elements of the reform program outlined by the Bank's Country Officer include liberalization of foreign exchange (recently undertaken) and trade policy (reduction in Common External Tariff), tax reform (introduction of GCT), acceleration of the privatization process through the divestment of public sector enterprises, and deregulation with improvements in the legal framework to ensure transparency of the process. The commitment of GOJ to divestment of energy sector enterprises was confirmed during a

meeting with NIBJ. Technical assistance funds for the preparation of the PSED project will be made available for the detailed work required for the privatization of energy sector corporations.

Petroleum Sector

5. PCJ/Petrojam presented written comments to the Mission which were discussed at both the September 17 meeting and subsequently. Factual technical points were noted for correction in the final report. The fundamental policy issue concerning the liberalization of petroleum imports could not be resolved during discussions. The analysis in the ESSIPS report shows refining in Jamaica under conditions of maximum efficiency and optimum utilization of capacity to be part of the least cost solution but vulnerable to loss of domestic market. Upgrading through the addition of a catalytic cracker would make it competitive in export markets.

6. PCJ/Petrojam contend that removal of the protection now provided to the refinery before upgrading would permit international petroleum companies to engage in predatory pricing that could not be detected under the Anti-Dumping Act or the forthcoming Competition and Fair Trade Practices legislation because of vertical integration of the marketing companies and could lead to the closure of the refinery. Petrojam, however, could protect itself against this possibility by securing long term sales contracts with its bulk supply customers including the marketing companies.

7. The introduction of common carrier terminalling was also considered by PCJ/Petrojam to be prejudicial to the viability the refinery because it would remove the necessity for the marketing companies or other importers to invest in tankage. The Mission responded that based on growing worldwide experience, the Bank has found the common carrier approach as a viable means of increasing competition. Terminalling fees would be set to recover investment costs including a return on capital.

8. In response to points raised by PCJ/Petrojam (i) that the refinery has been very efficient in its operations and (ii) that savings of US\$ 20 million would be lost if the refinery were closed, the Mission prepared a letter to the Minister MME (dated September 23, 1991) which presented the results of an analysis of the refinery operation in the business as usual case (minor upgrading, no new investments) at optimum and historical levels of capacity utilization. Based on current volumes and prices, there would be little saving in the (in the order of 2.5% of total product supply cost or US\$4.7 million) between optimum refining (at 83% capacity utilization) and 100% product imports. More significantly, refining in the business as usual case, if based on the average historical level of utilization (48%) would be more expensive by US\$1.1 million than full product importation. Benefits under the San Jose Accord would be US\$3 - 4 million in each case and would accrue to GOJ regardless of refinery ownership or product importer. Furthermore it should be noted that with liberalization of the petroleum sector, Petrojam would be free to expand into downstream distribution particularly in transportation fuels. At present it has access to over half the total non-bauxite market to JPS and bulk supply customers other than the marketing companies for which no retail network is required.

9. PCI/Petrojam undertook to prepare a paper before the departure of the mission outlining its recommendations to MME concerning the issue of the liberalization of petroleum product imports. MME on behalf of GOJ will then inform the Bank concerning the Government's position which will be noted in the final report following review within the Bank.

Power Sector

10. The Mission met with MME and JPS officials to receive comments on the power sector chapter of the Report. A minor correction will be made to note that while rehabilitation work is now underway, the life extension studies will be deferred as the units must be returned to service as soon as possible. The JPS representative stated that JPS' Board had directed management to assess the options for reducing fuel supply costs. The issues of petroleum product specifications and the direct import of fuel oil by JPS were therefore of particular concern.

11. JPS agreed with the recommendation and requested ESMAP assistance to proceed with the technical studies to assess the feasibility of burning lower quality fuel oil to be followed in a second phase by a review of the possible fuel purchasing arrangements. In addition, JPS supported the recommendation to carryout studies for (i) the Environmental Impact Assessment (EIA) of the proposed coal fired power plant, (ii) a site inventory for other power stations and (iii) the environmental clean-up at existing power stations. While CIDA intends to finance the EIA for the coal station, it has not expressed firm support for the other environmental studies.

12. Concerning the power tariff, JPS noted that fuel cost adjustments were being passed through as required; however, foreign exchange adjustments were not being made and, as a result, the tariff has eroded in real terms since the last major adjustment in May 1990. Approval of the pending tariff application is therefore needed to reestablish tariffs that would improve JPS financial performance and, in addition, encourage energy conservation. Also to support energy conservation, a further submission to CARICOM is planned by GOJ to reduce the CET on fluorescent lighting and solar water heating equipment from 45% to 5%. This equipment has already been zero rated in the GCT schedule.

Energy and Environment

13. A meeting was held with MME, NRCA, Forest Department, NRCD and the mission concerning environmental issues. The Advisor NRCA confirmed that the assignment of institutional responsibilities for energy and environmental issues is correctly outlined in the Report but that a timetable for action remains to be worked out. NRCA intends to put initial environmental standards in place by early 1992 with technical assistance provided by UNDP. A review of the draft Jamaica National Environment Action Plan prepared by NRCA shows that the recommended energy/environment strategy is consistent with the Plan. Financial support and institution building for NRCA remain the key to its implementation and additional assistance is being sought.

14. In connection with biomass fuels, the recommended wood resources inventory is being carried out with CIDA financing and PCJ is also carrying out a biomass survey. This latter activity is being coordinated with MME and other agencies; however, attention is needed to ensure that there is no duplication of effort.

15. With regard to stumpage fees and mechanisms for managing charcoaling and other forest uses, it was noted that studies had been proposed under the National Forest Action Plan (NFAP). The implementation of the bridging project to prepare NFAP for start up is thus essential to addressing the fuelwood related issues. The bridging project is to be funded by UNDP but is still under discussion.

Follow-up Actions on Strategy Recommendations

16. A meeting was held with the MME policy group and World Bank PSED mission to plan follow-up actions on the strategy recommendations. Planning of follow-up action relating to the petroleum import liberalization await agreement on the basic policy. Product specifications can be established, however, without delay as there is agreement on this matter. ESMAP assistance to MME and Jamaica Bureau of Standards (JBS) is proposed as has been provided for the Energy Efficiency Building Code and Appliance Testing programs.

17. Technical assistance to be provided under the PSED project is being identified (para. 4).

18. As twelve months have passed since the liberalization of the distribution and retail trade in petroleum products, it is opportune to review the impact of deregulation on prices and other aspects of the trade in all fuels. It was agreed that MME with ESMAP support should carry out a study in this area.

19. With regard to demand side management in the power sector and the establishment of ENERCO as an energy conservation entity, a joint JPS/MME working group has been appointed to prepare a project proposal for submittal to the Global Environmental Facility (GEF) through the appropriate channels for funding. Before this document can be fully completed, policy decisions are required by JPS and GOJ concerning the nature of tax or other incentives to be given to consumers beyond those already scheduled (para. 12). ESMAP would continue to support the DSM activities concerning the Building Code and Appliance Testing programs currently underway.

20. Follow-up on conservation in transportation will be carried out by MME in conjunction with Ministry of Transport and Town Planning Department.

21. In the household fuels area, it was agreed with the MME policy group that the critical issue relates to ensuring that low income groups have access to basic energy needs at affordable prices. Recommended follow-up actions as presented in the draft ESSIPS report would therefore be combined to address this problem. As part of the study on the retail trade in petroleum products, particular attention would be paid to the distribution and pricing of kerosene and LPG as being done for charcoal. Alternative

methods of targetting the kerosene subsidy would be reviewed as well as the level of the subsidy to meet social and environmental objectives.

22. Concerning environmental follow-up actions, preparations for establishing NRCA are in progress (para. 13). A formal submission to CIDA is in preparation by JPS concerning the Environmental Impact Assessment for the coal fired power plant. A similar submission based on terms of reference provided in the ESSIPS report concerning island wide baseline atmospheric emissions and power generation site inventory is also needed and should be made along with the request for funding for the coal plant EIA.

23. Engineering studies for the environmental clean-up at JPS power plants and the refinery are proposed for ESMAP support.

Finalization of ESSIPS Report

24. After the report is revised to reflect the comments of GOJ as received during these discussions and has been cleared by the Bank, the report will be finalized and published. Four hundred copies will be sent to MME and 100 to UNDP.

ESMAP Country Program for Jamaica

25. Funding for the ESMAP program in Jamaica for the next two years will be obtained following submission of the Country Program Paper to the annual donors meeting in November. The Program Paper is being prepared for review within the Bank and by GOJ based on the agreements outlined above.

Hon. Horace Clarke
Minister of Mining and Energy
Government of Jamaica

Joseph Gilling
Sr. Energy Economist
World Bank

27 September, 1991.

MINISTER'S ENERGY STRATEGY STEERING COMMITTEE
 - MEETING
 SEPTEMBER 17, 1991

List of Participants

Minister Horace Clarke	H.M.M.E.
Hon. Eli Matalon, O.J.	P.C.J.
Mr. Godfrey Perkins	M.M.E.
Mr. Peter Black	P.C.J.
Mrs. Andree Nembhard	P.C.J.
Mr. Pete Fenton	Petrojam
Dr. Keith Peart	Petrojam
Mr. Michael Hewitt	Petrojam
Mr. Tony Hylton	Policy Review Unit
	O.P.M.
Mr. Clifton Brown	P.I.O.J.
Miss Bevon Morrison	M.M.E.
Mr. Fernando DePeralto	B.O.J.
Mr. Basil Sutherland	J.P.S.Co. Ltd.
Dr. Ted Aldridge	M.F.D.P. Environmen
Mr. Abderrahmane Megateli	World Bank
Mr. Graeme Thomson	World Bank
Mr. Joseph Gilling	World Bank
Mr. Zia Mian	Energy Policy Adviser
	M.M.E.
Mr. William Matthews	Consultant, World Ban
Ms. Angela Tormin	U.N.D.P.
Mr. Amir Dossal	U.N.D.P.
Mrs. Joan McCalla	M.F.D. & R.
Mr. Chris Chin-Fatt	Petrojam
Ms. Patricia Shako	N.I.B.J.
Mr. Alwyn Brown	P.C.J.
Mrs. D. Whitely	M.M.E.
Dr. Arthur Geddes	M.M.E.



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September 27, 1991.

The Hon. Horace Clarke
Minister of Mining and Energy
38 Trafalgar Road
Kingston 10

Dear Minister,

We have received a copy of the September 23 letter sent to you by Mr. Gilling of the World Bank, and would like to add the following comments to his letter (a copy of which is attached).

- 1) The Table indicating the net TOTAL cost to Jamaica, wherein some US\$6 million per year in additional costs has been incurred due to underutilization of the Refinery over the past five years, underscores the importance of Refining versus finished product importation.

The recommendations as presented in the report for carte blanche import liberalization can only lead to decreased Refinery utilization, and attendant increased cost to the Country. We are in principle in agreement with deregulation. However, in this particular circumstance, we clearly see the mechanism (import liberalization), and the cost, but cannot see what gain or objective is to be accomplished by it.

- 2) Refinery utilization, particularly over the last five years, has been less than desirable for a variety of reasons detailed in our original response to the Bank's Working Draft.

However, presenting the average only is misleading. Attached is the historical utilization abstracted from the Bank's own report, and updated for the first five months of fiscal 1991. The data shows a continuous and consistent increase in utilization from a nadir of 38% in 1987 to a current utilization of 68%. This compares to the average of 48%, and the ideal situation of 83%.

Additionally, the Bank had confirmed the identification of one of the Refinery processing units, the Reformer, as being the major bottleneck in utilization. Our Reformer Upgrade Project, to eliminate this handicap, will be completed by year end.

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- 3) The letter suggests that since the US\$3-4 million San Jose Accord benefits are applicable to finished products, this savings is immaterial to total petroleum costs.

However, this saving accrues to the GOJ only. Under the recommended import liberalization, there is no incentive for importers to source product from Venezuela versus other supply options. It is therefore probable that the bulk of this saving would be lost to the country.

- 4) We note that neither the Letter nor the Report disputes the significant foreign exchange savings incurred by Petrojam.

The World Bank letter characteristically omits to mention that - even at the underutilized level indicated in the Letter, the 45% of the US\$13.9 million that is local costs, or approximately US\$6 million per year, in addition to the Accord benefits of US\$3-4 million, still add up to a significant US\$9-10 million per year of foreign exchange savings.

- 5) It also ought to be pointed out that the World Bank in this latest aspect of its study and report is using current prices of feedstock and products at a time when margins are much lower than they would be on a year average basis. However, despite this, as mentioned in 4) above, there are appreciable savings involved, as even US\$9-10 million per year of foreign exchange savings is substantial for our country.

As a final note, we wish to state that we have no dispute with deregulation or the Bank. Our only interests are that whatever Report is finally issued should be totally accurate, and that the recommendations therein should pragmatically be in the best interests of the nation.



H. J. Fenton

Managing Director

Copy to:	Hon. Eli Matalon	Petroleum Corporation of Jamaica
	Mr. Godfrey Perkins	Ministry of Mining & Energy
	Mr. Arthur Geddes	" " " " "
	Mrs. Andree Nembhard	Petroleum Corporation of Jamaica
	Mr. C. Chin Fatt	Petrojam
	Dr. K. C. Peart	"
	Mr. M. A. Hewett	"
	Mr. R. S. Jones	"
	Mr. Tony Hylton	Prime Minister's Office

JAMAICA
ENERGY SECTOR DEREGULATION AND PRIVATIZATION PROJECT

Consultancy Services

Deregulation of the Petroleum Subsector and Privatization of Petrojam

Terms of Reference

I. Background.

1. The petroleum sector in Jamaica is divided at present between private marketing companies (affiliates of multinational oil companies) and the government-owned Petroleum Corporation of Jamaica (PCJ). The marketing companies own a number of storage and distribution facilities and domestic retail sales of petroleum products. PCJ, through its subsidiary Petrojam Limited, owns and operates the sole refinery and has a *de facto* monopoly on the import of crude oil, while PCJ has a *de facto* monopoly on the import of refined petroleum products. This monopoly is due to prohibitive import tariffs applicable only to private importers (i.e., marketing companies) while imports of Petrojam are exempt.

2. Petrojam operates a 36,000 barrels per day refinery located adjacent to Kingston Harbour. It was established in 1982, when the refinery was acquired from Esso by the Government. Petrojam, while 100% Government owned, operates as an independent organization, itself having several subsidiaries and operating and service divisions. It is a simple hydro-skimming unit built in 1963 in Kingston.

3. As part of its ongoing liberalization and privatization programs, the Government has decided to further deregulate the sector and has approved Petrojam as an entity to be privatized. The proposed privatization of Petrojam and deregulation of the petroleum subsector are consistent with the energy sector strategy of the Government, which promotes a greater role for the private sector, effective management of energy sector entities and deregulation of the sector. The objective of the Consultants' work is to help define the specifics of this strategy and organize the preparatory steps towards its implementation.

4. **Privatization.** The Government of Jamaica has sustained a successful privatization program since the early 1980s. Privatization of the remaining public entities and assets has a high priority in the Manley Government's agenda. In early 1990, the Government announced its decision to undertake a far reaching accelerated privatization program to (i) reduce the size and role of the public sector, particularly in commercially oriented activities; (ii) increase private sector participation and competition in the economy; (iii) improve efficiency; (iv) reduce the financial drain on the budget; (v) encourage foreign capital and technology inflow; (vi) ensure high quality of service and (vii) widen the base of private ownership. The Prime Minister Paper issued in July 1991, spelled out the strategy, objectives, and institutional arrangements to implement the new privatization program. The Ministry Paper also contains a list of 67 public entities/assets, approved by Cabinet for privatization over the next few years. Petrojam has been specifically identified by the Government as one of the public sector entities to be privatized.

5. In the new privatization process, the Cabinet has overall responsibility for the approval and review of the privatization program and policy. A committee of the Cabinet, called the "Privatization Committee" has been established to propose modalities to be employed for privatization and final acceptance or rejection of offers. The National Investment Bank of Jamaica (NIBJ) is delegated as the central implementing agency for privatization by a cabinet decision. New procedures also allow for the establishment of "special enterprise teams" involving concerned ministries to work on large and complex privatization cases. In the case of Petrojam, there is a special steering committee established which coordinates energy sector strategy. The committee is called the Minister's Steering Committee and is comprised of representatives from the Ministry of Public Utilities, Transport and Energy (MPUTE), NIBJ, the Ministry of Planning and Finance, Planning Institute of Jamaica, Bank of Jamaica, Office of the Prime Minister, the Office of the Attorney General, PCJ, Petrojam and Jamaica Public Service Co., and chaired by the Minister of MPUTE.

6. Deregulation/Liberalization in the Petroleum Subsector. Parallel with its privatization program the Government has been deregulating the economy to create an environment conducive to private sector development and increase competition. The Government has already taken a number of significant steps to dismantle import monopolies, remove price, investment and import controls and reduce import duties and taxes. In the petroleum subsector previous steps included the deregulation of distribution and retail margins, allowing distribution companies to set their own wholesale and retail prices. However, Petrojam continues to fix ex-refinery prices.

7. The monopoly position of the PCJ derives from legislation¹ which provides PCJ and Petrojam certain privileges and tax exemptions. Under the present regime, while Petrojam enjoys exemptions from import taxes and duties, all other importers are subject to prohibitive taxes and duties. Petrojam sets ex-refinery prices on all products using pricing formulae based on USGC prices, which are at present adjusted on a weekly basis.

8. Moreover, despite the deregulation of domestic margins, there may still be other regulatory and legal barriers to entry and competition downstream i.e., tankage/storage, transportation and distribution wholesale and retailing stages. Increased competition among suppliers is an important aspect of the deregulation process.

9. Another important issue to be considered in the context of deregulation/privatization is an assessment of benefits from existing San Jose Accords for crude oil refined products imported from Venezuela and Mexico and the potential for the continuation of such benefits after taking into account alternative supply sources in the international market.

10. ESSIPS Study and Other Background Information. A recently completed Energy Sector Strategy and Investment Planning Study (ESSIPS - September 1991), commissioned by the Government to the World Bank's ESMAP group should serve as reference and provide substantial background material for the present study. Moreover, audited financial statements of Petrojam for past years and other relevant documents will be made available to the consultants for the privatization strategy part of this work.

¹ Including the Petroleum Act of 1979, the Petroleum Refining Industry (Encouragement) Act of 1963 and the Petroleum Refining and Industry (Recognized Refiner, Petrojam Ltd.) Order of 1991, which is made under the 1963 Act.

II. Objectives and Scope of the Study.

11. Objectives. In response to the Government's request, the present study will be undertaken with the support of the Bank in preparation of the privatization of Petrojam and liberalization/deregulation of the petroleum sector. The results of the study will also serve as input for two proposed Bank operations (Energy Sector Deregulation and Privatization Project and the Private Sector Development Adjustment Loan), both of which will be presented to the Board mid-1992.

12. There are three main objectives for the study. First, to determine the steps necessary to eliminate Petrojam's import monopoly and establish a competitive, non-protected petroleum products sector at the import, refining, transport, distribution, wholesale and retailing stages. Second, to determine appropriate, transparent market-based pricing principles which do not compromise GOJ's current fiscal objectives. Third, to develop a privatization strategy for Petrojam consistent with its efficient operation in a competitive environment.

13. The study will consist of two parts (which require different types of skills), dealing respectively with: (I) the Regulatory Framework for the petroleum sector and Pricing Policy and (II) Privatization Strategy for the refinery. Since there is some degree of interdependence between Part I and Part II of the study, while the preparations could begin simultaneously, the results will have to be integrated (a) to assess alternative privatization strategies in the deregulation context and (b) to review specific deregulation steps in light of their impact on the privatization process.

Regulatory Framework: The objective is to promote competition in the petroleum sector by establishing a sound regulatory framework and avoiding any *de facto* or *de jure* import monopolies, prior to the privatization of Petrojam. This is important so that the privatization takes place within the new regulatory framework and thus avoids creating a protected private monopoly. Transparency in the policy, legal and regulatory environment in the petroleum sector is essential to avoid a loss of benefits to the economy. A clear, well-defined legal/regulatory environment as well as pricing principles, are also needed to provide assurance both to the new owners of Petrojam and the private distribution companies that their future investments will not be subject to discretionary treatment in the future.

Privatization Strategy: The objective is to develop within the reformed regulatory framework a strategy for the privatization of the refinery including the necessary preparatory work (e.g., valuation and preparation of a draft prospectus) and exploring various options with respect to the modalities and methods of privatization, as well as an implementation schedule for the privatization.

14. Scope: The actual transaction of offering the refinery for sale through a bidding process will not be a part of this assignment, but will be managed by consultant(s) selected through a competitive, transparent process supervised by the Bank. In addition, an environmental Audit will be done in parallel as preparatory work for privatization under separate TOR, which will be finalized by March 15, 1992.

Part I: Regulatory Framework

Task A: Concerning the import and pricing regime for crude oil and petroleum products, the consultants will:

(a) analyze the existing regulations and legislation and other agreements (such as San Jose, and CARICOM - Common External Tariff, CET) concerning imports of crude oil and petroleum products to identify the existing regulatory provisions which led to the de facto monopoly of Petrojam, and other impediments to free imports of petroleum products and crude oil on the competitive basis.

(b) determine steps/modifications/amendments needed to implement the following import policy: modifying existing import taxes and duties such that all petroleum products and crude oil are subject to a single uniform import tariff (say, within the range of 5%-20%) while all other restrictions to petroleum imports are eliminated and all potential importers including Petrojam become subject to the same import tariff level, eliminating any room for discretion. Examine the impact of such a tariff structure and import regime on the competitiveness of a privatized refinery, consumer prices and the level of competition in the importing and distribution stages of petroleum products. Also determine adjustments needed in other domestic excise and other special taxes to secure revenues for the GOJ as consistent with its fiscal objectives.

(c) review existing pricing formulae for determining ex-refinery prices of petroleum products and the implications of introducing a fully-market determined price regime in line with international markets. Based on this review, establish and propose the basic principles for a new pricing mechanism.

(d) assess the likelihood and possibility of dumping of petroleum products, by reviewing trade practices in the petroleum subsector and legal safety-net provided by the Anti-Dumping Act.

(e) draft new regulations/modifications to existing legislation to implement the new liberalized import (and export) policies applying to petroleum products and to revise pricing principles.

(f) examine in detail the San Jose Agreements and to assess their benefits for the GOJ and the economy as a whole and potential for continuation of such benefits and formulate specific arrangements for the Government to maintain access to the advantages offered while maintaining a competitive import regime and pricing policy.

Task B: Concerning the review of other deregulation issues, the consultants will:

(i) review legislation/regulations and other factors (such as capacity of existing racks/docks, transport and other facilities and market structure) which may cause barriers to competition in the industry at the transport, production, storage, distribution and wholesale and retail marketing stages.

(ii) in particular, assess the possibility of unfair competition practices (price collusion) in domestic distribution under a free import regime, examining the market structure and provisions under the new proposed Competition Act.

(iii) draft regulations and modifications to the relevant legislation to eliminate other remaining barriers to competition at all stages mentioned above.

Part II: Privatization Strategy

Concerning the privatization strategy of the refinery, the consultants will:

(a) analyze options, privatization strategies and modalities for privatization (public share offers, sale as a going concern, ESOPs etc.) of Petrojam. Among other things, the consultants should consider the advantages and disadvantages of selling Petrojam as a unit or in parts (e.g., separating the refinery from other assets such as storage facilities), a public offering of shares vs. sale to a single buyer, and sale through negotiation vs sale through auction;

(b) in particular, study the merits of the following option and compare it to other privatization alternatives from the point of view of (i) increased competition in the sector; (ii) efficient use of existing facilities; (iii) prospects for privatization; (iv) expected sale proceeds: Establishment of an independent storage company assets which would serve all new entrants in the suppliers market (similar to a common carrier status).

(c) based on Petrojam's financial and other relevant audits prepare a valuation of Petrojam. The valuation should assume a completely liberalized trade regime, no new investments by the Government before privatization, and no specific conditions placed on the new owners other than meeting environmental and other regulatory standards. Valuation should be done employing various methods, including future business potential (future income streams), liquidation and recent sales of similar facilities. Results of the valuation exercise will be used solely as a "reference" in setting bidding parameters.

(d) In addition, again assuming a deregulated environment as in (c), assess the net value (if any) of the upgrading scenarios considered for the refinery under the ESMAP study (using future income streams method), which the private investors may find worthwhile. Results should be provided in a form that can be used by GOJ to advertise as appropriate in the sale prospectus.

(e) on the basis of this analysis, recommend the most appropriate strategy, among the available options, for proceeding with the privatization program;

(f) recommend a timetable, specifying all required activities to be completed and policy decisions that need to be taken to bring the refinery to the point of sale and prepare a draft prospectus as well as draft Request For Proposal (RFP) and a bid document that would include criteria for evaluation.

III. Organization

15. The study should be conducted by a major accounting/management consulting firm with extensive, practical experience in the regulation of the petroleum subsector, and the privatization of state-owned enterprises, including oil refining companies. If the firm does not have all the relevant experience and/or expertise to satisfactorily complete either Part I or Part II of the study, the firm could associate with one or more firms and/or individuals who have the relevant experience and expertise to undertake the assignment. The lead firm should have access to, inter alia, the following areas of substantive expertise either in-house or through sub-contractors or associate:

- petroleum sector regulation
- petroleum accounting and auditing
- refinery and process engineering
- petroleum refining operations and maintenance
- refining optimization models
- personnel management
- environmental assessment of oil refinery operations
- economics and financial and valuation modeling in petroleum and refining operations
- organization, management and restructuring
- legal counsel with experience in private refinery operations and privatization
- local accounting and legal requirements.

16. Consultants should indicate how they plan to organize the work in order to reach the objectives and to complete the tasks listed in section 2. In particular, an organization chart, indicating the basic structure, the permanent and temporary staff required and the external technical, legal and financial support needed from the firm or from other firms or consultants will be required.

17. In the process, consultant should submit a master timetable for the privatization process indicating key steps to be taken by the Government and concerned entities. In the process, consultants shall assemble copies of all documents evidencing:

- Right of a tenure to the property occupied
- Trade Union Agreements
- Legislation applicable to the subsector
- Supply contract
- Loan agreements
- Memorandum and Articles of Incorporation
- Licenses
- Documents related to existing tax status of the entity
- Ex-refinery pricing formulae.

18. In performing these tasks, GOJ, PCJ and Petrojam would provide the consultants as much information as possible concerning the legal ownership of Petrojam, quality and types of services currently provided and the characteristics of the work force.

19. It is expected that the consultants would work closely with the Permanent Secretary, Ministry of Public Utilities, Transport and Energy (MPUTE) or its designated person. The Permanent Secretary will be asked to provide a local team consisting of representatives of the National Investment Bank of Jamaica (NIBJ), Petroleum Corporation

of Jamaica PCJ/Petrojam, the Attorney General's Office, and other relevant GOJ agencies which will be responsible for implementing the energy strategy adopted by GOJ.

20. Throughout the study, the consultant should report to Mr. Abderrahmane Megateli of the World Bank in Washington, D.C., U.S.A., Tel. (202) 473-8631. The coordination of the activities in Jamaica will be carried out by Dr. Arthur Geddes, Technical Director, MPUTE, 36 Trafalgar Road, Kingston 10, Jamaica. Tel: (809) 926-9170-9, Fax: (809) 926-2835.

21. During the consultant's visit to Jamaica, MPUTE will provide all the required information to undertake the study and will also provide office space and secretarial support.

IV. Deliverables and Timetable

Part I

22. The study should be performed in the following stages:

(i) The consultant(s) should prepare a report that addresses Part I Task A concerning the import and pricing regime for crude oil and petroleum products and its recommendations. This report should be approximately 40 to 50 pages in length, not including attachments, but include an executive summary of not more than 10 pages. This report should be completed within the following number of days from the date of appointment:

- Submit draft report with recommendations	20 days
- Review by GOJ and the World Bank	35 days
- Submit final report on recommendations	45 days
- Approval by GOJ of recommendations in the study and review by World Bank	60 days
- Approval by GOJ of detailed requirements and deregulation scheme and review by World Bank	80 days

(ii) The consultant(s) should prepare a report that addresses Part I Task B concerning the review of other deregulation issues and draft regulation and modifications to the relevant legislation to eliminate other remaining barriers to entry, exit and competition in the industry at the level of production, storage, transport, distribution and wholesale and retail marketing stages. This report should be approximately 40 to 50 pages in length, not including attachments, but include an executive summary of not more than 10 pages. This report should be completed within the following number of days from the date of appointment:

- Submit draft report with recommendations	35 days
- Review by GOJ and the World Bank	50 days
- Submit final report on recommendations	65 days
- Approval by GOJ recommendation in the study and review by the World Bank	80 days

- Approval by GOJ of detailed requirements and deregulation framework and review by World Bank 105 days

Part II

- (iii) The consultant(s) should prepare a report on the detailed privatization strategy of Petrojam in a deregulated environment and implementation (with a timetable) strategy, as well as a draft Request For Proposal and bid document that would include criteria for evaluation. The report should be about 50 pages in length not including attachments and include an executive summary of not more than 10 pages. The report should be completed within the following number of days from the date of appointment:
 - Submit draft report on proposed strategy and a detailed institutional, strategy and implementation program and timetable to implement privatization 110 days
 - Review by GOJ and the World Bank 125 days
 - Submit final report on strategy and implementation program for the privatization 140 days
 - Approval by GOJ of detailed requirements, and privatization strategy and implementation plan 190 days

Consultants should submit fifteen (15) copies of the draft report and thirty (30) copies of the final report to GOJ and five (5) copies of the draft report and ten (10) copies of the final report to the World Bank.

V. Budget and Fees

23. The consultants should provide a firm fee quote indicating a man-month rate for each category of personnel for each part of the study with a ceiling. Details should be provided for each grade of staff, of the hours and rates on which the quota is based. The split between the local Jamaican and foreign components should also be given. The proposals should include international travel; preparation of interim presentations and reports; legal documents, and the final report; equipment; insurance; office supplies; subsistence allowances; transportation in Jamaica (beyond that provided by PCI/Petrojam the Government); and related expenses.

JAMAICA
ENERGY SECTOR DEREGULATION AND PRIVATIZATION PROJECT

Consultancy Services for Power Sector Regulatory Framework and Privatization of JPSCo.

Terms of Reference

I. Background

1. Public supply of power in Jamaica is dominated by the Jamaica Public Service Company, Ltd. (JPS). The bauxite, cement and sugar industries all have installed generation capacity for self-consumption, and although some of these units are connected to the transmission grid, JPS purchases only minimal amounts from these units. With the exception of this private generation capacity, JPS' monopoly is complete with respect to generation, transmission and distribution systems. The total generating capacity of JPS amounts to 523 MW; including four thermal power stations, with a total capacity of 499 MW (96%), and nine hydro stations, with a total capacity of 24 MW (4%), with minor contributions made by bagasse, peat and fuel wood. In 1990, JPS' net generation and purchases amounted to 1,944 GWh, of which sales were 1,569 GWh. Residential customers accounted for 32% of JPS' total sales, small commercial and industrial consumers accounted for 48%, large commercial and industrial consumers accounted for 11% and other consumers 9%. Losses were approximately 19%, of which non-technical losses ("unaccounted for") were about 9%. Technical losses include losses in transmission lines, substations, distribution and distribution transformers. Non-technical losses include defective meters, incorrect metering, and unregistered consumption. JPS has recently initiated programs to reduce both technical and non-technical losses.

2. JPS was incorporated by foreign investors as a private company in 1923. In 1971, the Government of Jamaica (GOJ) acquired a controlling interest in JPS, and subsequently completed the acquisition of 99% of the issued ordinary capital in 1975. The basic legislation governing the power sector consists of the Electric Lighting Act of 1890 and the Electricity Development Act of 1974. The Electric Lighting Act empowers the Minister to license any authority or company to supply electricity under the Act's provisions within any area on the island, subject to the terms of the license and regulations made under the Act. The Electricity Development Act established the Electricity Authority which under the Act, would function as the authority responsible for power sector development. In addition, the Electricity Authority is authorized to regulate the licence-holding utilities. Under the Electric Lighting Act GOJ granted to JPS, in 1978, a 39-year "All Island Electric License", which gives JPS exclusive rights to provide electricity publicly and obligates JPS to supply electricity to all parts of the island.

3. Originally, JPS was regulated by an independent Public Utility Commission. That Commission was superseded by the Electricity Authority in 1975 following enactment of the Electricity Development Act and the acquisition of the Company by GOJ. Although the Electricity Authority technically still has jurisdiction over JPS, in practice the Company reports directly to GOJ, through the Ministry of Public Utilities, Transport and Energy (MPUTE). JPS provides monthly financial reports to the Ministry, and it is closely involved in financial and investment planning for JPS. JPS files a request for a rate adjustment with MPUTE which then analyzes the request and submits it to the full Cabinet for approval. From 1984-1990, however, there were no tariff increases. This, combined with increasing inflation and devaluation of the Jamaican dollar, resulted in a deterioration of JPS' financial condition by 1989 and in 1989/90, the company had a negative rate of return. The situation improved in 1990/91 following a nominal rate increase of

37% in April of 1990 and the rate of return increased to about 6%, while the debt service cover ratio also improved from 1.75 to 2.10. Recently, another rate increase of about 17% was approved in December 1991.

4. Over the next 20 years, electricity demand in Jamaica is expected to increase at an average annual rate of approximately 4% per year. In order to meet that demand, substantial investment in the power sector will be required. The public sector, however, cannot meet these expansion needs. Accordingly, GOJ has opted to encourage the introduction of the private sector into the provision of electricity, and in 1990, GOJ established a Steering Committee for Private Sector Participation in the Energy Sector in order to coordinate and promote private sector participation in energy development. In the short term, GOJ has already undertaken steps to promote the development of private power plants in Jamaica on a build-own-operate ("BOO") basis. Private investors would establish a project company in Jamaica which would own, finance and operate these projects, and enter into a long-term power purchase agreement with JPS for the supply of power. The purchase of power would be based on a two-part tariff, including a capacity charge and an energy charge, the details of which would be outlined in the power purchase agreement. In order to attract investors, a prequalification notice for the developer of the first such plant, a 60 MW slow-speed diesel plant, was issued in May 1991, and a short list of qualified investors has been finalized. A Request for Proposals will be issued to the pre-qualified investors shortly and the selection of the developer is expected to be completed by April 1992, and the plant to come on line by 1994. GOJ expects to conduct similar solicitation for a 60 MW combustion turbine plant and a 180 MW coal-fired plant during 1992 and 1993.

5. In parallel with GOJ's solicitation of private investors to develop additional capacity, GOJ has declared its intention to privatize JPS. The proposed privatization of JPS, and induction of private power production would require regulation of the sector to ensure economic and efficient operation of the sector, reliable power supply to the consumer, and consistent and independent tariff policy. Independent regulatory oversight will give private investors' confidence and, therefore, help to increase private investment. At the same time, the elimination of the direct link between JPS and GOJ will require effective regulation to protect Jamaican consumers and investors.

6. In an effort to further the initial steps taken by GOJ, this study, consisting of three phases, would be commissioned by GOJ and administered by the World Bank. The first phase of the study would recommend the broad structure and ownership of the power sector and an appropriate regulatory framework for the privatized power sector. The second phase of the study would address the detailed implications of the recommended structure, including the organizations required for the new structure, including the regulatory institutions(s) allocation of assets in the sector, required tariff adjustment mechanism, etc. The third phase of the study would address the implementation program, including the required legislative and regulatory changes, and a detailed strategy, program, and implementation schedule for the privatization.

II. Objectives

7. The objectives of this study are:

- (i) recommend an institutional structure for privately-owned power sector and regulatory regime, which would promote the following objectives:
 - 1. attract foreign and local private capital and broaden local ownership
 - 2. provide efficient and reliable supply of electricity at least cost
 - 3. promote environmentally acceptable operation of the power sector
- (ii) define ownership of constituent utility(ies) as well as a regulatory framework consistent with the recommended ownership structure and required institutions to regulate the sector.
- (iii) prepare a privatization strategy to implement the institutional, regulatory and ownership changes recommended.

III. Scope of Work

Phase I - Broad Structure and Ownership of Power Sector

8. For Phase I of the study, the consultant(s) will be expected to perform the following tasks:

- (i) Review existing studies and any other information sources required to analyze the power sector, including the following aspects:
 - 1. Functions and operational performance of JPS, including its legal status and organization.
 - 2. Financial position and performance of JPS, including condition of the company's assets.
 - 3. Human resources and management of JPS.
 - 4. The current laws and institutional arrangements for regulation and operation of the power sector.
- (ii) Undertake an environmental screening of the existing generation transmission and distribution facilities of JPS to determine potential problem areas, and provide cost estimates associated with the most critical pollution mitigation and clean up activities. The recommendations should be based on World Bank environmental guidelines and should take into account studies being carried out under ongoing Inter-American Development Bank loans which will be available for reference upon completion.
- (iii) Analyze and evaluate the experience of other countries for alternative organizational structures and regulation of privately owned power sectors. Particular emphasis

should be placed on the models and experiences of developing countries with power sectors of similar size and economies at similar levels of development. The following aspects should be investigated:

1. extent of vertical and horizontal integration.
 2. feasibility and nature of potential competition in generation and supply.
 3. ownership options for generation, transmission and distribution.
 4. broad regulatory arrangements required for each alternative institutional and ownership structure.
- (iv) Recommend an organizational and ownership structure for the power sector and propose options and recommend an appropriate regulatory framework for the recommended structure.

Phase II - Detailed Organizational Structure and Regulatory Framework

9. For Phase II of the study, the consultant(s) will be required to perform the following tasks:

- (i) Based on the recommended structure proposed in Phase I, if more than one entity is considered in the recommended structure, develop a plan for creating the new corporate entities with public ownership, and define the following aspects:
1. the organizational structure and functions of the entities in the power sector.
 2. the allocation of existing physical assets and liabilities to each entity and the need for additional physical assets.
 3. the separation of finances and accounts and the need for additional financial resources.
 4. develop detailed specification for new commercial arrangements for the sector.
 5. the allocation of existing human resources to each entity. Identify issues arising in respect of human resources (e.g., pay and conditions, pension arrangements, redundancy provisions, union representation) and make appropriate recommendations.
- (ii) Based on the recommended structure for the power sector, provide a detailed outline of the required regulatory regime. In doing so, the following should be addressed:
1. Identify the institution(s) and institutional structure necessary to administer the recommended regulatory framework.
 2. Define the functions of the regulatory institution(s), including its role in ratemaking, system and least cost investment planning, licensing, dispatch,

maintenance of quality of service, safety, protection of the environment, and dispute resolution.

- 3. Explain the relationship of the regulatory institution(s) and existing governmental entities, and power sector entities including BOO projects.**
 - 4. Define the rights and obligations of the power sector or portions thereof (e.g., generating companies, transmission companies, and distribution companies) vis-a-vis the new regulatory institution(s), and other governmental entities, to BOO projects, and to the public.**
 - 5. Determine detailed guidelines and procedures for performing each of the functions of the regulatory institution(s). In particular, identify the criteria, periodicity, participants and procedures to be involved in ratemaking and investment approvals.**
- (iii) Determine the need for and propose modifications to existing legislation and procedures to implement the recommended regulatory framework.**
- (iv) Prepare detailed 10 year financial projections for the entities included in the recommended structure. Include the following:**
- 1. detailed calculation of revenues expected from each source based on historical data and all available load growth studies, least cost plans and tariff studies**
 - 2. projections of required investment in existing and new facilities based on historical data and all available planning studies for generation, transmission and distribution.**
 - 3. projections of operating and maintenance costs based on historical data and planning studies.**
 - 4. projected balance sheets, income statements and cash flow statements.**
 - 5. financing strategy to meet resources required.**
- (v) undertake an operational efficiency review to identify the scope for improvements, e.g., dispatching, fuel procurement, plant maintenance, local management and conservation, etc.**
- (vi) review tariff levels to identify the extent of variation from efficiency levels, and the nature of any tariff adjustment measures.**

Phase III - Implementation Program

10. For Phase III of the study, the consultant(s) would be required to perform the following tasks:

- (i) Identify the steps that must be taken to implement the recommended structure, including any changes to existing laws and regulations, other than those included in Phase II of the study, which concerns the regulatory framework. Assist in the drafting of new legislation and regulations.
- (ii) Evaluate briefly the feasibility of the different methods of implementing the recommended alternative for privatization of JPSCo.(e.g., sale of shares to the public, ESOP, trade sale of companies or assets, or a combination.) and recommend one or more methods. This should include preliminary estimations of the value of the entity.
- (iii) Identify the required permanent regulatory staff and prepare the job description for professional staff.
- (iv) In the event more than one entity is proposed for the sector, prepare a development plan for each new entity, including transfer of assets, liabilities and employees, contractual arrangements or other commercial arrangements, management development/training needs, etc.

IV. Organization

11. The lead firm should have access to the following areas of substantive expertise either in-house or through sub-contractors or associates:

- power sector regulation
- utility accounting and auditing
- power engineering
- utility operation and maintenance
- environmental assessment of power systems
- personnel management
- utility forecasting
- economists with experience in privatization of the power sector
- legal counsel with experience in private power and privatization
- investment bankers with experience in private power and privatization
- local accounting and legal requirements

12. It is expected that the consultants will work closely with the Permanent Secretary, MME. The Permanent Secretary will be asked to provide a local team consisting of representatives of the National Investment Bank of Jamaica, JPS, the Attorney General's Office, and other relevant GOJ agencies which will be responsible for implementing the strategy adopted by GOJ.

13. Throughout the study, the consultant should report to Mr. David Baughman of the World Bank, Tel.: (202) 473-2085. The coordination of the activities in Jamaica will be carried out by Dr. Arthur Geddes, Ministry of Public Utilities, Transport and Energy, 36 Trafalgar Road, Kingston 10, Jamaica, Tel.: (809) 926-9170-9; Fax: (809) 926-2835.

V. Deliverables and Time Table

Phase I

14. The study should be performed in the following stages:

(i) The consultant(s) should prepare a report that analyzes the current status of the power sector, the models and experience in other countries and recommend an institutional and ownership structure and an appropriate regulatory framework for the power sector. The report should include an executive summary of not more than 10 pages. This report should be completed within the following number of days from the date of appointment:

- Submit draft report with recommendations on an organization structure and regulatory framework for the power sector. 45 days
- Review by GOJ and the World Bank. 60 days
- Submit final report on recommendations. 75 days
- Approval by GOJ of recommendations in study, review by World Bank. 90 days

Phase II

(ii) The consultant(s) should prepare a detailed report that examines the functions, organization guidelines and procedures necessary to implement the framework recommended in Phase I. This report should be about 50 pages in length, not including attachments and include an executive summary of not more than 10 pages. Organizational charts and tables summarizing the material should be included. Any financial models used for financial projections would be subject to review by GOJ and the Bank. This report should be completed within the following number of days from the date of appointment:

- Submit draft report on the detailed institutional, organizational requirements for the recommended power sector structure and the appropriate regulatory regime. 120 days
- Review by GOJ and the World Bank. 135 days

- **Submit final report on detailed requirements for proposed structure.** 150 days
- **Approval by GOJ of detailed requirements and regulatory regime for recommended structure. Review by World Bank.** 165 days

Phase III

(iii) **The consultant(s) should prepare a report on the detailed privatization strategy and implementation strategy including identifying the required staffing and assisting in the drafting of the legislation to implement the proposed structure. The report should include an executive summary of not more than 10 pages. The report should be completed within the following number of days from the date of appointment:**

- **Submit draft report on proposed privatization strategy and a detailed institutional, strategy and implementation program to implement privatization, including staffing required and necessary legislation.** 180 days
- **Review by GOJ and the World Bank.** 195 days
- **Submit final report on strategy and implementation program for the privatization.** 210 days

Consultants should submit fifteen (15) copies of the draft report and thirty (30) copies of the final report to GOJ and five (5) copies of the draft report and ten (10) copies of the final report to the World Bank.

VI. Budget and Fees

15. The consultants should provide a firm fee quote. Details should be provided for each grade of staff, of the hours and rates on which the quote is based. The split between the local Jamaican and foreign components should also be given. The proposal should include international travel; preparation of interim presentations and reports; legal documents, and the final report; equipment; insurance; office supplies; subsistence allowances; transportation in Jamaica (beyond that provided by JPSCo. or the Government); and related expenses.

SALT RIVER
BASELINE STUDY - JPS ENERGY EXPANSION PROJECT
DRAFT
TERMS OF REFERENCE

In order to meet its growing electrical energy needs, Jamaica must construct additional power generation stations, using a mix of power station types and fuels. Some potential sites for such stations have been identified. Baseline studies of the terrestrial, marine, atmospheric and socio-economic environments of each site will provide the government of Jamaica with a better understanding of the environmental and socio-economic sensitivity of the sites so that appropriate protective measures can be taken before and after the decision to build on a site has been made. It will also help to identify a site best suited to a particular power station type. The information will, as well, provide a firm basis for an eventual EIS, once a proponent has been identified and the kind of power plant determined.

The following are general terms of reference only for the proposed Salt River site. They could be applicable to any power site, with site specific modifications as necessary. Detailed terms of reference are to follow.

Purpose

This document sets out terms of reference for baseline studies whose completion will provide information needed as a basis to conduct an EIA at a selected electric power generation site.

Scope of Work

To achieve that purpose, environmental and socio-economic baseline studies will be undertaken in relation to the potential power site identified. The specific extent of the areas to be studied will be determined by the power plant design and transmission line routes.

Environmental baseline data are those data required to determine the nature of, and the biological and socio-economic significance of the biota in the area likely to be impacted by the development. It involves a description of the physical environment as well. Ecological linkages and habitats need definition. It must be emphasized that it is not a complete biological and physical inventory, but must focus on the elements which have scientific, economic and/or social significance.

Socio-economic baseline data gathering would focus on those people likely to be adversely impacted by the construction and operation of the plant.

Because of the seasonal variability of much of the data, the study will need to be conducted over a period of at least one year and will be confined to a pre-determined area of possible impact.

In undertaking the baseline studies, the consultants will:

1. Describe the marine environment, its physical and biological components, including the identification of nurseries, of scientifically or economically important species and functional ecosystem linkages;
2. Describe the terrestrial environment, its physical and biological components, with emphasis on those plants and animals and their interactions of social, scientific and/or economic importance;
3. Obtain meteorological information, for purposes of modelling at a later period, the nature and extent of possible emissions impacts, ground level ambient concentration and wet deposition, such information to include daily average wind speeds and directions (diurnal and nocturnal), ambient levels of SO_x, NO_x, and particulate matter, daily rainfall and prevalence, duration, and dates of occurrence of inversions, and a record of the frequency and severity of hurricanes, seismic activity, or other natural events that could seriously impact the installation.
4. Undertake an assessment of the availability and quality of fresh water required for plant operations.
5. Identify the numbers and distribution, and economic activity of people who could be affected by emissions, or interference with fishing activities or by construction and operations of the plant (construction traffic, influx of workers to communities adjacent to the plant, etc.)
6. Identify other proposed uses of the area which may place constraints on the plant location and design (i.e. proposed park or eco-tourism area).

1. MARINE ENVIRONMENT STUDIES

Physical Environment

Sedimentation and shoreline dynamics studies, wave climate studies (over one year, periodically), current patterns (full tidal cycle). Salinity, density and temperature measurements, mangrove flushing parameters of salt water.

Biological environment

- Identify ecologically, economically or socially important species of invertebrates and vertebrates, and of marine plants;
- For the above species, provide habitat descriptions and important ecological relationships, including spawning and nursery grounds;
- Summarize current and available knowledge about temperature tolerances of the above species, including such tolerances of their important food species.

2. TERRESTRIAL STUDIES

Botanical Studies on Site (i.e., access roads, plant site, ash disposal site, etc.)

General site description

- Plant cover distribution (cover maps)
- Species composition
- Habitat descriptions
- Identification of ecologically, economically or socially important species
- Important ecological relationships described

Note: much of the proposed site, particularly the ash disposal area, is a dead mangrove stand).

Botanical Studies Off-site (i.e., power line route, possible area of emissions impact)

- List major plant communities, with components and dominants, including agricultural crops which could be impacted by emissions.

Determine ground ambient concentrations of SO_x NO_x and total suspended particulates (TSP).

- Determine relative vulnerability of soils to acidification.

Note: Determinations of ground ambient concentrations and of soil acidification vulnerability should proceed only if the technology of the power plant at the site has been determined and an early date for its construction has been set.

Faunal Studies

Invertebrates - rare or endangered species.

2. TERRESTRIAL STUDIES CONT'D

Vertebrates

- Amphibians, reptiles, and mammals, including rare or endangered species.

For the above species lists, estimated abundance and importance, habitat descriptions and important ecological relationships.

3. METEOROLOGICAL STUDIES

Meteorological Studies over land area within the radius of emission influence of the plant. By establishing a number of automatic weather stations, or by other means determine:

- Daily average wind speeds and directions (diurnal and nocturnal)
- Average ambient levels of SO_x, NO_x, and particulates
- Daily average rainfall
- Prevalence, duration, and dates of occurrence of inversions.

Through literature research, provide a record of the frequency and severity of hurricanes, storm surges, seismic activities or other natural events that could seriously impact the plant installation.

4. FRESH WATER STUDIES

To determine whether or not a desalinization plant will be needed at the power station site, assess:

- Surface and ground water availability and quality
- The relationship of projected plant requirements to current and future water demand figures, to be obtained from the appropriate water authorities.

5. SOCIO-ECONOMIC STUDIES

Assess the numbers, distribution, and general economic activity of people who could be affected by emissions, or by thermal plume or other impacts on fishing activities, or by construction and operation of the plant.

Factors to consider include not only emission and effluent impacts, but those having to do with heavy construction traffic through communities and/or rural roads, the feeding, accommodation and recreation requirements of construction workers, etc.

Economic activity assessment should include a statement about the commercial or subsistence value of, and number of people involved in any fishery conducted within the area likely to be affected by the thermal water plume and ship traffic.

6. PHYSICAL PLANNING COMPLIANCE STUDY

Determine if other proposed uses of the area, such as national parks, or eco-tourism development purposes, would place constraints on the plant location, design or operation.

**JAMAICA TOTAL VEHICLE FLEET
(FALL 1990 REGISTRATIONS*)**

	Number	%
TYPE		
Motor Cars	78,678	55%
Vans	5,97	4%
Trucks	25,642	18%
Bus	8,681	6%
Trailer	796	1%
Tractor	1,121	1%
Motor Cycle	<u>23,605</u>	<u>16%</u>
	144,220	100%
AGE		
10 yrs & older	76,651	53%
6 to 9 yrs old	22,574	23%
3 to 5 yrs old	12,399	9%
1 to 2 yrs old	<u>22,596</u>	<u>16%</u>
	144,220	100%
FUEL TYPE		
Gasoline	121,250	84%
Diesel	<u>22,970</u>	<u>16%</u>
	144,220	100%

** Note: A small additional number of registrations in the Temporary or Substitute category may exist. This number is not more than 9% of the above total.*

ENVIRONMENTAL GUIDELINES

The following material is taken from the World Bank's "Environmental Guidelines," September 1988, and covers standards applicable to (a) petroleum refineries, and (b) sulphur dioxide ambient levels.

Petroleum Refining

Table 1. Potential Sources of Oil Refinery Emissions

Emission	Principal Potential Sources
Sulfur Oxides	Boilers, process heaters, catalytic cracking unit regenerators, H ₂ S flares, decoking operations.
Hydrocarbons	Storage tanks, wastewater separators, catalyst regenerators, pumps and valves, cooling towers, volatile hydrocarbon handling equipment, process heaters, compressor engines.
Nitrogen Oxides	Process heaters, compressor engines, catalyst regenerators, flares.
Particulate Matter	Regenerators, boilers, decoking, incinerators.
Aldehydes	Catalyst regenerators
Ammonia	Catalyst regenerators
Odors	Treating units, drains, tank vents, wastewater separators.
Carbon Monoxide	Catalyst regenerators, decoking, compressor engine incinerators.

The categories used are patterned after the American Petroleum Institute (API) classification system. These categories and the refinery operations included in each are as follows:

- Topping: Topping, catalytic reforming, asphalt production, or lube oil manufacturing but no cracking or thermal operations.
- Cracking: Topping and cracking
- Petrochemicals: Topping, cracking and petrochemicals operations (first generation and isomerization products or second generation products).

- Lube: Topping, Cracking and lube oil manufacturing processes.
- Integrated; Topping, cracking, lube oil manufacturing processes, and petrochemicals operations.

The pollution parameters of major significance in this industry are as follows:

- 5-day Biochemical Oxygen Demand (BOD₅)
- Chemical Oxygen Demand (COD)
- Total Organic Carbon (TOC)
- Total Suspended Solids (TSS)
- Oils and Greases (O/G)
- Phenolic Compounds
- Ammonia Nitrogen (NH₃-N)
- Sulfides
- Total Chromium (Tot.Cr.)
- Hexavalent Chromium (Cr⁺⁶)
- Hydrogen Ion Concentration (pH)

The wastewater flows and characteristics of refinery effluents can vary considerably according to the type of operations. Table 2 lists the median (50% of occurrences less than or equal to the values shown) raw waste flows and loadings, representing the oil separator effluents for each of the processing categories cited above. In general, all wastewaters from processing units discharge to large basins or ponds (API separators) which function as oil and water separators. The oil is usually recovered as a valuable by-product. Hexavalent chromium is present in refinery effluents, due to the addition of chromates to cooling waters in order to inhibit corrosion.

Table 2. Liquid Effluent Limitations for Petroleum Refinery Wastes.

Process Category	Maximum Daily Discharge - Kg per 1000 m ³ of Feedstock <u>a/</u> <u>b/</u>									
	BOD ₅	COD	TOC	TSS	O/G	PHEN.	NH ₃ -N	SUL-FIDES	TOTAL CR	CR ⁺⁶
Topping	6.3	32	8.2	4.0	1.9	0.04	1.3	0.04	0.10	0.002
Cracking	8.7	61	11.	5.8	2.6	0.06	8.6	0.05	0.14	0.002
Petrochemicals	12	69	15.	7.7	3.5	0.08	11	0.06	0.19	0.003
Lube	18	126	24.	12.	5.6	0.12	11	0.10	0.31	0.005
Integrated	22	152	29.	14.	6.7	0.14	11	0.12	0.37	0.006
Runoff <u>c/</u>	0.03	0.19	0.03	0.02	0.01	--	--	--	--	--
Ballast <u>d/</u>	0.03	0.24	0.03	0.02	0.01	--	--	--	--	--

a/ Feedstock - Crude Oil and/or natural gas liquids throughout.

b/ For all effluents pH = 6 to 9.

c/ Applies only to process area runoff treated in main treatment system.
All runoff from tank fields and non-process areas shall not exceed 35 mg/L of TOC or 15 mg/L of O/G when discharged.

d/ Applies only to ballast waters treated at refinery.

CONTROL AND TREATMENT OF WASTES

The gaseous emissions and the liquid effluents are of equal importance in the refinery operations and the discharges must be controlled in order to avoid environmental damage. A combination of process control, in-plant housekeeping, and treatment technology can usually be effective in achieving reduction of these discharges to acceptable levels.

Gaseous Effluents

It is difficult to categorize emission sources on the basis of refinery operations, since many of them are common throughout the plant. For purposes of emissions control the refinery should be considered as an integrated systems of storage facilities, process heaters, cooling equipment, pumps, valves and other units and operations.

Hydrocarbon emissions originate principally from storage facilities, valves, pumps, compressors, wastewater separators, and loading facilities. These emissions can, in most instances be collected by vapor recovery systems or ventilating systems and eliminated by burning. Disposal is most frequently through elevated flares, using steam ejection. Flares must be so located as to avoid proximity to combustible materials, tanks and processing equipment.

Other measures for reducing emission discharges include high efficiency dust removal equipment on catalytic cracking units, waste heat boilers on catalyst regenerators, smokeless flares, and sulfur recovery systems. Improved housekeeping, coupled with maintenance and employee education can also contribute significantly.

Liquid Effluents

Technology for control and reduction of effluent loadings falls into three categories: in-plant control, at source pretreatment, and end-of-pipe technology.

Two types of in-plant measures can greatly reduce the volume of final effluents. The first of these utilizes the reuse of water from one process to another, such as using blowdowns from higher pressure boilers as feed to low pressure boilers or using treated effluent as makeup water whenever possible. The second approach is to utilize recycle systems that use water more than once for the same purpose, such as using steam condensate as boiler feed water or using cooling towers.

Good housekeeping will further reduce waste flows. Examples are minimizing waste when sampling product lines, using vacuum trucks or dry cleaning methods to clean up oil spills, applying effective maintenance and inspection in order to keep the refinery equipment as leakproof as possible, and providing individual disposal for waste streams having special characteristics, (such as spent cleaning solutions).

Process modification, in most cases applicable to both existing and new installations, could include:

- Substitution of improved catalysts having longer life and requiring less regeneration.
- Replacement of barometric condensers with surface condensers or air fan coolers to reduce a major oil-water emulsion source.
- Substitution of air fan cooler for water cooling to reduce blowdown discharges.
- Installation of hydrocracking and hydrotreating processes designed to generate the lowest possible waste loadings.
- Provision of automatic monitoring equipment, such as for TOC, to assure early detection of process upsets and avoiding excessive discharges to sewers.
- Maximum use of improved drying, sweetening, and finishing procedures to minimize volumes of spent caustics, filter solids and other materials requiring disposal.

Major at-source pretreatment measures include stripping of sour waters, neutralization and oxidation of spent caustics, ballast water separation, and slop oil recovery. Gravity separators remove the major portion of the free oil found in refinery waste waters. Most of these oils can be reprocessed, and hence the separator is considered an integral part of the refinery operations.

End-of-pipe control technology relies most heavily on a combination of flow equalization and biological treatment methods. Equalization, which eliminates surges in flows and loadings, is particularly important for a biological treatment system since, for example, sudden discharges containing high concentrations of certain materials can upset or completely kill the organisms in the system.

Among the biological techniques most commonly applied are dissolved air flotation, oxidation ponds, aerated lagoons, trickling filters, activated sludge, physical-chemical methods, granular media filters, and activated carbon. These may be applied singly or in combination, depending upon the volume and characteristics of the wastes to be treated, availability of land areas and other factors.

The most frequently used methods for disposal of chromium bearing wastes are by reduction of the hexavalent to the trivalent form (with sulfur dioxide, sulfites, ferrous sulfate, or other reducing agents), followed by neutralization and precipitation of the reduced chromium with alkali.

Sludges produced from biological treatment may be disposed of by land-filling, land farming or incineration.

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- (a) Vol. 39 (39FR9308), March 8, 1974
- (b) Vol. 40 (40FR46250), October, 1975
- (c) Vol. 41 (41FR36600), August 30, 1976
- (d) Vol. 41 (41FR43866), October 4, 1976
- (e) Vol. 43 (43FR10866), March 15 1978
- (f) Vol. 43 (43FR21616), May 18, 1978

Sulphur Dioxide Ambient Levels - Guidelines

Man-made emissions of sulfur dioxide originate from a variety of sources discharging to the atmosphere. The major source is from the combustion of fossil fuels such as coal and oil. Some 90 to 95 percent of pollution-related sulfur oxide emissions are in the form of sulfur dioxide. Another source of sulfur dioxide is auto exhaust gases, although it accounts for a relatively small portion of such discharges to the atmosphere. This guideline will concern itself with stationary sources only, particularly those resulting from combustion of fuels containing sulfur.

Sulfur dioxide oxidizes in the atmosphere to form sulfates, a particulate form of sulfur compounds. These compounds may have adverse effects on human health and property, depending upon particle sizes, the particulate form of sulfur present, dispersion as affected by weather conditions, and the presence of other pollutants which may magnify the effects.

SOURCES AND EFFECTS

Sulfur dioxide, has a sharp and choking odor, and is considered to be one of the most dangerous gases to man. It is one of several forms in which sulfur circulates globally. The sulfur cycle also includes hydrogen sulfide gas, sulfuric acid aerosol, and several sulfate salts in aerosol form. For purposes of this discussion, an aerosol is defined as a suspension of liquid droplets or solid particles in a gas.

The concentration of populations into large metropolitan areas, with the resulting energy needs and industrial activity, causes the emissions to accumulate over these areas and disperse slowly. A US study, made in 1968, showed nationwide distribution of sulfur oxide emission sources to be as follows:

Fuel combustion		73.5%
Coal	60.5%	
Residual fuel oil	11.8%	
Distillate fuel oil	1.2%	
Industrial Processes		22.0%
Transportation		2.4%
Coal Refuse		1.8%
Solid Waste Disposal		0.3%

Electric power plants, the bulk of which utilize coal and oils as fuel, are the leading sources of sulfur dioxide emissions, as shown above. Except for transportation sources (which include motor vehicles, vessels, and railroads), over 97% of the man-made sources are stationary. The degree of sulfur dioxide production from any individual source depends not only on the amount, but also on the type of fuel burned.

Sulfur, in a free or combined state, occurs in practically all fossil fuels. When freed to the atmosphere, usually by combustion, the sulfur or its compounds react with the oxygen present in the air to form oxides. These can combine with moisture to form sulfurous acid, followed by formation of sulfuric acid, as follows:



Acids formed in the atmosphere fall with rain and can affect crops and plants, and surface waters (particularly lakes). Some lichens, for example, store acid in their roots then die, and they are sometimes used as indicators of sulfur dioxide fallout.

Sulfur dioxide emissions, through the formation of acids and other salts in the atmosphere, can cause damages to human health and property. High levels of sulfate concentrations will aggravate asthma, lung and heart disease. Sulfur dioxide in the presence of photochemical oxidants and by-products such as sulfuric acid and hydrogen sulfide has been shown to affect the respiratory tract. It is also widely believed that long term exposure to sulfates may increase the likelihood of respiratory illness such as bronchitis, emphysema and asthma. This effect is more probable when high concentrations of particulates are present.

Sensitive vegetation can be severely damaged by low levels of sulfur dioxide, levels even lower than those said to cause distress to lung diseased patients. Such effects result from the synergistic action of sulfur dioxide with low levels of ozone or nitrogen oxide which may be present. Wheat, barley, oats, white pine, cotton, alfalfa, buckwheat, sugar beets, and other crop plants have been reported killed by relatively low levels of sulfur dioxide fallout. Studies made in the USSR during the past decade showed that pine trees growing in an atmosphere having SO_2 concentrations of $500 \mu\text{g}/\text{m}^3$ had a growth loss of 48 percent in comparison with pine trees growing in an atmosphere free of SO_2 .

Sulfur oxides and their acid by-products will attack any exposed metal surface, including steel rail tracks. Reactions will also occur on other substances such as brick, stonework and even granite, (such as statues and monuments). Plastics, rubber, paper, and many other similar materials will become discolored and brittle when exposed. Buildings, bridges, steel girders, automobiles and highways are all affected by excessive emissions.

EMISSION SAMPLING AND MEASUREMENT

Although several units have been used in the past to express the concentrations of sulfur dioxide in the air, the unit in most common use today is in terms of weight per unit volume of air-micrograms of SO₂ per cubic meter of air ($\mu\text{g}/\text{m}^3$). This unit should be used by the Bank's staff in their reports dealing with this pollutant. Where analytical results are given in parts per million (ppm) of SO₂, the data can be converted to $\mu\text{g}/\text{m}^3$ as follows:

$$1 \text{ ppm SO}_2 = 2620 \mu\text{g}/\text{m}^3$$

It is important to note that this conversion factor applies to SO₂ only, and will not apply to any other substance having a different molecular weight.

Because industrial operations may involve frequent cyclic changes, the timing of testing or monitoring must be properly coordinated. Individual polluting substances should be identified and fluctuations of peak loadings determined in advance. All the variables associated with source testing should be considered so that the sampling and analytical results will be representative of the entire source process.

Procedures for the collection and analysis of both stationary and ambient source samples, for determining sulfur dioxide levels, are contained in the guideline titled "Sulfur Dioxide Sampling and Analyses", available from the Bank's Office of Environmental Affairs.

ACCEPTABLE STANDARDS

Standards are generally of two types -- emission and ambient. Emission standards apply to allowable concentrations at the source, such as stacks, ventilating systems and other discharge points. Ambient standards apply to the allowable concentrations of a contaminant in the air surrounding an industrial area or community. Emission levels are necessary for identification of specific pollution sources and design of remedial works. Ambient levels are essential for determining possible environmental damages and for avoiding adverse physical, health and other effects upon the surrounding area and its inhabitants. The standards presented below represent the concentrations of SO₂ which may be permitted in the area surrounding the emission source.

For all Bank projects ambient air concentrations of sulfur oxides should not exceed the following for new plants:

Inside plant fence	Annual Arith. mean:	100 $\mu\text{g}/\text{m}^3$
	Max. 24-hr. peak	1000 $\mu\text{g}/\text{m}^3$
Outside plant fence	Annual Arith. mean:	100 $\mu\text{g}/\text{m}^3$
	Max. 24-hr. peak	500 $\mu\text{g}/\text{m}^3$

In special situations strict adherence to these standards may be difficult. All such cases are to be carefully documented by the Bank missions. Factors which may affect the ability to meet these standards include:

- Expansion of existing plant - The annual arithmetic mean and the Max. 24-hr peak resulting from the combination of the old units with the new ones should be no greater than the values obtained for the old units alone.

More simply, emission plumes from new and existing sources should not mix to the extent that combined ambient concentrations exceed maximum ambient concentrations obtained from the existing source alone. This may be accomplished by (a) increasing the stack height of the new source, (b) changing the stack location of the new source, or (c) reducing new source emission levels. Furthermore, if plume mixing is not a problem, the new source units should by themselves meet the above standards.
- Revamping of existing plants - Every effort should be made to decrease existing pollution levels and provide measures which will minimize concentrations without placing unreasonable economic burdens on the industry.
- Inversions - When the SO_2 source location is in a valley or surrounded by mountains, inversion layers which may occur during certain seasons of the year, could trap the stack emissions. These emissions can drop back to ground level, stagnate there, and damage crops sensitive to SO_2 and NO_x . In some projects, it may be impossible to change the site location (i.e. in case of an expansion of an existing plant). In this case, to protect crops, the peak concentration will be decreased from 500 $\mu\text{g}/\text{m}^3$ during 24 hours down to 350 $\mu\text{g}/\text{m}^3$ during 4 hours, unless it can be shown that the effluent will not be trapped by the inversion layer.

- Non-ferrous metal smelters - Substitutions of flash or electric furnaces may be necessary to meet guideline requirements.

The existing US national ambient air quality standards are given below for comparison with the above figures.

- Primary - based on health effects on humans

Annual arith. mean: $80 \mu\text{g}/\text{m}^3$
Max. 24-hr. - once yearly: $365 \mu\text{g}/\text{m}^3$

- Secondary - based on environmental effects

Annual arith. mean: $60 \mu\text{g}/\text{m}^3$
Max. 24-hr. - once yearly: $260 \mu\text{g}/\text{m}^3$
Max. 3-hr. - once yearly: $1300 \mu\text{g}/\text{m}^3$

CONTROL TECHNOLOGY

Technology to be applied for control of emissions must be designed for each individual case since, in most instances, the system used must be capable of removing or reducing more than one pollutant at the same time.

Since SO_2 emissions are due principally to the content of sulfur and its compounds in the coal and oil used for fuel, the first measure to be considered is the substitution of low sulfur fuels or natural gas. Any increase in fuel costs should be balanced against the cost of treating the gaseous wastes.

Emissions may be reduced through process changes. In-plant measures could include changing raw materials, modifying process operations, or recovering and reusing materials otherwise being wasted through the stack. Raising the point of discharge above the ground, by increasing the stack height, will reduce contaminant concentrations at ground level.

When measures such as those outlined above cannot be applied, chemical or physical processes should be utilized. Sulfur dioxide may be removed by adsorption, absorption, or a chemical process such as catalytic conversion. In some of these processes, the SO_2 can be removed and serve as the raw material for sulfuric acid production.

One of the promising methods for flue gas desulfurization utilizes the reaction of magnesium oxide with SO_2 to form magnesium sulfite. The magnesium sulfite solids are separated by centrifuging, dried to remove the moisture, and then calcined to regenerate the magnesium oxide for recycling, and generate concentrated SO_2 to be used for sulfuric acid production.

Limestone scrubbers have been used successfully for desulfurization of flue gases. Injection of lime or magnesium into the fuel combustion chamber has also been effective in reducing sulfur dioxide emissions. However, it should be noted that these processes produce calcium sulfate wastes, which can present a disposal problem. They are therefore recommended in areas where land is both available and inexpensive.

Ammonia scrubbing systems have been in successful operation in sulfuric acid plants since the mid 1930's. The main drawback has been the disposal of the ammonium sulfate by-product. Any World Bank financed sulfuric acid plant where the sponsor insists on a single absorption design should be equipped with ammonia scrubbing.

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DRAFT TERMS OF REFERENCE

ENVIRONMENTAL EMISSIONS INVENTORY

Objectives

A regional and national emission guideline program should be based on (a) emission inventories, (b) enhanced monitoring, (c) impact assessments covering health, soils, vegetation and marine biota, (d) cost/benefit evaluation of alternate constraints, and (e) definition of appropriate emission standards, fuels, vehicles, etc. Such a program will evolve with time approaching the most critical Jamaican needs first and maturing into a fully comprehensive program, interlinked with international commitments. An emission inventory is an essential precursor and must cover air, land and water related emissions. Such an inventory will also start on these emissions - compounds and rates - considered most critical in the short term - many on a regional basis only and evolve into a regulatory updated comprehensive national and regional inventory.

At first many "standard" factors could be used in lieu of actual measurements to save time and expense, but being replaced with actual measurement or Jamaican source specific factors with time. Inventorying is not a one time effort.

The proposed inventory would assess air pollutants related to oil refining, electricity generation and the use of fuels and electricity by Jamaican industry, commercial establishments and the populace generally. Dispersion modelling taking into account wind, rainfall, and topographic features would be carried out to identify areas particularly susceptible to acid rain.

Initial Air Emission Inventory

The Jamaican inventory would first center on the primary pollutants from industrial and people related sources - SO₂, NO_x, CO, particulates, hydrocarbons, other organic compounds and any other special chemical species identified as being of local importance.

The inventory would plot point sources with inventories for each where these exceed certain percentages of the regional or national emissions, as appropriate. Pseudo point sources would be used for groups of small point sources and area emissions - e.g. from vehicles. Area emissions and small point sources will always be the most difficult to define.

The initial effort would identify as many sources as possible and apply regional/parish rates for each, using for example, fuel consumption estimates with factors for various pollutants.

Initial Inventorying Activities

The following activities are envisaged:

- (a) overall data base and model development
- (b) mapping base - national grid

- (c) industry inventories - who, what size, where, contacts
- (d) fuel use distribution - type, where, sulphur, etc
- (e) industry sector by sector review*
- (f) dumps and other waste combustion reviews*
- (g) vehicle emissions - fleet data (Petrojam) - review*
- (h) commercial, institutional sector review*
- (i) agriculture and residential sector review*
- (j) marine and miscellaneous sectors review*
- (k) input data into overall model

The data base would provide emissions by geographic region down to major point sources for input into dispersion models and for direct use in analyzing geographic emission profiles. Initially, time of day factors may be omitted but the model must allow for those to be employed at a later date.

Those reviews starred * would initially use "standard" U.S. or other factors to be improved over time, except for coal and liquid fuel related emissions. The U.S. EPA's Mobile 4 program might be considered at a later date for the vehicle emissions if they turn out to be significant.

Standard data base programs are available for such inventorying but some effort will be needed to select the most appropriate one.

Inventory Team

For the initial survey approximately six man months of effort over a three month period is foreseen but there may already be appreciable data to reduce that level of effort. However, other parallel activities in the environmental control area should be considered in the organization and staffing. For example, dispersion models and meteorological bases are essential for the use of the inventory data.

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME

COMPLETED ACTIVITIES

<i>Country</i>	<i>Activity</i>	<i>Date</i>	<i>Number</i>
SUB-SAHARAN AFRICA (AFR)			
Africa Regional	Anglophone Africa Household Energy Workshop (English)	07/88	085/88
	Regional Power Seminar, on Reducing Electric Power System Losses in Africa (English)	08/88	087/88
	Institutional Evaluation of EGL (English)	02/89	098/89
	Biomass Mapping Regional Workshops (English - Out of Print)	05/89	--
	Francophone Household Energy Workshop (French)	08/89	103/89
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development (English)	03/90	112/90
	Biomass Assessment and Mapping (English - Out of Print)	03/90	--
Angola	Energy Assessment (English and Portuguese)	05/89	4708-ANG
	Power Rehabilitation and Technical Assistance (English)	10/91	142/91
Benin	Energy Assessment (English and French)	06/85	5222-BEN
Botswana	Energy Assessment (English)	09/84	4998-BT
	Pump Electrification Feasibility Study (English)	01/86	047/86
	Review of Electricity Service Connection Policy (English)	07/87	071/87
	Tuli Block Farms Electrification Study (English)	07/87	072/87
	Household Energy Issues Study (English - Out of Print)	02/88	--
	Urban Household Energy Strategy Study (English)	05/91	132/91
Burkina Faso	Energy Assessment (English and French)	01/86	5730-BUR
	Technical Assistance Program (English)	03/86	052/86
	Urban Household Energy Strategy Study (English and French)	06/91	134/91
Burundi	Energy Assessment (English)	06/82	3778-BU
	Petroleum Supply Management (English)	01/84	012/84
	Status Report (English and French)	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987) (English and French)	05/85	036/85
	Improved Charcoal Cookstove Strategy (English and French)	09/85	042/85
	Peat Utilization Project (English)	11/85	046/85
	Energy Assessment (English and French)	01/92	9215-BU
Cape Verde	Energy Assessment (English and Portuguese)	08/84	5073-CV
	Household Energy Strategy Study (English)	02/90	110/90
Comoros	Energy Assessment (English and French)	01/88	7104-COM
Congo	Energy Assessment (English)	01/88	6420-COB
	Power Development Plan (English and French)	03/90	106/90
Côte d'Ivoire	Energy Assessment (English and French)	04/85	5250-IVC
	Improved Biomass Utilization (English and French)	04/87	069/87
	Power System Efficiency Study (Out of Print)	12/87	--
	Power Sector Efficiency Study (French)	02/92	140/91
Ethiopia	Energy Assessment (English)	07/84	4741-ET
	Power System Efficiency Study (English)	10/85	045/85
	Agricultural Residue Briquetting Pilot Project (English)	12/86	062/86
	Bagasse Study (English)	12/86	063/86
	Cooking Efficiency Project (English)	12/87	--

<i>Country</i>	<i>Activity</i>	<i>Date</i>	<i>Number</i>
Gabon	Energy Assessment (English)	07/88	6915-GA
The Gambia	Energy Assessment (English)	11/83	4743-GM
	Solar Water Heating Retrofit Project (English)	02/85	030/85
	Solar Photovoltaic Applications (English)	03/85	032/85
	Petroleum Supply Management Assistance (English)	04/85	035/85
Ghana	Energy Assessment (English)	11/86	6234-GH
	Energy Rationalization in the Industrial Sector (English)	06/88	084/88
	Sawmill Residues Utilization Study (English)	11/88	074/87
Guinea	Energy Assessment (Out of Print)	11/86	6137-GUI
Guinea-Bissau	Energy Assessment (English and Portuguese)	08/84	5083-GUB
	Recommended Technical Assistance Projects (English & Portuguese)	04/85	033/85
	Management Options for the Electric Power and Water Supply Subsectors (English)	02/90	100/90
	Power and Water Institutional Restructuring (French)	04/91	118/91
Kenya	Energy Assessment (English)	05/82	3800-KE
	Power System Efficiency Study (English)	03/84	014/84
	Status Report (English)	05/84	016/84
	Coal Conversion Action Plan (English - Out of Print)	02/87	-
	Solar Water Heating Study (English)	02/87	066/87
	Peri-Urban Woodfuel Development (English)	10/87	076/87
	Power Master Plan (English - Out of Print)	11/87	-
Lesotho	Energy Assessment (English)	01/84	4676-LSO
Liberia	Energy Assessment (English)	12/84	5279-LBR
	Recommended Technical Assistance Projects (English)	06/85	038/85
	Power System Efficiency Study (English)	12/87	081/87
Madagascar	Energy Assessment (English)	01/87	5700-MAG
	Power System Efficiency Study (English and French)	12/87	075/87
Malawi	Energy Assessment (English)	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry (English)	11/83	009/83
	Status Report (English)	01/84	013/84
Mali	Energy Assessment (English and French)	11/91	8423-MLI
	Household Energy Strategy (English and French)	03/92	147/92
Islamic Republic of Mauritania	Energy Assessment (English and French)	04/85	5224-MAU
	Household Energy Strategy Study (English and French)	07/90	123/90
Mauritius	Energy Assessment (English)	12/81	3510-MAS
	Status Report (English)	10/83	008/83
	Power System Efficiency Audit (English)	05/87	070/87
	Bagasse Power Potential (English)	10/87	077/87
Mozambique	Energy Assessment (English)	01/87	6128-MOZ
	Household Electricity Utilization Study (English)	03/90	113/90
Niger	Energy Assessment (French)	05/84	4642-NIR
	Status Report (English and French)	02/86	051/86
	Improved Stoves Project (English and French)	12/87	080/87
	Household Energy Conservation and Substitution (English and French)	01/88	082/88
Nigeria	Energy Assessment (English)	08/83	4440-UNI

<i>Country</i>	<i>Activity</i>	<i>Date</i>	<i>Number</i>
Rwanda	Energy Assessment (English)	06/82	3779-RW
	Energy Assessment (English and French)	07/91	8017-RW
	Status Report (English and French)	05/84	017/84
	Improved Charcoal Cookstove Strategy (English and French)	08/86	059/86
	Improved Charcoal Production Techniques (English and French)	02/87	065/87
	Commercialization of Improved Charcoal Stoves and Carbonization Techniques Mid-Term Progress Report (English and French)	12/91	141/91
SADCC	SADCC Regional Sector: Regional Capacity-Building Program for Energy Surveys and Policy Analysis (English)	11/91	--
Sao Tome and Principe	Energy Assessment (English)	10/85	5803-STP
Senegal	Energy Assessment (English)	07/83	4182-SE
	Status Report (English and French)	10/84	025/84
	Industrial Energy Conservation Study (English)	05/85	037/85
	Preparatory Assistance for Donor Meeting (English and French)	04/86	056/86
	Urban Household Energy Strategy (English)	02/89	096/89
	Seychelles	Energy Assessment (English)	01/84
	Electric Power System Efficiency Study (English)	08/84	021/84
Sierra Leone	Energy Assessment (English)	10/87	6597-SL
Somalia	Energy Assessment (English)	12/85	5796-SO
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment (English)	07/83	4511-SU
	Power System Efficiency Study (English)	06/84	018/84
	Status Report (English)	11/84	026/84
	Wood Energy/Forestry Feasibility (English - Out of Print)	07/87	073/87
	Swaziland	Energy Assessment (English)	02/87
Tanzania	Energy Assessment (English)	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study (English)	08/88	086/88
	Tobacco Curing Efficiency Study (English)	05/89	102/89
	Remote Sensing and Mapping of Woodlands (English)	06/90	--
	Industrial Energy Efficiency Technical Assistance (English - Out of Print)	08/90	122/90
	Togo	Energy Assessment (English)	06/85
	Wood Recovery in the Nangbeto Lake (English and French)	04/86	055/86
	Power Efficiency Improvement (English and French)	12/87	078/87
Uganda	Energy Assessment (English)	07/83	4453-UG
	Status Report (English)	08/84	020/84
	Institutional Review of the Energy Sector (English)	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry (English)	02/86	049/86
	Fuelwood/Forestry Feasibility Study (English)	03/86	053/86
	Power System Efficiency Study (English)	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry (English)	02/89	097/89
	Tobacco Curing Pilot Project (English - Out of Print)	03/89	UNDP Terminal Report
Zaire	Energy Assessment (English)	05/86	5837-ZR
Zambia	Energy Assessment (English)	01/83	4110-ZA
	Status Report (English)	08/85	039/85
	Energy Sector Institutional Review (English)	11/86	060/86

<i>Country</i>	<i>Activity</i>	<i>Date</i>	<i>Number</i>
Zambia	Power Subsector Efficiency Study (English)	02/89	093/88
	Energy Strategy Study (English)	02/89	094/88
	Urban Household Energy Strategy Study (English)	08/90	121/90
Zimbabwe	Energy Assessment (English)	06/82	3765-ZIM
	Power System Efficiency Study (English)	06/83	005/83
	Status Report (English)	08/84	019/84
	Power Sector Management Assistance Project (English)	04/85	034/85
	Petroleum Management Assistance (English)	12/89	109/89
	Power Sector Management Institution Building (English - Out of Print)	09/89	--
	Charcoal Utilization Prefeasibility Study (English)	06/90	119/90
	Integrated Energy Strategy Evaluation (English)	01/92	8768-ZIM
EAST ASIA AND PACIFIC (EAP)			
Asia Regional	Pacific Household and Rural Energy Seminar (English)	11/90	--
China	County-Level Rural Energy Assessments (English)	05/89	101/89
	Fuelwood Forestry Preinvestment Study (English)	12/89	105/89
Fiji	Energy Assessment (English)	06/83	4462-FIJ
Indonesia	Energy Assessment (English)	11/81	3543-IND
	Status Report (English)	09/84	022/84
	Power Generation Efficiency Study (English)	02/86	050/86
	Energy Efficiency in the Brick, Tile and Lime Industries (English)	04/87	067/87
	Diesel Generating Plant Efficiency Study (English)	12/88	095/88
	Urban Household Energy Strategy Study (English)	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II (English)	12/90	124/90
Malaysia	Sabah Power System Efficiency Study (English)	03/87	068/87
	Gas Utilization Study (English)	09/91	9645-MA
Myanmar	Energy Assessment (English)	06/85	5416-BA
Papua New Guinea	Energy Assessment (English)	06/82	3882-PNG
	Status Report (English)	07/83	006/83
	Energy Strategy Paper (English - Out of Print)	--	--
	Institutional Review in the Energy Sector (English)	10/84	023/84
	Power Tariff Study (English)	10/84	024/84
Solomon Islands	Energy Assessment (English)	06/83	4404-SOL
	Energy Assessment (English)	01/92	979/SOL
South Pacific	Petroleum Transport in the South Pacific (English-Out of Print)	05/86	--
Thailand	Energy Assessment (English)	09/85	5793-TH
	Rural Energy Issues and Options (English - Out of Print)	09/85	044/85
	Accelerated Dissemination of Improved Stoves and Charcoal Kilns (English - Out of Print)	09/87	079/87
	Northeast Region Village Forestry and Woodfuels Preinvestment Study (English)	02/88	083/88
Thailand	Impact of Lower Oil Prices (English)	08/88	--
	Coal Development and Utilization Study (English)	10/89	--

<i>Country</i>	<i>Activity</i>	<i>Date</i>	<i>Number</i>
Tonga	Energy Assessment (English)	06/85	5498-TON
Vanuatu	Energy Assessment (English)	06/85	5577-VA
Western Samoa	Energy Assessment (English)	06/85	5497-WSO

SOUTH ASIA (SAS)

Bangladesh	Energy Assessment (English)	10/82	3873-BD
	Priority Investment Program	05/83	002/83
	Status Report (English)	04/84	015/84
	Power System Efficiency Study (English)	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study (English - (Out of Print)	12/88	--
India	Opportunities for Commercialization of Nonconventional Energy Systems (English)	11/88	091/88
	Maharashtra Bagasse Energy Efficiency Project (English)	05/91	120/91
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III (English)	07/91	139/91
Nepal	Energy Assessment (English)	08/83	4474-NEP
	Status Report (English)	01/85	028/84
Pakistan	Household Energy Assessment (English - Out of Print)	05/88	--
	Assessment of Photovoltaic Programs, Applications, and Markets (English)	10/89	103/89
Sri Lanka	Energy Assessment (English)	05/82	3792-CE
	Power System Loss Reduction Study (English)	07/83	007/83
	Status Report (English)	01/84	010/84
	Industrial Energy Conservation Study (English)	03/86	054/86

EUROPE AND CENTRAL ASIA (ECA)

Portugal	Energy Assessment (English)	04/84	4824-PO
Turkey	Energy Assessment (English)	03/83	3877-TU

MIDDLE EAST AND NORTH AFRICA (MNA)

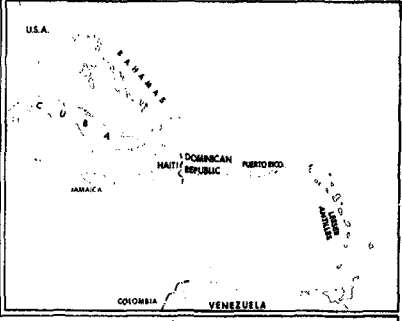
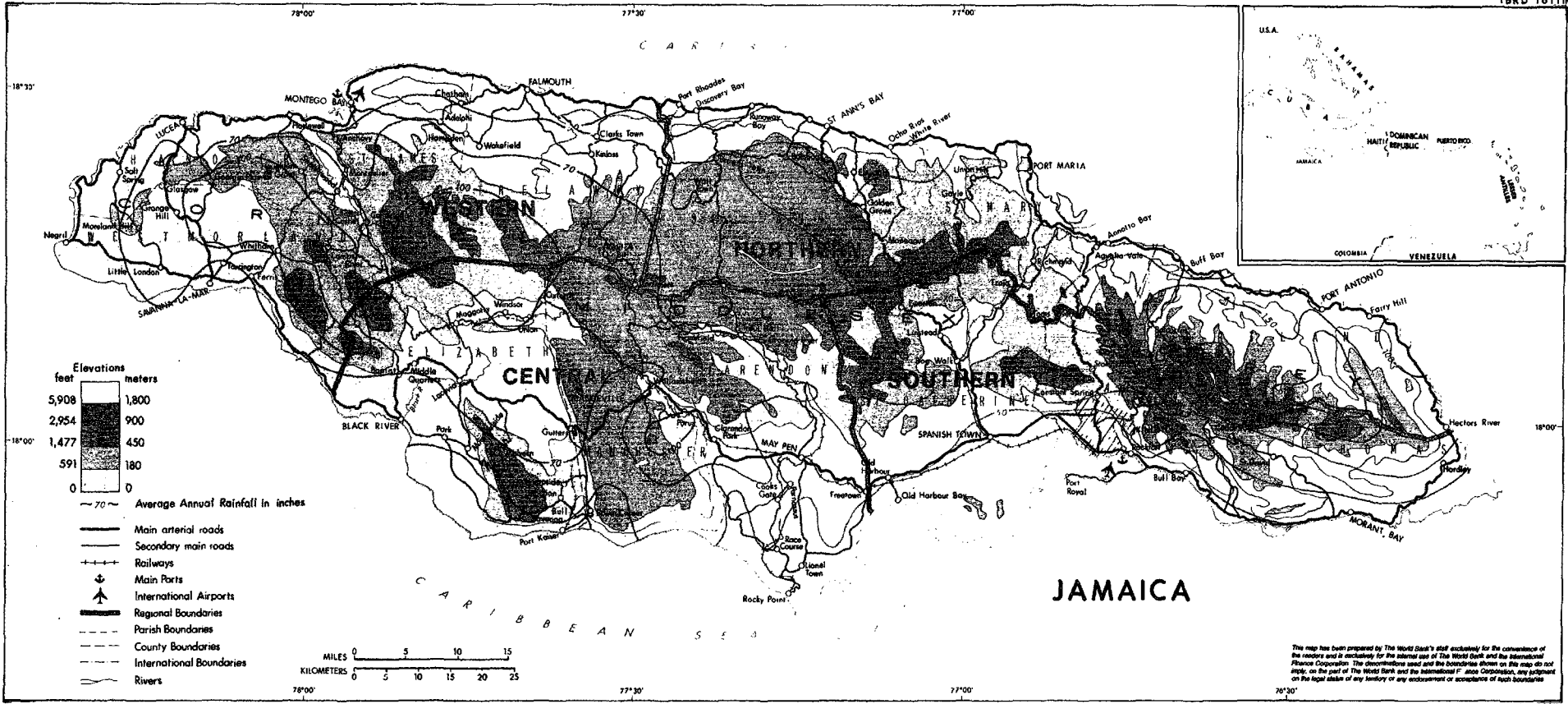
Morocco	Energy Assessment (English and French)	03/84	4157-MOR
	Status Report (English and French)	01/86	048/86
Syria	Energy Assessment (English)	05/86	5822-SYR
	Electric Power Efficiency Study (English)	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector (English)	04/89	099/89
	Energy Efficiency Improvement in the Fertilizer Sector(English)	06/90	115/90
Tunisia	Fuel Substitution (English and French)	03/90	--
	Power Efficiency Study (English and French)	02/92	136/91
	Energy Management Strategy in the Residential and Tertiary Sectors (English)	04/92	146/92

<i>Country</i>	<i>Activity</i>	<i>Date</i>	<i>Number</i>
Yemen	Energy Assessment (English)	12/84	4892-YAR
	Energy Investment Priorities (English - Out of Print)	02/87	6376-YAR
	Household Energy Strategy Study Phase I (English)	03/91	126/91
LATIN AMERICA AND THE CARIBBEAN (LAC)			
LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean (English)	07/89	--
Bolivia	Energy Assessment (English)	04/83	4213-BO
	National Energy Plan (English)	12/87	--
	National Energy Plan (Spanish)	08/91	131/91
	La Paz Private Power Technical Assistance (English)	11/90	111/90
	Natural Gas Distribution: Economics and Regulation (English)	03/92	125/92
	Prefeasibility Evaluation Rural Electrification and Demand Assessment (English and Spanish)	04/91	129/91
	Private Power Generation and Transmission (English)	01/92	137/91
Chile	Energy Sector Review (English - Out of Print)	08/88	7129-CH
Colombia	Energy Strategy Paper (English)	12/86	--
Costa Rica	Energy Assessment (English and Spanish)	01/84	4655-CR
	Recommended Technical Assistance Projects (English)	11/84	027/84
	Forest Residues Utilization Study (English and Spanish)	02/90	108/90
Dominican Republic	Energy Assessment (English)	05/91	8234-DO
Ecuador	Energy Assessment (Spanish)	12/85	5865-EC
	Energy Strategy Phase I (Spanish)	07/88	--
	Energy Strategy (English)	04/91	--
Haiti	Energy Assessment (English and French)	06/82	3672-HA
	Status Report (English and French)	08/85	041/85
	Household Energy Strategy (English and French)	12/91	143/91
Honduras	Energy Assessment (English)	08/87	6476-HO
	Petroleum Supply Management (English)	03/91	128/91
Jamaica	Energy Assessment (English)	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study (English)	11/86	061/86
	Energy Efficiency Building Code Phase I (English-Out of Print)	03/88	--
	Energy Efficiency Standards and Labels Phase I (English - Out of Print)	03/88	--
	Management Information System Phase I (English - Out of Print)	03/88	--
	Charcoal Production Project (English)	09/88	090/88
	FIDCO Sawmill Residues Utilization Study (English)	09/88	088/88
	Energy Sector Strategy and Investment Planning Study (English)	07/92	135/92
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz (English and Spanish)	08/91	138/91
Panama	Power System Efficiency Study (English - Out of Print)	06/83	004/83
Paraguay	Energy Assessment (English)	10/84	5145-PA
	Recommended Technical Assistance Projects (English-Out of Print)	09/85	--
	Status Report (English and Spanish)	09/85	043/85

<i>Country</i>	<i>Activity</i>	<i>Date</i>	<i>Number</i>
Peru	Energy Assessment (English)	01/84	4677-PE
	Status Report (English - Out of Print)	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra (English and Spanish)	02/87	064/87
	Energy Strategy (Spanish)	12/90	--
Saint Lucia	Energy Assessment (English)	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment (English)	09/84	5103-STV
Trinidad and Tobago	Energy Assessment (English - Out of Print)	12/85	5930-TR

GLOBAL

Energy End Use Efficiency: Research and Strategy (English - Out of Print)	11/89	--
Guidelines for Utility Customer Management and Metering (English and Spanish)	07/91	--
Women and Energy--A Resource Guide		
The International Network: Policies and Experience (English)	04/90	--
Assessment of Personal Computer Models for Energy Planning in Developing Countries (English)	10/91	--



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