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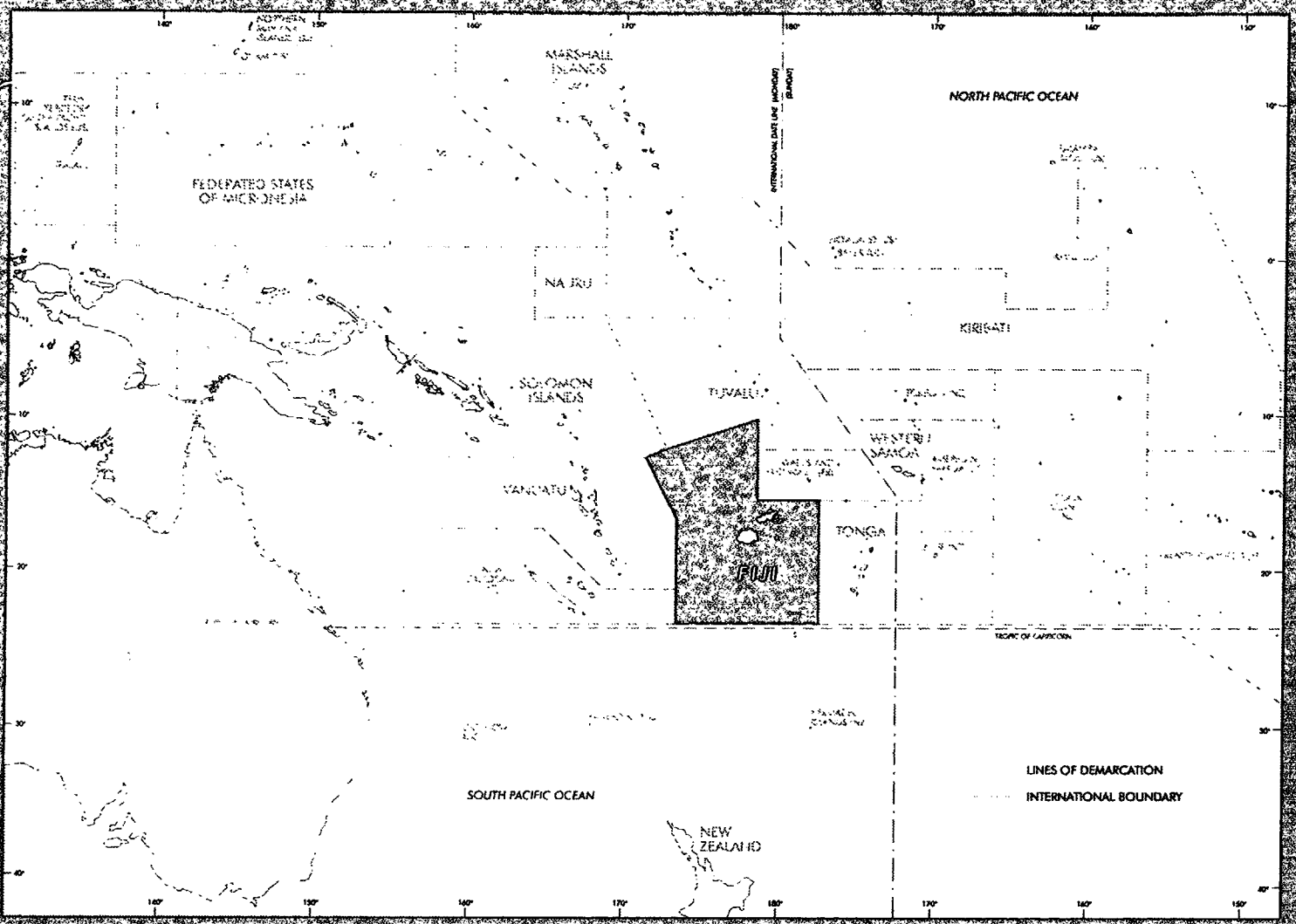
PREA

Pacific Regional Energy Assessment

Volume 4: Fiji: Issues and Options in the Energy Sector



The World Bank
in cooperation with
The UNDP/ESCAP Pacific Energy Development Programme
The Asian Development Bank
and

CURRENCY EQUIVALENT

US$1.00 = F$1.39

FISCAL YEAR

January 1 to December 31

ACRONYMS

ADB	Asian Development Bank
AFRA	Average Freight Rate Assessment
CCOP	Coordinating Committee for Ocean Prospecting
CPO	Central Planning Office
DOE	Department of Energy
EGM	Emperor Gold Mines
ESCAP	Economic and Social Commission for Asia and the Pacific
FINAPECO	Fiji National Petroleum Company
FNPF	Fiji National Provident Fund
FSC	Fiji Sugar Corp
GOF	Government of Fiji
PAFCO	Pacific Fisheries Co.
PIB	Prices and Incomes Board
PEDP	Pacific Energy Development Programme
PWD	Public Works Department
SOPAC	South Pacific Applied Geosciences Commission
VLIS	Viti Levu Interconnected System

ABBREVIATIONS

ADO	automotive diesel oil
IDO	industrial diesel oil
IFO	industrial fuel oil
IOC	international oil company
LCT	local coastal tanker
MR	medium range
OTEC	ocean thermal energy conversion
PV	photovoltaic

MEASUREMENTS

bbl	barrel = 159 liters
kgoe	kilograms of oil equivalent
kl	kiloliter
MB	thousand barrels
MT	metric ton
TOE	tons of oil equivalent

This report is based on the findings of an energy assessment mission, which visited Fiji in February 1991. The mission comprised Andres Liebenthal (mission leader - World Bank), Magdalena Manzo (financial economist - World Bank), Herbert Wade (rural and renewable energy specialist - consultant), Michael Charleson (power engineer - consultant), William Matthews (petroleum specialist - consultant), Douglas Macdonald (power economist - consultant) and Chuck Filiaga (assistant power planner - PEDP).

Pacific Islands Series
Report No. 1
Volume 4

FIJI

ISSUES AND OPTIONS IN THE ENERGY SECTOR

August 31, 1992

Abstract

Fiji, a large Pacific Island country, is a diversified middle-income economy. The establishment of Finapeco, a company intended to replace international oil companies, will adversely affect Fiji, and the report recommends that Finapeco be wound down as soon as possible. The petroleum pricing system should be reformed in two steps. First, the current system's technical deficiencies should be eliminated, and second, prices should be fully deregulated, accompanied by effective regulation in non-price areas. FEA, the power utility, should reduce its high transmission and distribution losses, exploit the cogeneration potential of industrial operations, and base its tariffs on marginal costs. The Government should provide financial support to FEA, and require FEA to establish an effective cash and debt management program, while leaving FEA fully accountable for the management of corporate funds and its service operations. In the near term, hydro power has the greatest potential for renewable energy development. Since Fiji's hydro resources are being investigated adequately, there is no need for changes in the existing programs. The costs of rural electrification have become a significant burden, and the Government should consider carefully any proposals for stand-alone rural electrification projects. If it is decided to pursue solar powered TV and video systems for use in the remote areas, an organization with an adequate technical and administrative capability for solar based rural electrification should be created.

Industry and Energy Operations Division
Country Department III
East Asia & Pacific Region

FIJI

ISSUES AND OPTIONS IN THE ENERGY SECTOR

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ENERGY CONVERSIONS AND MEASUREMENTS

	Unit	Typical Density kg/litre	Typical Density l/tonne	Gross Energy MJ/kg	Gross Energy MJ/litre	Oil Equiv toe/unit (net)
Biomass Fuels						
Fuelwood (5% mcwb)	tonne			18.0		0.42
Coconut Residues (air dry) [1]						
Shell (15% mcwb)$_{harvested}$	tonne			14.6		0.34
Husk (30% mcwb)$_{harvested}$	tonne			12.0		0.28
Average (air dry$_{husk\ and\ shell}$) [2]	tonne			14.0		0.33
Coconut Palm Wood (air dry)	tonne			11.5		0.27
Charcoal				30.0		0.70
Vegetable and Mineral Fuels						
Crude Oil	tonne			42.6		1.00
Coconut Oil	tonne	0.910	1100	38.4		0.90
LPG (propane)	tonne	0.510	1960	50.0	25.5	1.17
Ethanol	tonne			27.0		0.63
Gasoline (Super)	tonne	0.730	1370	46.5	34.0	1.09
Gasoline (Unleaded)	tonne	0.735	1360	46.5	34.2	1.09
Aviation Gasoline (Avgas)	tonne	0.695	1440	47.5	33.0	1.12
Lighting Kerosene	tonne	0.790	1270	46.4	36.7	1.09
Power Kerosene (Avtur, DPK)	tonne	0.795	1260	46.4	36.9	1.09
Automotive Diesel (ADO)	tonne	0.840	1190	46.0	38.6	1.08
High Sulphur Fuel Oil (IFO)	tonne	0.980	1020	42.9	42.0	1.01
Low Sulphur Fuel Oil (IFO)	tonne	0.900	1110	44.5	40.1	1.04
Electricity (MWh)						
Fuelwood [3]	MWh					0.93

Fuel Conversion Efficiency

Diesel: Text uses actual where known, otherwise:

Average efficiency for small (< 100 kW output) diesel engine 0.46 l/kWh (22%).
Average efficiency of large (>100 kW output) modern diesel 0.284 l/kWh (36%).
Average efficiency of low speed, base load diesel (Pacific region) 0.30–0.33 l/kWh (28–32% eff).

Energy Measurements

Area: 1.0 km^2 = 100 hectares = 0.386 mi^2
1.0 acre = 0.41 hectares

Mass: 1.0 long tons = 1.016 tonnes

Energy: 1 kWh = 3.6 MJ = 860 kcal = 3412 Btu = 0.086 kgoe
1 toe = 11.83 MWh = 42.6 GJ = 10 million kcal = 39.68 million Btu
1 MJ = 238.8 kcal = 947.8 Btu = 0.024 kgoe = 0.28 kWh

Notes: (1) Average yield of 2.93 air dry tonnes residues/tonne copra produced (Average NCV 14.0 MJ/kg) mcwb = moisture content wet basis. NCV = net calorific value.
(2) Proportion: kernel 33%, shell 23%, husk 44% by dry weight.
(3) Assumes converson efficiency of 9% (biomass–fuelled boiler).

EXECUTIVE SUMMARY

1. Fiji is a large Pacific Island economy, with a land area of 18,272 km^2, a population of about 725,000, and a per capita income of about US$1,700. Most of the population and economic activity is concentrated on two large islands--Viti Levu and Vanua Levu. Fiji is a diversified middle-income country which has an internationally competitive sugar industry, a significant industrial base, well-developed tourism, and good prospects for further development of forests, fisheries, and agriculture. In the early 1970s, Fiji experienced a strong economic performance, but from the mid-1970s, growth slowed and became erratic. There was very little growth in 1980-85, a decline in 1987, with recovery in 1989. Fiji can improve its economic performance in the 1990s by adopting cautious fiscal and monetary policies, possible exchange-rate adjustments, reducing distortions and deregulating economic activity.1/

2. The major energy-related agencies are the Department of Energy (DOE) within the Ministry of Civil Aviation, Tourism and Energy, the Public Works Department (PWD), and the Prices and Incomes Board (PIB). DOE is solely responsible for national energy policies, energy conservation and renewable energy implementation, and shares responsibility for rural electrification with the Fiji Electricity Authority (FEA) and PWD. DOE is also responsible for issues related to petroleum and electricity supply, particularly tariff structures and proposals for major capital investment. DOE provides advisory services to FEA, and advises GOF on petroleum supply. The PIB regulates the wholesale and retail prices of petroleum products.

Petroleum Subsector

3. Fiji imports all of its petroleum in the form of finished products, with the market shared by three international oil companies. LPG (butane) is imported and distributed by two other companies. This supply arrangement is efficient and the effective landed cost allowed by PIB is reasonable.

4. Fiji's consumption of petroleum products grew at 2.2% over 1985-90, with a decline in 1987. The major inland products are ADO, motor spirit, and IDO. Kerosene is primarily used for household lighting and cooking. Total Fiji consumption is projected to increase at a rate of 3.7% per annum over 1990-2000, while inland consumption alone is projected to increase at 4.8% per annum.

Finapeco

5. Fiji has recently established the Fiji National Petroleum Company (Finapeco) to replace the international oil companies in order to (i) bring onshore to Fiji some of the present offshore trading profits, (ii) put the control of petroleum supply in indigenous Fijian hands, and (iii) possibly in the longer term, engage in refining in Fiji. In late 1991, Finapeco is scheduled to become the exclusive petroleum product supplier. Finapeco will arrange with

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1/ For a discussion of Fiji's economic situation and prospects, see Toward Higher Growth in Pacific Island Economies: Lessons from the 1980s, World Bank Report No. 9059-ASIA, January, 1991.

Petronas, Malaysia for the purchase/supply of 10,000 bbl/day of crude, and with Esso (Singapore) for the processing of 10,000 bbl/day of crude, and the supply, including freight, of appropriate refined petroleum products to meet Fijian requirements.

6. The establishment of Finapeco with a monopoly on the import of oil will have adverse economic and financial implications for Fiji, as well as for the neighboring countries that are linked to Fiji through the existing petroleum supply network. Further, Finapeco's establishment is not consistent with the GOF's broader development objectives, such as reducing the role of the state and increasing the level of competition in the economy.

7. The incremental economic and financial costs of Finapeco to Fiji are estimated to be about F$1.6 million (US$1.1 million) and F$4.3 million (US$3.1 million) per year, respectively. The sources of these incremental costs are (i) Finapeco's higher FOB cost of product, (ii) Finapeco's higher marine freight cost, (iii) Finapeco's higher onshore margin, (iv) Finapeco's higher overhead charge, and (v) Finapeco's letter of credit and interest costs. In contrast, Finapeco's benefits are unclear. Finapeco is unlikely to improve product quality, security of supply, or the extent of indigenous Fijian control over the supply of fuel.

8. Finapeco is an additional burden on GOF in terms of incremental costs to the consumer, diversion of scarce managerial capacity, and additional commercial risks. In addition, there is a risk that in the long-term Finapeco's monopoly status will lead to a gradual loss of efficiency and a reduced responsiveness to customer needs.

9. In order to avoid the incremental costs as well as the long-term risks, it is recommended that the GOF should wind down Finapeco as soon as possible, before additional costs are incurred.2/ Such a decision would also benefit neighboring countries that are linked to Fiji through the existing petroleum supply network.

Petroleum Prices

10. The PIB's price regulatory framework has kept petroleum prices at reasonable levels, but it has some deficiencies. First, the system lacks transparency, clarity, regularity and standardization. Second, there is no provision for regular standardized submissions of company cost data for adjustment of internal distribution factors in the price buildup. Third, the PIB Secretariat's expertise in the area of international product supply, pricing and affreightment is not well-developed.

11. A two-phase approach to price reform is recommended. First, the above deficiencies in the PIB's system should be eliminated, with technical assistance from specialized experts. Later, once the improved system has been functioning for some years, there should be complete price deregulation, accompanied by effective regulation in non-price areas such as weights and measures, facilities design and inspection, safety, quality control, etc.

2/ In August 1992, the GOF announced its decision to shut down Finapeco.

Electricity Subsector

12. FEA, a wholly Government-owned statutory authority, is responsible for the generation, transmission and distribution of electrical power in Fiji; at present, FEA supplies electricity on Viti Levu, Vanua Levu, and Ovalau. At the end of 1990, FEA had 72,500 consumers, classified as domestic (86%), commercial and industrial (12%), and others (2%). FEA is the most advanced power utility in the Pacific islands region.

13. In 1990, FEA had sales of 369 GWh, with the bulk 94%) of the sales coming from the hydro-based Viti Levu Interconnected System (VLIS). FEA also operates isolated diesel systems at Rakiraki (on Viti Levu), Labasa and Savusavu (on Vanua Levu), and Levuka (on Ovalau). Over 1985-90, overall FEA sales increased at an average annual rate of 5.3%, with a decline in 1987; sales of the isolated systems generally increased more rapidly, starting from an initial low base.

14. Commercial and industrial consumers accounted for nearly 80% (277.4 GWh) of total 1990 VLIS sales, with the largest consumer, Emperor Gold Mines (EGM), alone accounting for 61.5 GWh, which is almost 18% of the total. The Fiji Sugar Corp (FSC) is a large captive power producer that also buys and sells electricity to FEA. FSC supply is important at Labasa and Rakiraki, but on the VLIS, FEA has not purchased significant amounts of energy from FSC since 1986.

15. Load Forecast: VLIS sales are projected to increase, in the base case, at a rate of 3.3% a year to 2000, with the low and high growth rates being 2.8% and 3.9%, respectively. The bulk of the increase in sales is projected to come from commercial customers. For the isolated systems, Rakiraki sales are projected to increase at 4.9%, Labasa sales at 6%, Savusavu sales 4.9%, and Levuka sales at 5.1% per annum.

16. Transmission and distribution losses on the FEA system range from 9.2% in Labasa to 6.2% in Levuka. These losses can be gradually be reduced, particularly on the 11 kV and low voltage distribution systems. To reduce the losses, it is recommended that FEA review its present design criteria for the distribution systems. To further reduce losses on all plant, transformers, and lines in an economical manner, it is recommended that FEA raise the power factor to 0.9, effective after a grace period of, say, three years.

17. The reliability of supply criteria is critical in determining the VLIS expansion plan. FEA's reliability of supply criteria require sufficient diesel generating capacity, both on the eastern and western sides of the main island, to meet at least 85% of peak demand in the event of transmission line failure. While the risks of transmission line failure are real, in order to eliminate the costs associated with FEA's reliability criteria, it is recommended that FEA formulate a relaxed reliability of supply criteria, and study alternative approaches for achieving it.

18. FEA's expansion plan: FEA will be able to meet the increasing electricity requirements in its existing supply areas, with moderate scope for expansion, with an investment program averaging F$6.2 million (in constant 1990 F$) per year over the 1991-2000 period (see Table 3.6). There may be no need for capacity expansion for the VLIS, though the isolated systems will need additional

capacity. If FEA's reliability of supply criteria are relaxed, there will be adequate generating capacity to meet the projected VLIS load until the early 2000s. Hence, the expansion plan does not call for any plant additions; however, if the larger diesel units are not capable of baseload operation for lengthy periods, then it will be necessary to consider the addition of a large diesel unit, or an equivalent hydro development. Repairs to the foundation of one of the diesel units, and the transfer of an out-of-service MW diesel unit from Suva to Kinoya will add 6 MW of capacity to the system at relatively small cost.

19. Other Investment: Although there is some technical justification for FEA's planned subtransmission and distribution expenditures for VLIS for the period to 2000, FEA may not be able to afford them, given its precarious financial condition. Hence, it is recommended that FEA review these and other prospective investments closely in the next few years in light of its evolving financial situation.

20. Monasavu capacity: There are indications that the firm and average reservoir capacity of the Monasavu scheme may exceed the current estimates. A proposed study will assess the firm and average capability of the reservoir, on the basis of newly available data. It is recommended that the first phase of this study start as soon as possible, and that the second phase of the study include the development of a reservoir operating rule curve.

21. It is recommended FEA exploit the cogeneration potential of a number of industrial operations, particularly FSC, which is the largest potential cogenerator. It is recommended that FEA aggressively pursue the possibility of power purchases from FSC at Lautoka for the VLIS.

22. Isolated systems expansion plans: The recommended development plans for the isolated systems include: for Rakiraki, the installation of two 365 kW diesel units in 1991, the retirement of one 365 kW unit at that time, and the installation of another 365 kW unit in 1997 or 1998; for Labasa, the transfer of three 1.14 MW units to the new station during the next three years, and the installation of an additional 1.6 MW unit in 1993 and 1997; and for Levuka, additional 365 kW units in 1992 and 1993. FEA may have to curtail its planned subtransmission, distribution and rural electrification reinforcements and extensions because of its financial difficulties.

23. Electricity Tariffs: It is recommended that electricity tariffs be based on the marginal costs of electricity supply, which have been recently developed in an ADB funded study. This will imply a substantial restructuring of the electricity tariff. The across-the-board 10% tariff increase instituted in August, 1991 did not restructure the tariff.

Strengthening FEA

24. FEA's financial position is now considerably worse than it was in 1989, and FEA lacks a working capital base. Hence, it is recommended that FEA be strengthened by establishing an effective cash and debt management program.

25. Financial Recommendations: Even with domestic debt restructuring and a freeze on capital expenditures in 1991, provided that working capital is kept at a two-month level, FEA will be short of funds in 1991. In order to prevent FEA

from incurring further overdrafts and short-term debt and allow FEA to rebuild its equity base, it is recommended that (i) GOF inject fresh equity of at least F$15 million in 1991, (ii) FEA's promissory notes be converted into longer term debt by floating FEA bonds, (iii) the average tariff be increased by 6.5%, effective immediately (over and above the 10% increase instituted in August, 1991), followed by 10% nominal increases in 1992, 1993, and 1994, and (iv) GOF provide the funds to finance any capital expenditures, but insist that tariffs be high enough to attain an 8% rate of return on the revalued rate base.

26. It is recommended FEA continue to remain fully accountable for the management of corporate funds and its service operations. However, FEA should apply tight financial controls, and the FEA annual budget should not include additional short-term borrowing or bank overdrafts. Further, FEA management should adopt a closely monitored rolling cash flow plan, with clear priorities for expenditures for each functional group.

27. In order to enable FEA to formulate its strategies with adequate lead time, it is recommended that FEA pursue multi-year plans, including a three-year indicative budget, which will give direction to and complement the rolling cash flow plan. This planning will require additional staff in FEA's system planning and development department.

28. Two changes are needed in FEA's accounting practices to bring them into line with normal accounting practices. The first change relates to the effect of devaluations on FEA's assets, while the other change relates to the depreciation rate charged on assets. Further, it is recommended that a comprehensive physical and cost appraisal of FEA's assets be made, and that results be used as the basis for restoring the appropriate value of equity and future depreciation charges. It is also recommended that FEA adopt asset revaluation as an accounting policy.

Rural Electrification

29. Fiji's rural electrification system has become increasingly strained because (i) FEA has reached the economic limit of grid extensions for rural districts, and (ii) the number of stand-alone projects to be installed and administered by PWD and DOE has expanded well beyond the ability of either organization to administer and maintain.

30. The costs of rural electrification are a significant burden. At present, rural electrification requires a subsidy estimated to be over F$1 million per year. This subsidy will be substantially higher if proper operation and maintenance capability is not present, as is the case with the proposed projects.

31. At present, there are proposals for two major stand-alone rural electrification projects with a total investment of F$8.21 million (Lakeba, Gau, Koro, Moala and Rotuma) in stand-alone diesel systems, and F$3.5 million (Taveuni) for stand-alone hydro. In order to ensure that the rural electrification investment programs are economically and socially justified, it is recommended that the proposals for the expansion of rural electrification be re-evaluated.

32. If it is decided to pursue these projects, then a specialist agency must be developed to take care of the technical and administrative operations of all stand-alone rural electrification schemes. Hence, it is recommended that a Rural Electrification Authority be created, preferably using the PWD rural electrification group as a core. This Authority would design, install and manage these new projects as well as accepting all existing stand-alone rural electrification projects under its management umbrella.

Renewable Energy

Solar

33. Solar energy is widely used in urban areas for water heating, and there does not appear to be a market beyond domestic and light commercial water heating. The market is developed and increasing well, and no government attention is recommended.

34. In addition, there are household solar lighting systems, remote village solar radio-telephones, inter-island solar HF communication links, and a number of solar buoy and lighthouse installations. While the communications and marine marker systems appear to be working well, the domestic lighting systems have a high failure rate because of inadequate maintenance. The systems thus far have been designed, installed and maintained by DOE, which does not have the proper organization or manpower.

35. Nationally broadcast television, which is likely in the near future, is expected to create a strong demand for rural electrification. Fiji commercial interests and DOE are presently evaluating solar powered TV and video systems for use in the remote areas.

36. Photovoltaic applications will be particularly useful in the more remote islands, for which the data are not being collected at present. Hence, it is recommended that the DOE, in coordination with the Fiji Meteorological Service and the Forum Secretariat Energy Division, select additional remote sites for solar radiation data collection and seek donor assistance for implementation.

37. Though the market pressures may be strong for electrification through solar photovoltaics, the support for rural solar power is weak. Unless an organization is created with an adequate technical and administrative capability for solar based rural electrification, the past failure of solar photovoltaic projects will be repeated. The proposed Rural Electrification Authority could have this responsibility.

Biomass

38. The largest fuel quality biomass resource is waste from the processing of sugar cane, cocoa, coconut and rice, of which bagasse (from sugar cane) is the largest quantity. Bagasse has been used for many years to fire sugar mill boilers for process heat, and the Labasa and Rakiraki mill also produces cogenerated electricity. The efficiency of the use of bagasse for process heat and electricity production can be improved by capital investment in storage facilities at Labasa and in more efficient boilers, additional generating equipment and bagasse storage at the Lautoka and Rakiraki sites. These

investments would be economically attractive provided FEA were to purchase electricity at a rate comparable to its diesel production costs. In view of the benefits to FEA from purchasing cogenerated electricity, it is recommended that FEA provide further incentives for expanded bagasse-based electricity production on Viti Levu and Vanua Levu.

39. The husks and shells that are the by-products of the copra industry are mainly used to dry copra. On large scale plantations, it is possible to generate electricity as a by-product of the drying process.

40. Fiji's forestry and mill waste from the harvesting and processing of pine and plantation hardwoods is also a significant biomass energy resource. While large-scale projects based on the harvesting and processing of indigenous hardwoods are uneconomical, small-scale use for plant process heat and, in some cases, steam-based electrical generation to service the processing facility may be practical. Such uses should be incorporated on a project by project basis. In order to use this potential resource, it is recommended that DOE develop a program for technical and financial assistance, in association with donors, to encourage appropriate development of small-scale biomass utilization at indigenous hardwood processing sites.

41. The production of lumber and other products based on <u>pine plantation trees</u> presently results in over 30,000 MT of fuel quality biomass waste each year, and production increases are forecast through the next decade. Since this resource is concentrated at three sites, it can be used for energy purposes. While significant amounts of this waste are already being utilized for process heat and sawmill power, if FEA were to price its purchases at the equivalent of its avoided cost, this would provide the appropriate incentives for investment in electrical production for provision to the grid.

42. Except in the core urban areas, there is no evidence of households having difficulty in obtaining fuelwood, though in some areas convenient access to household fuels may become difficult within the next ten years. In the future, large scale forestry programs may be able to provide continuing convenient access to fuelwood.

43. The staff of the Forestry Department is insufficient to fully enforce the forestry laws and regulations, so that violators are not always caught, and nor are those caught always prosecuted. In order to ensure that forestry rules are observed, it is recommended that the strength of the Forestry Department be increased.

<u>Hydro</u>

44. In the near term, hydro power has the greatest potential for renewable energy development. There are over 70 sites that have hydroelectric potential ranging from 50 kW to several megawatts, of which about ten sites appear to have economic promise. There are also over 15 sites with hydroelectric potentials below 50 kW, of which no more than five sites appear to have economic promise. These identified sites require additional investigation, particularly stream monitoring and general hydrological data collection, before the decision to develop is made. Since Fiji's hydro resources are being identified and

investigated in an adequate and timely manner, no change in the existing programs is recommended.

45. Wind power, geothermal energy, OTEC, and wave energy: Since these sources of energy are still experimental, particularly in the Pacific Islands environment, it is recommended that no major investments be undertaken, but, in order to permit future development, low-cost data collection be undertaken.

I. THE ECONOMIC AND INSTITUTIONAL CONTEXT

Energy and the Economy

1.1 Among the Pacific Island economies, Fiji stands out in terms of its size and levels of economic and social development. With a land area of 18,272 km^2, Fiji's population was estimated to be 725,000 in 1990, with a per capita income of approximately US$1,700. Fiji has about 300 islands, but most of the population and economic activity is concentrated on two large islands - Viti Levu and Vanua Levu. In overall economic terms, Fiji is a diversified middle-income country which has an internationally competitive sugar industry, a significant industrial base, well-developed tourism, and good prospects for further development of forests, fisheries, and agriculture.

1.2 In the early 1970s, Fiji experienced a strong economic performance, but from the mid-1970s, growth slowed and became erratic. In the period 1980-85, there was very little increase in real GDP. The economic situation deteriorated after the military coup in May, 1987. However, the economy quickly stabilized at reduced levels of activity, revived in 1989, and the 1990 growth rate in nominal GDP was estimated to be 4%. In 1989, Fiji's balance of payments showed a current account deficit which was approximately 3% of the GDP. The import of petroleum products was approximately 16% of total imports and approximately 28% of merchandise exports. Selected economic indicators are shown in the Statistical Appendix, Table 1.

1.3 In the early 1980s, Fiji constructed the Monasavu hydroelectric project. As a result, there was a sharp reduction in the quantity of imported diesel needed for thermal generation of electricity.

1.4 Fiji's economic performance in the 1990s can be much better than that achieved in 1980s. This improvement will require full recovery of private investment, based on major changes in economic policies. The basic need is for a macroeconomic policy framework conducive to further development. This framework call for cautious fiscal and monetary policies, and possible exchange-rate adjustments. Further, economic efficiency should be promoted by reducing distortions and deregulating economic activity.1/

Institutional Framework

Government of Fiji

1.5 Fiji's major energy-related agencies are the Department of Energy (DOE) within the Ministry of Civil Aviation, Tourism and Energy, the Public Works Department (PWD), and the Prices and Incomes Board (PIB). DOE has direct responsibility for national energy policies, energy conservation and renewable energy implementation. DOE shares responsibility for rural electrification with the Fiji Electricity Authority (FEA) and PWD, with FEA providing rural grid extensions, PWD providing rural village diesel generation, and DOE providing

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1/ For a discussion of Fiji's economic situation and prospects, see Toward Higher Growth in Pacific Island Economies: Lessons from the 1980s, World Bank Report No. 9059-ASIA, January 1991.

micro hydro, small steam and solar photovoltaic (PV) power to rural communities. DOE is also responsible for issues related to petroleum and electricity supply, particularly tariff structures and proposals for major capital investment. DOE provides advisory services to FEA, and advises GOF on petroleum supply and mining. The PIB regulates the retail prices of gasoline, kerosene, and automotive diesel oil (ADO), which are formally under the jurisdiction of the Ministry of Finance.

Power Subsector

1.6 FEA is a wholly Government-owned statutory authority, established under the Electricity Act of 1966 from the merger of three local utilities. FEA is responsible for the generation, transmission and distribution of electrical power in Fiji. At present, FEA supplies electricity on Viti Levu, Vanua Levu, and Ovalau.

1.7 FEA, a well managed organization, is the most advanced power utility in the Pacific Islands region. FEA operates its power systems with a high level of service reliability, and has excellent facilities for the repair and maintenance of electrical and electronic equipment and for the calibration of meters. It has good training facilities, with an active training and apprenticeship program.

Petroleum Subsector

1.8 Fiji has no known indigenous petroleum resources and imports all of its present inland and bunker consumption in the form of finished products. The procurement, storage and distribution of liquid products is shared by affiliates of three multinational companies--BP, Mobil and Shell, whose market shares in 1990 were 25%, 29%, and 46%, respectively.

1.9 Petroleum products have been traditionally supplied in medium-range (MR) tankers through the companies' affiliate network from refineries in Australia, New Zealand and Singapore to their marine terminals in Fiji. Each company owns and operates terminals in both Vuda (near Nadi) and Suva; in addition, Mobil leases two tanks at Vatia (owned by Emperor Gold Mines) and owns a small terminal at Labasa (on Vanua Levu). Shell has a throughput arrangement with Mobil at the Labasa depot.

1.10 Most of the road haulage of petroleum products to retail outlets is by independent companies, although these independent truckers receive financial backing from the petroleum companies and bear the company logos on the trucks. There are also independent jobbers with their own fleet of small trucks, who deliver petroleum products to small outlets and bulk purchasers. There are a total of 72 company petroleum outlets in Fiji--69 on Viti Levu, 3 on Vanua Levu.

1.11 LPG (butane) is imported and distributed by two companies--Fijigas and Bluegas. Fijigas, owned 51% by Boral, Australia and 49% by 27 local shareholders, dominates the Fiji market with approximately 95% of the volume. Fijigas imports its LPG from Australia. Small pressurized tankers in the 1,300 metric ton (MT) range drop part cargoes at marine terminals in Suva, Lautoka and Labasa. Bluegas, jointly owned by the Punja Group (45%), Elf (25%), Total (25%) and Fiji Development Bank (5%), commenced operations only in 1989 and is building

up its market. Bluegas has one terminal at Vuda Point into which small parcels of LPG are offloaded from small tankers.

1.12 The LPG terminals include cylinder-filling and bulk truck-loading facilities on-site. There is also a small Fijigas cylinder-filling depot at Sigatoka, with 4 MT of storage capacity. The most common distribution mode is in 13 kg cylinders for domestic use. There are larger cylinders, up to 50 kg for larger domestic or commercial use, as well as bulk distribution via road tankers.

Fiji National Petroleum Company (FINAPECO)

1.13 Finapeco was established by a cabinet order on November 13, 1990. It has been registered as a limited company, with an approved capital of F$6 million. While its formal mandate and objectives are not known precisely, interviews with the GOF and company officials indicate that the objectives are to:

(a) To bring onshore to Fiji some of the present offshore trading profits and activities of product procurement and freight transport.

(b) To put the control of petroleum supply in indigenous Fijian hands.

(c) Possibly longer term, to engage in refining in Fiji.

1.14 The initial operating plans of Finapeco are to manage, under an exclusive license, replacing BP, Mobil, and Shell, the entire petroleum product procurement and affreightment for Fiji. By late 1991, Finapeco is scheduled to take control of the product supply function, providing petroleum products into the marine receiving depots of the three existing distributors. There are no immediate plans for Finapeco to own or operate any of the product receiving, storage and distribution infrastructure of Fiji.

II. ENERGY CONSUMPTION

Petroleum Products

2.1 In 1990, total petroleum consumption, both inland and bunkers, was 377,000 kl, up from 337,000 kl in 1985, for an annual growth rate of 2.2% over the period. The consumption of all products suffered a decline in 1987 as a result of the economic impact of two military coups, but recovered to pre-coup levels by 1989, and continued increasing in 1990, buoyed by rapid GDP growth. Excluding products in international trade, the 1990 inland consumption at 252,000 kl has increased at a faster rate than overall consumption, at approximately 3.3% per annum over 1985-90. These growth rates compare with average real GDP growth of about 4% per annum over this period. As a guide to recent sectoral end-use, Table 2.1 provides a breakdown of inland consumption for 1990, while Annex 1 provides a summary of petroleum product consumption over the past six years.

Table 2.1: SECTORAL BREAKDOWN, INLAND CONSUMPTION OF PETROLEUM PRODUCTS, 1990 (kl)

	Domestic	Trans-port	Commer-cial	Indus-trial	Public Power Gener.	Non-Energy	TOTAL
LPG	8,209	0	1,437	1,437	0	0	11,082
Avgas	0	1,795	0	0	0	0	1,795
Motor Spirit	0	62,183	0	0	0	0	62,183
Solvent	3,231	0	0	0	0	0	3,231
Kerosene	21,551	0	0	0	0	0	21,551
ADO /a	0	93,056	0	13,294	0	0	106,350
IDO /a	0	0	0	26,424	7,361	0	33,785
IFO	0	0	0	6,556	0	0	6,556
Lubes	0	0	0	0	0	5,234	5,234
TOTAL	32,991	157,034	1,437	47,710	7,361	5,234	251,767

/a All of the IDO and a portion of the ADO consumed in the Industrial sector is used in private power generation.

Source: Mission estimates.

2.2 Among the major inland products, automotive diesel oil (ADO) has shown a growth rate of 4.0% per annum over 1985-90. ADO is used predominantly for transportation with private power generation accounting for less than 10% of total consumption. The consumption of motor spirit, all in transportation, has increased at a slower rate, approximately 2% per annum over 1985-90. Most of the growth in industrial diesel oil (IDO) consumption, approximately 5.8% per annum over 1985-90, is due to increased use by FEA; the general industrial use has not

changed significantly over 1985-90. As indicated by the sectoral breakdown for 1990, all of the industrial use is for in-house power generation. The other industrial fuel is IFO, which at a consumption of approximately 6,500 kl per year is a minor product in the energy balance. Its consumption fluctuates in response to factors related to activity in two or three key industries such as cement, sugar and brewing.

2.3 Kerosene is primarily used for household lighting and cooking applications. Growth at 4.1% per annum has been unusually strong over 1985-90 when compared to other developing countries of similar economic rank, where kerosene consumption for rural lighting and some cooking typically increases less than 1% per annum. (Table 2.1 and Annex 1). Since the volume of consumption in Fiji is small, the explanation may lie in a small "leakage" into other applications and/or a mis-classification of market disposition.

2.4 The other household fuels are "solvent", a white gasoline used primarily in mantle-type lamps and ironing in rural areas, and LPG. While solvent consumption is minor and declining, LPG is increasing at a rate of approximately 10% per annum.

2.5 As in most small countries with some international aviation and bunker business, there is no clear trend in the consumption of jet fuel or in diesel and fuel oil bunkers for marine use, because these uses depend heavily on regional traffic patterns and relative pricing, which can vary widely and are often beyond the control of the host country. There is rarely any close relationship between the consumption of these products and growth in the economy.

Demand Forecast

2.6 The forecast to the year 2000 of petroleum product consumption is shown in Table 2.2. On the assumption that the real GDP will increase at 4.0% per annum over 1990-2000, total consumption is projected to increase from 377 thousand kl in 1990 to approximately 540 thousand kl by the year 2000, at an average growth rate of 3.7% per annum over 1990-2000. The corresponding average growth rate for inland consumption alone is 4.8% per annum.

2.7 It is estimated that the growth rate of automotive driving activity will be approximately equal to the real GDP growth rate. It is expected that gasoline-driven vehicles will become more efficient over 1990-2000, i.e., the average km/l will increase, by 9%. This results in a 3.0% per annum growth in motor spirit use. It is expected that there will be no net efficiency gains for the ADO-fuelled vehicles, and ADO consumption growth is projected to increase at the same rate as real GDP.

Table 2.2: SUMMARY FORECAST OF PETROLEUM PRODUCTS CONSUMPTION

	Forecast 1990-2000 per annum	1990 (actual)	1995	2000
INLAND		MT		
LPG	10.0%	6,372	10,262	16,527
		kl		
LPG	10.0%	11,082	17,847	28,743
Avgas	4.0%	1,795	2,184	2,657
Motor Spirit	3.0%	62,183	72,087	83,569
Solvent	0.0%	3,231	3,231	3,231
Kerosene	1.0%	21,551	22,650	23,806
ADO	4.0%	106,350	129,391	157,424
IDO (to FEA)	22.7%	7,361	31,313	57,148
IDO (to Industry)	1.0%	26,424	27,772	29,188
IDO (Total)	9.8%	33,785	59,085	86,337
IFO	2.0%	6,556	7,238	7,992
Lubes	4.0%	5,234	6,368	7,748
TOTAL INLAND	4.8%	251,767	320,082	401,506
INTNL AV & BUNKERS				
Jet A1	0.0%	97,116	97,116	97,116
ADO	4.0%	12,539	15,256	18,561
IDO	4.0%	6,310	7,677	9,340
IFO	4.0%	8,927	10,861	13,214
TOTAL AV/BUNK	1.0%	124,892	130,910	138,231
TOTAL FIJI	3.7%	376,659	450,991	539,737

Source: Annex 2.

2.8 Sales of IDO to industry are projected to continue to increase at the historical rate of 1.0% per annum. The sales of IFO to industry are forecast to increase at 2.0% per annum, slightly lower than the 2.4% experienced over 1985-90. Kerosene consumption is forecast to increase at 1.0% per annum. The use of solvent is projected to remain at the current level. The consumption of LPG is projected to continue to increase rapidly, at an average growth rate of 10% per annum, as households gradually shift from kerosene to LPG for cooking. The

resultant LPG consumption of 16,500 MT per year by the year 2000 would imply that roughly 50% of the households would use LPG as the prime cooking fuel.

2.9 Given the difficulty of forecasting the use of petroleum products in international aviation and bunkers, it was assumed that jet fuel consumption will remain flat at 1990 levels through the forecast period, and the diesel/fuel oil use in bunkers will increase at a 4.0% per annum rate, matching real GDP growth. The specialty products, avgas and lubricants, are projected to increase at 4.0% per annum, which is equal to the GDP growth rate but slightly lower than the historical growth rate.

Electricity

2.10 In 1990, the Fiji Electricity Authority (FEA) had sales of 369 GWh, with the bulk (approximately 94%) of the sales coming from the hydro-based Viti Levu Interconnected System (VLIS), a grid system which serves the principal towns and many villages on the main island of Viti Levu. FEA also operates isolated diesel systems at Rakiraki (on Viti Levu), Labasa and Savusavu (on Vanua Levu), and Levuka (on Ovalau). Of FEA's 72,500 consumers in 1990, nearly 86% were residential, 12% were commercial/industrial, and 2% were other consumers.

2.11 From 1985 to 1990, overall FEA sales increased at an average annual rate of 5.3% (Table 2.3), with a decline in 1987, following the coups, and then recovered. For the same period, VLIS sales increased at 5.1% a year, while sales of the isolated systems generally increased more rapidly, starting from an initial low base.

Table 2.3: FEA HISTORICAL ELECTRICAL SALES
(GWh)

System	1985	1986	1987	1988	1989	1990	Av. annual growth (%)
Viti Levu	270.0	296.0	293.0	304.0	324.0	347.0	5.1
Rakiraki	1.6	1.7	2.0	2.0	2.0	2.2	7.5
Labasa	11.2	11.29	11.50	11.86	12.84	13.74	4.2
Savusavu	1.2	1.8	1.8	2.0	2.2	2.5	16.9
Levuka	1.0	1.0	2.4	3.4	3.6	3.8	31.6
Total	284.9	311.8	310.7	323.3	344.8	368.9	5.3

Source: FEA.

2.12 Commercial and industrial consumers accounted for nearly 80% (277.4 GWh) of total 1990 VLIS sales, with the largest consumer, Emperor Gold Mines (EGM), alone accounting for 61.5 GWh, which is almost 18% of the total. FEA

sells electricity to EGM at a concessional rate 2/ in order to utilize excess energy available from the Monasavu hydropower development, but it is expected that excess hydropower will soon no longer be available, probably in 1991/92. Residential consumers (65.0 GWh) accounted for nearly 19% of 1990 VLIS sales, and street lighting and institutions for the rest.

2.13 The Fiji Sugar Corp (FSC) is a large captive power producer that also buys from and sells electricity to FEA. FSC supply is important at Labasa and Rakiraki, but on the VLIS, FEA has not purchased significant amounts of energy from FSC since 1986.

2.14 Over 1985-90, the electricity sales in Rakiraki increased at 7.5% per annum, mainly from the extension of the system into the more rural surrounding areas, while the sales to FSC, the largest consumer with 26% of total 1990 Rakiraki sales, have remained essentially constant. The average annual growth rate of Labasa sales was 4.2% per annum; the major consumers are FSC (12% of Labasa 1990 sales) and Fiji Forest Industries. Savusavu sales increased at 16.9% per annum; the Government-owned copra mill is the largest consumer, accounting for 46% of total Savusavu sales. Levuka sales increased at 31.6% per annum, mainly from the growth of Pacific Fisheries Co. (PAFCO) operations, with PAFCO accounting for 60% of Levuka 1990 sales. PAFCO is currently expanding and upgrading its production facilities, which are scheduled to be in full operation by 1992.

Load Forecast - VLIS

2.15 FEA's sales forecasts for the VLIS are based upon an econometric model that forecasts energy sales based on assumptions for gross domestic product (GDP), population, and the price of electricity. This model is appropriate for use in the planning of future developments. The forecast assumes that sales to EGM will remain fixed at 60 GWh over 1991-2000, even though it will lose its concessional rate soon. In order to arrive at projections of gross generation and peak demand, the sales forecasts have to be adjusted for system losses and load factor for each year. A slightly optimistic assumption has been made that system losses, including station use, will remain constant at 9%, close to the 1990 level of 8.6%. The load factor has been assumed to remain essentially constant at 64%, close to the 1990 level of 63.7%.

2.16 The base case projections, used for development planning purposes, assume a 4% average annual GDP growth rate to 2000, while the low and high projections assume 3% and 5% GDP growth rates, respectively. In the base case, VLIS electricity sales increase at an annual average rate of 3.3% a year to the planning horizon of 2000, with the low and high growth rates being 2.8% and 3.9%, respectively. The difference between base case forecasts and the high and low forecasts is small (Table 2.4).

2/ The rate for interruptible supply to EGM was raised from F¢9.0/kWh to F¢11.5/kWh, effective August, 1991.

Table 2.4: PROJECTED SALES, GENERATION AND PEAK DEMAND FOR THE VLIS

	Sales			Generation			Peak Demand		
	High	Base	Low	High	Base	Low	High	Base	Low
	(GWh)						(MW)		
1990 (Actual)	-	346.6	-	-	383.9	-	-	67.3	-
1995	412.3	401.8	391.5	453.4	441.5	430.2	80.7	78.6	70.6
2000	502.4	476.1	451.2	552.1	523.2	495.8	98.3	93.1	88.3
Av. annual growth (%) (1990-2000)	3.9%	3.3%	2.8%	3.9%	3.3%	2.8%	3.8%	3.2%	2.7%

Source: FEA; Annex 3.

2.17 The bulk of the projected increase in sales will come from commercial customers, including new developments such as a number of hotels (particularly in the Western Region), new office/shop complexes (particularly in the Suva area) and several industrial/manufacturing projects throughout Viti Levu, as well as from existing customers. Residential sales are expected to increase at a slower rate in the future than in the past, owing to a slowing down of consumption growth from existing customers, after an initial boost associated with new appliances, and an increasing proportion of new connections being in recently electrified rural areas, with their lower average consumption.

Load Forecast - Isolated Systems

2.18 Based on discussions with FEA staff, information obtained from major consumers, and a review of the sales growth over the period 1977-89, FEA's forecasts of growth in demand on the other systems appear reasonable. A summary of the projections is shown in Table 2.5.

2.19 Over the period 1991-2000, Rakiraki sales are projected to increase at 4.9%, which is considerably less than the 14% annual growth experienced in the 1980s. The main reason is that sales to FSC, the largest consumer, are likely to remain constant during the period. Labasa sales are projected to increase at an annual average rate of 6% per annum. On the Labasa system, the 11 kV circuit (which can be upgraded to 33 kV when the load requirements increase) has been extended by 23 km to Seaqaqa township. Another project will add more than 1,600 residential consumers during the next three years in Labasa and neighboring areas. Consequently, residential and commercial load is expected to increase at a slightly higher rate than in the past. The load of the largest consumer, FSC, is forecast to remain constant during the period.

2.20 Savusavu sales are projected to increase at an annual average rate of 4.9% per year until 2000. Considerable activity is expected in the Savusavu area in the period under consideration. The Government has designated the area as a development center, and a new wharf and other infrastructure projects are planned. The largest consumer, the copra mill, is understood to be expanding its

facilities with a consequent increase in electrical load. An 11 kV line from the small run-of-river hydro project at Wainiqeu to Savusavu will likely result in further consumer connections. Levuka sales are projected to increase at an annual average rate of 5.1% a year until 2000. The Levuka system has been experiencing strong growth since 1987 as a result of the activities of PAFCO. The expansion of the PAFCO facilities will be completed in 1993 when full production is expected. PAFCO operations are expected to have a positive effect on the whole area. The growth overall is expected to be higher until 1993, and is projected to decline a little in the later years to 2000. The peak demand forecast for Levuka is based upon an improved load factor, due largely to the PAFCO operation.

Table 2.5: PROJECTED SALES, GENERATION AND PEAK DEMAND FOR THE ISOLATED SYSTEMS

Year	1990 (Actual)	1995	2000
Rakiraki			
Sales (MWh)	2,266	2,895	3,657
Peak Demand (MW)	0.563	0.82	1.03
Av. annual sales growth (%) (1990-2000)			4.9
Labasa			
Sales (MWh)	13,735	18,415	24,680
Peak Demand (MW)	3.47	4.9	6.6
Av. annual sales growth (%) (1990-2000)			6.0
Savusavu			
Sales (MWh)	2,545	3,243	4,115
Av. annual sales growth (%) (1990-2000)			4.9
Levuka			
Sales (MWh)	3,763	5,822	6,166
Av. annual sales growth (%) (1990-2000)			5.1

Source: FEA.

Renewable Energy

Solar

2.21 Solar energy is widely used in urban areas for water heating, but there does not appear to be a market beyond domestic and light commercial water heating. The market is developed and increasing well, and no government attention is recommended.

2.22 DOE has installed solar electricity in over 300 houses, and local vendors have privately installed another solar systems on another 200-300 houses.

Additionally, there are nearly 200 remote village solar radio-telephones, and several higher power inter-island solar HF communication links. A number of solar buoy and lighthouse installations are supported by the Marine Department.

2.23 While the communications and marine marker systems appear to be working well, the domestic lighting systems have a high failure rate. This is due partly to systems being too small for the user's needs and partly due to inadequate maintenance. The systems thus far have been designed, installed and maintained by DOE staff, and DOE does not have the proper organization or manpower to adequately as large a number of systems as have been installed.

Biomass

2.24 Fuelwood. There is no organized market for fuelwood in Fiji. Except in the core urban areas, there is no evidence of households having difficulty in obtaining fuelwood, though in some areas convenient access to household fuels may become difficult within the next ten years. The Forestry Department's pilot program to develop a community forest project has been progressing favorably; in the future, large scale forestry programs may be able to provide continuing convenient access to fuelwood.

2.25 In the urban areas, fuelwood use is largely for special events, when meals are cooked in traditional underground ovens ("lovos"), since most urban families usually cook with kerosene or LPG. Fuelwood can be purchased in small bundles from a few stores or in larger quantities from sawmills. Licenses to produce domestic firewood are issued by the Forestry Department. This Department's 1989 report shows that approximately 18,500 m^3 of stacked firewood was produced under license, equivalent to less than 0.2 m^3 per Fiji household per year, which is not considered significant.

2.26 Copra. As by-products of the copra industry, in 1989, Fiji produced approximately 38 thousand MT of husk and shell, most of which was used to dry copra. Individual or small cooperative copra producers usually dry copra in metal drums that require the use of virtually all the husk and shells produced. Larger plantations use large scale drying methods that allow, as in the case of the Tarte plantation at Vuna, Taveuni, the production of electricity sufficient for the plantation as a by-product of the drying process. The system uses steam for copra drying and a 40 kW alternator driven by a reciprocating steam engine for electricity production. A small (10 kW) steam based dryer and electricity production unit has not been an economic success, at least partly due to the expense of bringing the bulky husks and shells to the dryer site.

2.27 Bagasse. At present, bagasse is the largest agricultural waste product. FSC has been using a large percentage of the bagasse produced as an energy source for process steam and electricity production. In 1989, FSC used approximately 1 million MT of bagasse in this manner.

III. ENERGY SUPPLY

Petroleum Products

Present Arrangements

3.1 Three suppliers, BP, Mobil, and Shell, currently import petroleum products under inter-affiliate supply arrangements, from Australia, New Zealand and Singapore. To economize on freight and inventory carrying charges, the companies engage in joint cargo arrangements on medium-range (MR) vessels. Australia has been the predominant source, with just over 50% of the market, with the remainder shared roughly equally by New Zealand and Singapore.

3.2 Regardless of the source of the petroleum product, the landed costs for the oil companies consist (i) an FOB component based on 50% of their affiliated refinery's Singapore posting and 50% Singapore spot price, (ii) a freight component based on MR Average Freight Rate Assessment (AFRA) Worldscale from Singapore, and (iii) freight-related factors such as in-transit losses and cargo insurance. The freight movement is usually a minimum of two port discharges (Vuda and Suva) and often three or four (e.g., additional drops at Vatia or Labasa).

3.3 The Prices and Incomes Board (PIB), Fiji's price establishment and adjustment body, allows a final selling price that reflects a landed cost based on (i) 50% Singapore spot price and 50% of the lowest of the three Singapore postings, and (ii) marine freight charges, at MR AFRA Worldscale with a 15% premium, based on the two-port discharge. This premium is an allowance for "clean" vessels and "remote trading", since the AFRA rate generally reflects charter rates for dirty vessels in active markets where there may be opportunities for back-hauls or triangulation.

3.4 The present supply arrangement, and the landed cost as allowed by PIB, is an efficient system in the context of Fiji's petroleum demand, scale factors and geography. While the cost factors allowed by the PIB appear to be low in relation to costs of supply from Singapore, the companies' benefit by importing approximately 75% of the product from shorter-haul sources (Australia and New Zealand), and not from remote Singapore, even though the PIB formula assumes that all of the products will be imported from Singapore. The fact that the companies have been functioning under the PIB system for some years suggests that the PIB's approach is acceptable to the oil companies.

Proposed New Finapeco Arrangement

3.5 In late 1991, Finapeco is scheduled to take exclusive control of the petroleum product supply function. This takeover and subsequent operation will be implemented through two supply arrangements:

(a) Finapeco has arranged with Petronas, Malaysia for the purchase/supply of 10,000 bbl/day of crude at the Official Selling Price (OSP);

(b) Finapeco has arranged with Esso (Singapore) for the processing of 10,000 bbl/day of crude, and the supply, including freight, of

appropriate products to meet Fijian requirements. This crude processing/product supply arrangement follows a call for tenders to four companies - BP, Esso, Mobil and Shell - with Esso judged to have provided the best offer.

3.6 The establishment of Finapeco as a new enterprise with a monopoly on the import of oil is a matter of serious concern. This concern arises from the economic and financial implications for Fiji of the new supply arrangements, the lack of consistency with the GOF's broader development objectives, such as reducing the role of the state and increasing the level of competition in the economy, and the implications for neighboring countries, which are linked to Fiji through the existing petroleum supply network.

Economic and financial implications for Fiji

3.7 The functioning of Finapeco will result in additional economic and financial costs to Fiji, compared to the existing supply arrangements. These incremental economic and financial costs are difficult to calculate precisely because of the fluctuations in international petroleum products and freight markets. However, a simulation of the pre-Gulf War year (August, 1989 - July, 1990), which is taken as a representative "normal" year, can provide a reasonable estimate of the likely costs. Based on this simulation, the incremental economic cost to Fiji is estimated to be about F$1.6 million (US$1.1 million) per year, and the incremental financial cost to Fiji to be about F$4.3 million (US$3.1 million) per year, which is equivalent to about F¢2/liter (Tables 3.1 and 3.2).

3.8 The actual economic and financial costs of the new arrangements may be different from the estimated values because of future changes in international petroleum and freight markets. However, the sources of these additional costs will remain relevant even when such changes take place.

Table 3.1. INCREMENTAL ECONOMIC COSTS OF FINAPECO ARRANGEMENTS /a

A. Incremental Economic Costs Associated with Gasoline, Kerosene, and ADO

	Gasoline	Kerosene	ADO	Total/ Average
1. Unit Incremental Costs (US$/bbl)				
FOB Cost of Petroleum Product	0.11	0.14	-0.03	0.03
FOB Cost of Reduced Discount for Leaded Gasoline	1.58	0.00	0.00	0.52
Marine Freight Cost	0.30	0.33	0.34	0.33
Total CIF Incremental Cost	2.00	0.47	0.31	0.88
2. Product Volumes (MB/year)	377.4	134.0	641.6	1,153.0
3. Incremental Costs /c				
US$'000s	753.9	62.9	197.2	1,013.6
F$ '000s	1,047.3	87.5	274.1	1,409.0

B. Incremental Economic Costs Associated with Other Products /b

1. Unit Incremental Marine Freight Cost (US$/bbl)	0.33
2. Product Volumes (MB/year)	315
3. Incremental Costs /c	
US$'000s	102.9
F$ '000s	143.0

C. Total Incremental Economic Costs

US$'000s	1,116.5
F$ '000s	1,552.0
F¢/liter	0.67

/a Compared to the CIF costs under the present arrangement, as allowed by the PIB. The analysis is based on a simulation of the historical year August, 1989 through July, 1990. The values may not add up due to rounding.

/b The only cost increment for these products is for the marine freight charges, which is assumed to be the same as the average marine freight increment for gasoline, kerosene, ADO. Jet A1 and bunkers are excluded because they are entrepôt items, and have no economic cost associated with them.

/c Incremental Costs = Unit Incremental Costs*Product Volumes.

Source: Mission estimates.

3.9 For the major fuels, the estimate of the incremental economic cost is F$1.4 million (US$1.0 million) per year, which is derived from a comparison of the PIB's current allowance for the CIF cost of landed products with the terms of Finapeco's contract with Esso (Table 3.1). The elements of this comparison are:

(a) Incremental FOB cost of product. Under both the current PIB formula and the proposed Finapeco terms, 50% of the FOB cost of the product is based on the Singapore spot price. However, under the current PIB formula, the remaining 50% of the price is based on the lowest of four Singapore postings, while under the proposed Finapeco terms, the remaining 50% will be based on the average of four Singapore postings. This cost differential means that Finapeco's costs would have been higher by approximately F$0.06 million (US$0.04 million) per year than under the current system.

(b) Reduced discount for leaded gasoline. Finapeco will purchase leaded gasoline at a discount of US$2.20/bbl from the price of low-lead gasoline. This discount is less than that obtainable under the current PIB formula, which uses the greatest discount offered (estimated to be US$3.78/bbl). This cost differential means that Finapeco's costs would have been higher by approximately F$0.83 million (US$0.60 million) per year than under the current system.

Thus, Finapeco's FOB cost for the major fuels, which is the sum of items (1) and (2) above, would have been higher by approximately F$0.89 million (US$0.64 million) per year than the cost under the current system.

(c) Incremental marine freight cost. Under both the current PIB formula and the proposed Finapeco terms, the marine freight costs will be based on MR AFRA Worldscale with a premium for clean vessels and/or remote trading. However, under the current PIB formula, the premium is 15%, which is less than the premium of 58 points of Worldscale under the proposed Finapeco terms. Because of this difference, Finapeco's marine freight cost would have been higher by approximately F$0.53 million (US$0.38 million) per year than the cost under the current system.

3.10 In addition to the estimated incremental economic cost of F$1.4 million for the major fuels, on a pro-rata basis, the incremental marine freight costs associated with other petroleum products would have been F$0.14 million (US$0.01 million) per year (US$0.33/bbl).

Table 3.2: INCREMENTAL FINANCIAL COSTS OF FINAPECO ARRANGEMENTS /a

	Gasoline	Kerosene	ADO	Total/ Average
A. Incremental Financial Costs Associated with Gasoline, Kerosene, and ADO				
1. Unit Incremental Costs (US$/bbl)				
FOB Cost of Petroleum Product	0.48	0.72	0.57	0.56
FOB Cost of Reduced Discount for Leaded Gasoline	1.58	0.00	0.00	0.52
Marine Freight Cost	0.30	0.33	0.34	0.33
Total CIF Incremental Cost	2.36	1.05	0.92	1.40
Finapeco Overhead charge	0.50	0.50	0.50	0.50
Total Unit Incremental Cost	2.86	1.55	1.42	1.90
2. Product Volumes (MB/year)	377.4	134.0	641.6	1,153.0
3. Incremental Costs /c				
US$'000s	1,078.1	207.5	908.4	2,194.1
F$ '000s	1,498.6	288.4	1,262.7	3,049.8
B. Incremental Financial Costs Associated with Other Products /b				
1. Total Unit Incremental Cost (US$/bbl)				1.39
2. Product Volumes (MB/year)				315
3. Incremental Costs /c				
US$'000s				437.9
F$ '000s				608.6
C. Incremental Financial Costs Associated with Financing /d				
US$'000s				500.0
F$ '000s				695.0
D. Total Incremental Financial Costs				
US$'000s				3,132.0
F$ '000s				4,353.5
F¢/liter				1.86

/a Compared to the CIF costs under the present arrangement, as allowed by the PIB, based on a simulation of the historical year August, 1989 through July, 1990. The values may not add up due to rounding.
/b The cost increment for these products are for FOB cost of petroleum ($0.56), marine freight cost ($0.33), and the Finapeco overhead charge ($0.50), based on the estimated for gasoline, kerosene, and ADO. Jet A1 and bunkers are excluded because they are entrepôt items.
/c Incremental Costs = Unit Incremental Costs*Product Volumes.
/d Associated with the letter of credit needed to finance the purchase of crude.

Source: Mission estimates.

3.11 The incremental financial cost to Fiji consists of the incremental economic costs discussed above and additional distribution and overhead costs (Table 3.2). The elements of these additional costs are:

(a) Incremental onshore margin. Finapeco has proposed to base its sale price to the distribution companies on the average of four Singapore postings, while under the current PIB formula, the sale price is based 50% on the Singapore spot price and 50% on the lowest Singapore posting. The difference amounts to approximately F$1.73 million (US$1.24 million) per year.

(b) Incremental overhead charge. In order to cover its administrative costs, Finapeco has proposed to add a US$0.50/bbl overhead charge to its CIF price, while such administrative charges are not allowed in the current PIB formula. The additional cost amounts to approximately F$1.02 million (US$0.73 million) per year.

(c) Letter of credit and interest costs. Finapeco will need to finance its purchase of crude oil, and it will need to raise a letter of credit and pay interest on a working capital overdraft. This cost is estimated to be F$0.7 million (US$0.5 million) per year. This cost has been assumed by the GOF on behalf of Finapeco.

3.12 As these additional expenditures are incremental to those considered under the current PIB formula to determine the allowable price of fuels, they represent incremental financial costs to Fiji consumers of Finapeco's proposed operations. In addition, as these costs would be incurred before Finapeco sells the fuel to onshore distribution companies, it would not be feasible nor appropriate to compensate for these costs through an equivalent F$0.02/liter reduction in the PIB's existing allowance for the oil companies' local distribution expenses, as has been proposed by Finapeco.

3.13 While the incremental costs of Finapeco to Fiji are evident and quantifiable, the incremental benefits are unclear. A comparison of the existing supply network with the new Finapeco arrangement with Esso provides little grounds for expecting a difference in product quality, security of supply, or the extent of indigenous Fijian control over the supply of fuel. In general, product quality should not be a matter of concern, as all the major international oil companies (IOC) can supply the same quality of product as Finapeco, in response to market requirements. On the issue of security of supply, the current supply network with the three major IOCs in the region has possibly a higher degree of reliability than reliance on a single supplier. The perception of greater national control with Finapeco is also likely to be limited by the fact that Fiji will continue to have to rely on petroleum product imports for a long time, as the size of the domestic market and its strategic location render it uneconomical to consider refinery operations even in the long term.

3.14 On this basis, it is concluded that the GOF has taken on an additional burden in terms of incremental costs to the consumer, diversion of scarce managerial capacity, and additional commercial risks. In addition, as with any monopoly, there is a risk that in the long-term an exclusive import license will lead to a gradual loss of efficiency, and a reduced responsiveness to customer needs.

3.15 It is recommended that, in order to avoid the incremental costs as well as the long-term risks, the GOF should wind down Finapeco as soon as possible, before additional costs are incurred.3/ Such a decision would also benefit neighboring countries who are linked to Fiji through the existing petroleum supply network of the international oil companies, and who are facing the choice of paying the incremental cost of Finapeco or seeking alternative supply arrangements at a cost that is likely to be higher than that of the existing supply network.

Electricity

Present Power System

3.16 The Fiji Electric Authority (FEA) operates five power systems in Fiji (See Map). The Viti Levu Interconnected System (VLIS) consists of the Wailoa Hydroelectric Station at the Monasavu reservoir and five diesel generating stations (Table 3.3). The isolated Rakiraki system on Viti Levu has about 1 MW of installed capacity. At Labasa, on Vanua Levu, FEA is now constructing a new diesel power station, and installing diesel units transferred from Lautoka; the large units in the old Labasa station will be transferred to the new station during the next three years and the old station will cease operations. During the sugar cane crushing season (typically June to December), the Rakiraki and Labasa systems purchase energy produced in FSC's bagasse fired steam generating plants, which are operated on a baseload basis. The Savusavu system, on Vanua Levu, is supplied from a diesel station. An 800 kW run-of-river hydro plant, now under construction at Wainiqeu, will be interconnected with the Savusavu diesel plant by an 11 kV line in 1992. The Levuka system, on Ovalau, is based on a diesel station located in town, and supplies a largely urban area.

3.17 Transmission and distribution losses on the FEA system range from 9.2% in Labasa to 6.2% in Levuka (Table 3.4). While this level of losses is generally satisfactory, they might gradually be reduced, particularly on the 11 kV and low voltage distribution systems. To reduce the losses, it is recommended that FEA review its present design criteria for the distribution systems, and carry out relevant system analysis to ascertain if its present design practice is technically and economically appropriate. The system power factor on the VLIS is between 0.8 and 0.85. FEA is forcing its larger commercial consumers to meet the regulatory requirement that their power factor be no less than 0.85. To further reduce losses on all plant, transformers, and lines in an economical manner, it is recommended that FEA raise the power factor to 0.9, effective after a grace period of, say, three years.

3/ In August 1992, the GOF announced its decision to shut down Finapeco.

Table 3.3: EXISTING GENERATING CAPACITY
(MW)

	Installed Capacity	Available Capacity
VLIS		
Diesel Plants (Western Region)	23.15	21.95
Diesel Plants (Central Region)	44.54	39.88
Hydroelectric Plants (Wailoa) /a	83.20	72.00
Total	150.89	133.83
Isolated Systems		
Rakiraki Power Station	1.04	1.04
Labasa Power Station	6.60	6.52
Savusavu Power Station	1.41	1.34
Levuka Power Station	1.63	1.48

/a At present, the station peak output limited to approximately 72 MW because of restrictions in the waterways.

Source: Annex 4.

Table 3.4: TRANSMISSION AND DISTRIBUTION LOSSES - 1990
(% of gross generation)

System	Total Losses	Station use	Transmission and distribution
VLIS	8.6	1.3	7.3
Rakiraki	6.9	n.a.	n.a.
Labasa	9.2	3.0	6.2
Savusavu /a	5.3	1.1	4.2
Levuka	6.2	1.7	4.5

/a The figures are not reliable.

Source: FEA.

Rural Electrification

3.18 Nearly 1,000 of Fiji's 3,000 villages and settlements have been electrified through grid extensions, stand-alone diesel systems, small hydro systems and photovoltaics. The majority of rural electrification has been through grid extensions from the primary FEA systems of Viti Levu, Vanua Levu, and Ovalau. By the end of 1991, approximately 170 villages will have received small diesel systems for village electrification through PWD. DOE has been responsible for the electrification of a small number of villages through small hydro, biomass combustion and photovoltaic means.

3.19 In general, only the rural electrification by grid extension has consistently provided reliable power to rural consumers. Both the stand alone diesels and the renewables projects have suffered from inadequate maintenance and poor physical communication between rural users and urban technicians and administrators.

3.20 By 1992, an European Community (EC)-funded program will be implemented, which will include extension of the distribution systems in Vanua Levu and the Western and Central regions of Viti Levu (cost F$8.8 million), construction of a diesel station with two 365 kW units at Korovou (cost F$0.6 million), and construction of a 13 km 11 kV line to interconnect the Wainiqeu hydro scheme with Savusavu (cost F$0.7 million). FEA will be responsible for the local cost component (approximately 40%) of the distribution works included in this program.

VLIS Power System Expansion

3.21 A preliminary expansion plan has been developed for VLIS, based on a review with FEA of its development plans for the 1990s. This plan, which draws extensively on the FEA Tariff Study,3/ (i) uses the projected base case load growth rate, (ii) assumes that the present level of losses and the present load factor will not change, (iii) takes account of the capability of the existing plant, (iv) takes into account FEA's need to minimize its capital investments in the next five to ten years, given FEA's present difficult financial situation (see para. 4.18), and (v) assumes a relaxation of FEA's reliability of supply criteria. The system information and data used in determining the expansion plan requirements are summarized in Table 3.5 and provided in greater detail in Annex 5. The investment cost streams are summarized in Table 3.6.

3.22 The reliability of supply criteria are critical in determining the VLIS expansion plan, because, under normal operating conditions, the VLIS system firm capacity (Table 3.5) exceeds the projected peak demand. Thus, any justification for additional capacity must be based on the likelihood of a failure on the steel-tower 132 kV transmission line from Wailoa to Vuda in the west, and to Suva in the east. FEA's reliability of supply criteria require sufficient diesel generating capacity, both on the eastern and western sides of the island, to meet at least 85% of peak demand in the event of transmission line failure. While this transmission line is vulnerable to cyclones, in the eight years of its

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3/ Fiji Electricity Authority Tariff Study, Asian Development Bank, April 1991.

existence, during which many cyclones have occurred, not a single tower has failed.

Table 3.5: VLIS POWER DEVELOPMENT PLAN: SUMMARY DATA

	1991	1995	2000
Capacity and Peak Demand		MW	
Diesel capability	61.8	68.1	68.1
Firm hydro capability	61.0	67.0	72.0
Total capability	122.8	135.1	140.1
Reserve allowance	20.0	27.2	32.2
System firm capacity	102.8	107.9	107.9
Projected peak demand	68.6	78.6	93.1
Energy Generation		GWh	
Hydro Generation	367	367	367
Diesel Generation	18	75	156
Total Generation	385	442	523

Source: Mission estimates.

3.23 In view of the transmission line's past reliability, the question is whether an alternative technical solution would be cheaper than providing excess generating capacity. While the risks of transmission line failure are real, and FEA's desire to provide a high level of reliability of supply is understandable, it is doubtful that the consumers would be prepared to pay for such reliability. Rather than building additional standby capacity, it is recommended that FEA study alternative approaches for achieving a reasonable reliability of supply, albeit with some relaxation in the reliability of supply criteria.

3.24 One alternative, which FEA has already investigated, is the use of special lightweight emergency towers that can be moved by helicopter and installed relatively quickly if a tower fails. Another alternative is the use of temporary wood pole structures, which have been used in many parts of the world at 132 kV (and even higher) voltage levels. The necessary poles and related equipment could be maintained at suitable locations ready for emergency installation if transmission line failure occurs. These materials would be significantly cheaper than excess generating capacity. These, and other possible, solutions may well require the acceptance of several days of load shedding if a 132 kV line tower topples. This load shedding should be acceptable to FEA's customers, especially when it is recognized that large parts of the distribution system may be out of service following a cyclone. In view of the potential cost savings from a revision of the reliability criteria, it is

recommended that FEA review this matter urgently so that unnecessary commitments to additional generating capacity may be avoided, and firm criteria for development planning be established.

3.25 If FEA's reliability of supply criteria are relaxed somewhat, there will be adequate generating capacity to meet the projected load until the early 2000s. This result assumes that FEA will supply 60 GWh/year to EGM; any reduction in EGM operations, or a decision by EGM to install its own generation facilities, will extend the period during which FEA would not have to add capacity.

3.26 Even though one-third of the FEA diesel units, close to 9 MW of capacity, are pre-1970, the general condition of the FEA diesel plants is of a high standard, and it appears that the existing units are capable of providing reliable service to 2000, based upon the operating hours expected of them. The total diesel generation in 2000, assuming no new hydro capacity is added, is projected to be about 156 GWh, assuming EGM's consumption to be 60 GWh/year. At this generation level, only about one-third of the diesel capability would have to be operated, and there would be ample reserve capacity for maintenance and unplanned outages.

3.27 Since the VLIS diesel capacity together with the Wailoa Hydro Plant appear capable of meeting the generation requirements until beyond 2000, the recommended expansion plan does not call for any plant additions, with the qualification that if the larger diesel units are not capable of baseload operation for lengthy periods, then it will be necessary consider the addition of a large diesel unit, or an equivalent hydro development. There will be adequate time, before plant additions are required about 2000, to assess the hydro/diesel/gas turbine options, and the information available in a few years time, on load demand, oil prices, and further hydrological and other data on potential hydropower developments will be more realistic for conditions in the year 2000 than information available today. The expansion plan does include repairs to the foundation of one of the Kinoya 9.5 MW diesel units, presently derated to 6.0 MW, and for the transfer of an out-of-service 2.8 MW diesel unit from the decommissioned Suva Power Station to Kinoya. These projects will add 6 MW of capacity to the system at a relatively small cost.

3.28 Although there is some technical justification for FEA's planned subtransmission and distribution expenditures for VLIS for the period to 2000, FEA may not be able to afford them, given its precarious financial condition. (See para 4.18). In view of this, although these expenditures have been included in the plan, it is recommended that FEA review these and other prospective investments closely in the next few years in light of its evolving financial situation.

3.29 <u>The firm and average capacity available from the Monasavu reservoir</u> can affect the overall VLIS development plan. There are indications that the firm and average reservoir capacity may exceed the original design figures that have been used until now. Any increase in generation from Monasavu could extend the period of time before additional generation is necessary on the system and will certainly reduce the amount of diesel generation required, resulting in considerable savings to FEA. A two-phase study, proposed by the Department of Energy, will assess the firm and average capability of the reservoir, on the

basis of data that was not available when Monasavu was designed. It is recommended that this study start as soon as possible; the terms of reference for the first phase of this study are included in Annex 6. Since power demand has increased beyond the presently accepted firm capacity level, it is essential that an operating rule curve be used for the operation of the reservoir, in order to achieve optimal use of the resource by avoiding unnecessary higher-cost diesel generation. Hence, it is recommended that the second phase of the study, including the development of a reservoir operating rule curve, follow shortly after completion of the first phase.

3.30 The cogeneration potential of a number of industrial operations in Fiji has not been fully utilized in the past. In the future, there would be significant benefits to FEA, both in lower capital expenditures and reduced diesel generation, if it would purchase larger amounts of power from FSC, the largest cogenerator. In view of the potential savings from power purchases, compared to FEA's own incremental costs, it is recommended that FEA aggressively pursue the possibility of power purchases from FSC's plant in Lautoka for VLIS. In order to realize these benefits, FSC would have to invest in high efficiency steam boilers and electric generators; increased excess electricity could also accrue with greater efficiency in the process. Without an adequate price for exported electricity under an acceptable contract, FSC would not undertake these capital expenditures.

Isolated Systems Expansion Plans

3.31 The recommended development plans for the isolated systems are based on the 1991 FEA Tariff Study, with the only difference being the timing of generation additions. For Rakiraki, the plan includes the installation of two 365 kW diesel units in 1991, the retirement of one similar sized unit at that time, and the installation of a further 365 kW unit in 1997 or 1998. For Labasa, the plan includes the transfer of three 1.14 MW units to the new station during the next three years, and the installation of an additional 1.6 MW unit in 1993 and 1997. For Levuka, the plan includes an additional 365 kW unit in 1992 and 1993. FEA may relocate the power station from the central part of town to avoid environmental problems, but, given the uncertainties regarding this relocation, no costs have been included for this work. FEA may have to curtail its planned subtransmission, distribution and rural electrification reinforcements and extensions because of financial difficulties.

Overall FEA Expansion Plans

3.32 Based on the above discussion, it is concluded that FEA will be able to meet the increasing electricity requirements in its existing supply areas, with moderate scope for expansion, with an investment program averaging F$6.2 million (in constant 1990 F$) per year over the 1991-2000 period (see Table 3.6). Capacity expansion is needed only for the isolated systems, and the major expense for the VLIS will be for subtransmission and distribution, though FEA's financial condition may make it difficult to undertake these expenditures.

Table 3.6: CAPITAL INVESTMENT COST SUMMARY 1991-2000
(F$'000, constant 1990 prices)

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
VLIS											
Foundation repairs Kinoya	Foreign	145									
	Local	55									
Transfer of 2.8 MW to Kinoya	Foreign			50							
	Local			200							
Subtransmission distribution	Foreign	4,200	3,000	3,500	1,600	2,600	2,600	1,800	2,400	2,300	2,300
	Local	2,265	1,842	1,337	1,000	1,490	1,450	1,300	1,560	1,300	1,300
Rakiraki											
Addition 365 kW diesel units	Foreign	240						105			
	Local	50						20			
Misc. rural electricity	Foreign	65	65	65	65	65	65	65	65	65	65
	Local	40	40	40	40	40	40	40	40	40	40
Labasa											
New 1.6 MW diesel units	Foreign			1,300				1,300			
	Local			230				236			
Transfer of diesel plant	Foreign	200	40								
	Local	800	135								
Subtransmission, distribution & R.E.	Foreign	625	1,000	650	180	800	820	800	500	500	500
	Local	340	707	385	100	430	444	445	280	280	280
Savusavu											
Distribution and RE	Foreign	670	450	275	85	85	85	85	85	85	85
	Local	445	293	180	55	55	55	55	55	55	55
Levuka											
Office and cooling towers	Foreign	34									
	Local	80									
Additional 365 kW diesel units	Foreign		105	105							
	Local		20	20							
Distribution and RE	Foreign	27	27	27	27	27	27	27	27	27	27
	Local	20	20	20	20	20	20	20	20	20	20
Total Investment	Foreign	6,206	4,687	5,972	1,957	3,577	3,597	4,182	3,077	2,977	2,977
	Local	4,095	3,057	2,412	1,215	2,035	2,009	2,116	1,955	1,695	1,695
	Total	10,301	7,744	8,384	3,172	5,612	5,606	6,298	5,032	4,672	4,672

Source: Mission estimates.

Renewable energy

Hydro

3.33 In the near term, hydro power has the greatest potential for renewable energy development. The great majority of Fiji's electrical energy already comes from one hydro system, Monasavu, and there are many smaller sites which either could be integrated into the grid or could provide power to a small grid near the facility. FEA has identified, and in many cases made surveys of, over 70 sites that have hydroelectric potential ranging from 50 kW to several megawatts. At this time, about ten sites appear to have economic promise through stand-alone mini-grids or integration into the primary FEA generation system. DOE has also located, and in some cases surveyed, over 15 additional sites with hydroelectric potential below 50 kW. Of the known sites, DOE estimates that no more than five sites are in close enough proximity to loads to make village scale generation comparable in cost to other village generation options such as small diesel or photovoltaics.

3.34 These identified sites require additional investigation, particularly stream monitoring and general hydrological data collection, before a decision to develop them is made. Stream monitoring equipment has already been purchased, and a Japanese volunteer is expected to become available in 1991 to examine potential mini and micro hydro sites in detail.

3.35 Since Fiji's hydro resources are being identified and investigated in an adequate and timely manner, no change in the existing programs is recommended.

Solar

3.36 Measurements show that there is excellent quality, long term solar radiation at Nadi and Laucala Bay. Unfortunately, these measurements are relevant only within a few kilometers of the measuring sites because of substantial micro-climatic variations resulting from the mountainous topography, which strongly affects local cloud cover. Experience with photovoltaic powered radio-telephones indicates that the villages located in the mountainous interiors of the large islands require at least double the panel capacity as systems located in sunny coastal areas.

3.37 While solar radiation patterns have not been mapped out, it appears that excellent solar conditions exist in some parts of Fiji. In 1986, the Forum Secretariat contracted with the New Zealand Meteorological Society to improve the data collection and analysis of solar radiation in the Pacific region. Though instruments have been installed in several countries, little analysis of existing sunshine and hour and solar radiometric data has been carried out. When the analysis is completed, adequate solar information for the areas with major populations and the major outer islands will become available. However, photovoltaic applications will be particularly useful in the more remote islands, for which the data are not being collected at present. Hence, it is recommended that the DOE, in coordination with the Fiji Meteorological Service and the Forum Secretariat Energy Division, select additional remote sites for solar radiation data collection and seek donor assistance for implementation.

Biomass

3.38 The largest energy quality biomass resource is agricultural waste from the processing of sugar cane, cocoa, coconut and rice. Fiji's largest biomass resource lies in the forests, which include both indigenous and plantation tracts, so that forestry and mill waste from harvesting and processing of pine and plantation hardwoods is also a significant biomass energy resource. However, mill operations are dispersed and individually much smaller than plantation based forestry, so that it is relatively difficult to use this resource. Fish and poultry production are concentrated sufficiently to make consideration of the economic production of biogas appropriate, but no development has taken place. Large animal production is dispersed, so that there are no concentrations sufficiently great to allow development of biogas energy systems for other than individual or household use.

3.39 Bagasse. The waste (bagasse) from sugar milling has been used for many years to fire sugar mill boilers for process heat, and the Labasa mill has also been producing sufficient cogenerated electricity to provide most of the electrical needs of the Labasa grid during the processing season of the mill (typically June through January). Most of the bagasse is used inefficiently for process heat and electricity production. The utilization of the remaining energy potential would require capital investment in storage at Labasa and in more efficient boilers, additional generating equipment and bagasse storage at the Lautoka and Rakiraki sites. The electricity production season is shorter than it could be because there are no long term bagasse storage facilities. Therefore, the generating season could be extended significantly if the proper storage for the excess bagasse were provided. These investments would be financially attractive provided FEA were to purchase electricity at a rate comparable to its diesel production costs. In view of the benefits to FEA from purchasing cogenerated electricity (see para 23, 3.26), it is recommended that FEA provide appropriate incentives for expanded bagasse-based electricity production on Viti Levu and Vanua Levu through pricing electricity purchase at a price equivalent to its avoided cost or shared capital arrangements.

3.40 Wood. While large scale projects based on the harvesting and processing of indigenous hardwoods are uneconomical, small scale use for plant process heat and, in some cases, steam based electrical generation to service the processing facility may be practical. Such uses should be incorporated on a project by project basis. In order to use this potential resource, it is recommended that DOE continue its program for technical and financial assistance, in association with donors, to encourage appropriate development of small scale biomass utilization at indigenous hardwood processing sites.

3.41 The production of lumber and other products based on pine plantation trees presently results in over 30,000 MT of fuel quality biomass waste each year, and production increases are forecast through the next decade. Since this resource is concentrated at three sites, it can be effectively used for energy purposes. While significant amounts of this waste are already being utilized for process heat and sawmill power, if FEA increased its purchase price, investments to allow increased electrical production for provision to the grid could be justified.

IV. POLICY AND INSTITUTIONAL ISSUES

Petroleum Products Pricing

4.1 The prices of four petroleum produc s - motor spirit, ADO, solvent (white benzine) and pre-mixed outboard fuel are controlled at the wholesale and retail level. The basic price is set for the main centers of Suva, Lautoka and Lami, and prices for other areas include an allowance for freight. The controlling body is the Prices and Incomes Board (PIB). The PIB Secretariat analyzes the actual landed costs of the companies based on shipments and roughly every quarter adjusts wholesale and retail prices of these products based on changes in external cost factors - FOB costs, F$/US$ exchange rate, and freight rates. The exact timing of the changes is based largely on a fairly accurate tracking of the companies' Fiji inventory positions. Less frequent adjustments are made for changes in internal distribution cost factors, based on company submissions. These infrequent adjustments for onshore costs are usually incorporated in a general adjustment for external changes and are not designated transparently as internal adjustments. The formal adjustment/establishment process entails a recommendation by the Secretariat to the one-member Board, the Permanent Secretary of Trade & Industry, who passes on his recommendation to the Minister of Finance for promulgation. A price decrease requires 14 days notice to come into effect, while a price increase is immediate.

4.2 Table 4.1 summarizes the official retail and wholesale prices in effect (on February 11, 1991) for motor spirit and ADO. Prices are differentiated by location to reflect transport costs; there are a total of twelve separate schedules in the PIB price order, defined by location. Three of the schedules are shown by way of illustration (Table 4.1). The wholesale and retail prices are the only figures which appear in the published order, and other sub-elements, such as CIF cost and total duties, are not explicitly known. The total duty has been estimated by combining the applicable duty rate information shown in Annex 7 with other information on internal costs. The 43% rate of taxation on gasoline is high compared with U.S. and Canadian rates but lower than the typical European and African levels which average about 60% of retail price. It should be pointed out, however, that since most of the tax is a flat charge (F¢ 33/liter), a return to more normal CIF cost levels and corresponding lower retail prices, will result in total duties of about 50% of retail price in Fiji. The taxation of ADO at 27% of retail price (increasing to some 30% at lower prices) is comparable to North American levels, but lower than the average of about 40% in sub-Saharan Africa and 50% in Europe.

4.3 Although the PIB price regulatory framework, with its formula system of external supply cost determination, seems to be doing an effective job of controlling prices at efficient levels, there are some deficiencies in the process. The present system lacks transparency, clarity, regularity and standardization in determination of the prices of petroleum products. There is no explicit price determination methodology, with all the approved elements stated explicitly. There is no provision for regular (e.g., once every year, at the same time) standardized submissions of company cost data for adjustment of internal distribution factors in the price build-up. Further, the PIB Secretariat information support and expertise in the area of international product supply, pricing and affreightment is not well-developed, even though this

analytical capability is particularly important in monitoring the impacts of changing supply arrangements and fluctuating markets. For example, to calculate the true supply cost, it is essential to know the amount of imports from Australia and New Zealand, as opposed to the present formula, which is based only on Singapore.

Table 4.1: FIJI OFFICIAL PETROLEUM PRODUCT PRICES (EFFECTIVE ON FEB 11, 1991)

	Schedule 1 Suva, Lautoka, Lami		Schedule 4 Viti Levu Remote		Schedule 5 Labasa and Environs	
	F¢/l	US$/USgal	F¢/l	US$/USgal	F¢/l	US$/USgal
Motor Spirit						
Wholesale Price	81.04	2.20	85.04	2.32	83.41	2.27
Retail Price	85.00	2.32	89.00	2.43	88.00	2.40
Estimated duties as % of retail price	36.40 43.0%					
ADO						
Wholesale Price	64.90	1.76	68.90	1.87	67.21	1.82
Retail Price	68.00	1.85	72.00	1.96	70.00	1.90
Estimated duties as % of retail price	18.60 27.0%					

Source: Mission estimates based on PIB data.

4.4 In order to ensure that petroleum product prices in Fiji are as low as possible, it is recommended that GOF adopt a two-phase price reform approach.

(a) Phase 1. Improve and upgrade the formula-based price-setting mechanism. This requires the development of a completely transparent price determination methodology, with all the elements shown clearly. Internal distribution cost elements would be standardized to a limited number of basic categories and the companies would submit audited historical data once per year, pursuant to determination of the levels for the ensuing year. GOF would require technical assistance for this phase, which may be provided by experts from a regional energy agency.

(b) Phase 2. Institute complete price deregulation. Once the Phase 1 system has been functioning effectively for some years, petroleum

product prices should be fully deregulated in order to obtain the full benefits of effective competition, not only from the existing firms but also from potential entrants who would exert competitive downwards pressure on prices. After deregulation, GOF should continue to monitor prices. The formula mechanism and staff expertise developed in Phase 1 will serve as an effective monitoring system to assess the performance under liberalization. Complete price deregulation should be accompanied by effective subsector regulation in non-price areas such as weights and measures, facilities design and inspection, safety, quality control, etc.

LPG

4.5 The price of LPG is not regulated by GOF. A uniform price is maintained by Fijigas for bottled gas at all major centers in Fiji. In February, 1991, this price was F$1.43 per kg for 13 kg cylinders, and F$1.41 per kg for 50 kg cylinders. A deposit of F$20 per bottle is charged for bottle purchase, maintenance and service, though this deposit covers only about one-third of total costs.

Electricity

4.6 Electricity tariffs should reflect the economic costs of electricity supply in terms of both the relative balance between peak (capacity) and energy charges for each consumer group and the relative level of tariffs between consumer groups. Hence, it is recommended that the tariffs for each consumer group reflect the corresponding marginal costs of supply.

Marginal Costs of Electricity Supply

4.7 Marginal Capacity Costs. On the VLIS, the current capacity is likely to be adequate for many years. Therefore, from a generation standpoint, peak demand imposes very little cost on FEA. Accordingly, the marginal cost of generating capacity on the VLIS should be measured in terms of the costs of retaining existing plant which could otherwise be decommissioned, and not in terms of the costs associated with new investments in generating plant. Based on this approach, the net avoidable costs of generating capacity was estimated recently by the FEA Tariff Study to be F$12/kW per year.

4.8 For the isolated supply systems, the expansion plan calls for 365 kW diesel sets for Rakiraki, Savusavu, and Levuka. On the basis of the investment costs associated with this type of diesel sets, the FEA Tariff Study estimated the net effective cost to be F$60/kW per year. For the Labasa system, based on a 1.6 MW diesel set, the net effective cost was estimated to be F$90/kW.

4.9 Marginal Costs of Energy. On the VLIS, the marginal energy cost will change over time. During 1991-95, the incremental energy demand can be expected to be met from Monasavu, at a marginal cost of less than F$0.01/kWh. After 1995, incremental energy demand will have to be met from diesel plant (or new hydro schemes), with a marginal energy cost in the range F$0.08-0.12/kWh.

4.10 The marginal energy cost at Rakiraki, Savusavu and Levuka is estimated to be F$0.13/kWh (net of station usage). For Labasa, the cost is estimated to be F$0.12/kWh.

4.11 Marginal Capacity Costs of Transmission/Distribution. The average incremental cost of transmission, sub-transmission and distribution varies considerably by system and voltage level (see Table 4.2). Each voltage level has been estimated for the VLIS and the isolated systems, as a proxy for the marginal cost of capacity.

Table 4.2: MARGINAL TRANSMISSION/DISTRIBUTION CAPACITY COSTS /a
(F$/kW per year)

	11/6.6kV	415/240V
VLIS	152.75	177.92
Rakiraki	14.35	25.32
Savusavu	34.72	65.90
Labasa	16.04	25.62
Levuka	10.07	43.74

/a Includes allowance for losses at each voltage level.

Source: FEA Tariff Study.

Electricity Tariffs

4.12 A substantial restructuring of the electricity tariff is required if it is to reflect the marginal costs of supply. Further, the average electricity tariff should be sufficiently high to allow FEA to operate in a financially sound manner. The FEA Tariff study has developed a restructured electricity tariff. As part of this proposed tariff, the minimum monthly charge is replaced by a much reduced Consumer Service Charge that reflects the actual costs imposed by each consumer group. For most lower income domestic consumers, this reduction will help to offset the proposed tariff increases.4/

4.13 In order to encourage cogeneration, FEA will have to set prices that will attract industries to sell to the system, but ensure that both parties

4/ Effective August 1, 1991, FEA instituted a 10% across-the-board increase in its electricity tariff. However, no changes were made to the tariff structure at this time. (See Statistical Appendix, Table 8).

benefit financially from the arrangement, in addition to improving reliability of supply for both. FEA should be prepared to pay up to the system avoided cost of generation at each of its supply systems.

4.14 At present, FSC is both a consumer and supplier of energy to FEA. Under the present arrangement, FEA sells to FSC at a subsidized rate, and also buys from FSC at a subsidized rate. This system does not place the arrangement between FSC and FEA on a sound financial basis. Hence, it is recommended that FEA charge FSC the same rate as other HV industrial consumers, and buy from FSC at its system avoided cost. This sound financial arrangement would also allow FEA to offer the same system-specific purchase price to any other potential supplier.

4.15 Whether FEA should continue to supply power to EGM even beyond the grid's hydro station capability involves two issues: (a) evaluation of the energy supply capability including the re-calculation of the rule curve for the Monasavu reservoir, and (b) evaluation of the financial adequacy of power supply arrangement between FEA and EGM. The discount given for hydro supply to EGM on "as available" basis should be reviewed to check if FEA can get a better price from EGM, as it did in August, 1991, provided the rate is kept attractively low compared to EGM's variable cost of operating their diesel units. If FEA's diesel units are to be eventually used to supply EGM, then it does not make financial sense for FEA to supply EGM unless the rates are set based on a margin over FEA's variable costs of diesel supply.

Strengthening FEA

FEA's Financial Performance

4.16 A summary of FEA's past and projected financial performance is provided in Annex 8. As noted in the World Bank's 1989 Financial Options Review, FEA's financial position deteriorated markedly during the 1980s, largely as a result of cost overruns on the Monasavu project (F$90 million), additional diesel expenditure caused by the delay in commissioning the project (F$46 million), revenue shortfalls through a failure to implement planned tariff increases (F$13 million), and increased debt service costs following the 1987 currency devaluation (F$104 million). In order to restore FEA to a sound financial position, the World Bank recommended that a series of measures, including the restructuring of FEA's domestic debt to allow a three-to-five year moratorium on principal repayments, a program of real tariff increases, the conversion of a F$15.5 million GOF loan to equity, and the injection of further equity capital by GOF over a five year period.

4.17 The above recommendations were discussed and agreed to at a meeting of FEA creditors in London (February, 1990). Some progress towards a financial restructuring has been made since then. In March, 1991, FEA reached agreement with the Fiji National Provident Fund (FNPF) for the consolidation of FEA's domestic debt (short-term loans and bonds) into a single 15 year loan at a 10.5% per annum interest rate with a five year grace period on principal repayments. While electricity tariffs were increased by 10% in August, 1991, this did not imply an increase in real terms, given an inflation rate of approximately 12%. While the F$5.5 million GOF loan has been converted to equity, FEA has received no further injections of equity capital. As a result of these delays in

restructuring, FEA's position is now considerably worse than it was in 1989, and in the absence of any working capital, the utility is funding long-term investments by issuing short-term promissory notes.

Future FEA Financing Strategy

4.18 Short-term need for funds. On the basis of financial projections,5/ FEA's immediate needs for funds within the next twelve months are estimated at F$95 million (Table 4.3).

Table 4.3: FEA'S SHORT-TERM NEEDS FOR FUNDS

Item	Funds Needed F$ million
Provision of 2 months' working capital	15
Promissory notes payable	60
Principal repayment of FNPF debt	10
Remaining funding shortfall	10
Total	95

Source: Mission estimates.

4.19 In order to prevent FEA from incurring further overdrafts and short-term debt and allow FEA to rebuild its equity base, it is recommended that the following measures be undertaken.

(a) Fresh Equity. GOF should inject fresh equity into FEA at the outset rather than through annual increments of F$5 million allotments from 1990 to 1996. Since Government finances will preclude GOF from injecting the entire F$25 million in 1991, a minimum outlay of F$15 million (equivalent to FEA's two months' cash flow needs) is recommended for 1991. The balance of F$10 million (or much less if the working capital base expands adequately over the year) can be addressed in 1992. These GOF equity investments would also attract commercial banks to invest in FEA's proposed bond issues.

(b) Bond Flotation. FEA's promissory notes should be converted into longer term debt by floating FEA bonds, in tranches as FEA's promissory notes mature or as conditions in the securities market permit. The terms of the bonds (3-9 years) may vary to satisfy market

5/ The projected profile of FEA's financial operations during the 1990s, given in Annex 8, assumes that asset revaluation is adopted, and adjustments are made to FEA's accounting treatment of the 1987 foreign exchange losses.

requirements so as to ensure maximum subscription as well as equalize FEA's payment streams over the years.

(c) Tariff Increases. There should be a tariff increase of 6.5%, effective immediately, over and above the 10% increase instituted in August, 1991, followed by 10% nominal increases in 1992, 1993, and 1994. These proposed increases reflect, in part, the GOF's decision to make FEA liable for corporate income tax from January, 1991.

(d) Future Capital Expenditure. GOF should provide the funds to finance any capital expenditures, but insist that tariffs be high enough to attain an 8% rate of return on the revalued rate base.

4.20 Financial Controls. It is recommended that FEA apply tight financial controls in its operations. As a policy, the FEA annual budget should not plan additional short-term borrowing or bank overdrafts. Further, FEA management should adopt a closely monitored rolling cash flow plan (daily, weekly and monthly), and use it as a financial and operational control instrument. This rolling cash plan should set sub-limits to authorized budgetary disbursement so as to restrain FEA from using overdraft facilities. Further, the plan should be used to determine, prior to contracting of services and supplies, if and when funds will be available to meet the desired expenditures. Accordingly, procurement and service contracts cannot be entered into unless they are cleared for funds availability. This control system will prevent FEA from incurring fresh debts, and accordingly avoid the issuance of more promissory notes.

4.21 In order to avoid the potential friction arising from a tightly controlled disbursement system, it is recommended that FEA's management establish clear criteria for prioritizing expenditures. In doing so, occasionally trade-offs will have to be made between maintaining a high level of security of power supply and preventing FEA from becoming insolvent. The management should inform the operating units that the control system is intended to provide them with early information on funds availability to allow them to undertake contingency operating procedures when their funding requests cannot be supported.

4.22 Changes in Accounting Practices. Two changes are needed in FEA's accounting practices. First, consequent to the 1987 devaluation, a foreign exchange loss on FEA's foreign loan portfolio was charged against income for that year, resulting in an operating loss of F$110 million. For FEA's balance sheet, the loss translated to a negative retained earnings level resulting in an erosion of FEA's total equity base from F$63 million in the previous year to negative F$42 million in 1987. A normal accounting practice is to carry forward unrealized foreign exchange gains/losses on loans by increasing the values of the associated assets, which are then recovered through a higher depreciation charge. In order to conform to normal accounting practices, it is recommended that this accounting treatment of unrealized foreign exchange losses be reviewed.

4.23 Second, in FEA's accounts, a relatively low level of depreciation is charged, as a result not only of historical cost-based asset valuation, but also of the unrealistically long normal operating life assigned to the assets, such as 80 years for the buildings, 75 years for hydro dam infrastructure and 50 years for hydro plant and machinery. In order to put FEA's asset valuation on a more realistic basis, it is recommended that the normal operating life of the assets

be re-estimated and if possible, in the light of FEA's limited capital resources, a faster-paced depreciation method should be considered (e.g., sum-of-years digits) in lieu of a straight-line depreciation approach for a closer match with FEA's actual financial flows.

4.24 On this basis, it is recommended that a comprehensive physical and cost appraisal of FEA's assets be made, and that results be used as basis for restoring the appropriate value of equity and future depreciation charges. It is also recommended that FEA adopt asset revaluation as an accounting policy, as this will help preserve the firm's financial viability, given the capital-intensive nature of its hydroplant operations.

FEA's Operational Strategy

4.25 FEA's Operational Autonomy. In the past, FEA's relative operational autonomy from GOF has permitted FEA to render satisfactory service to its customers. In view of FEA's successful record in the past and the likely costs of greater regulation in the future, it is recommended that FEA's operational autonomy continue in the future, even though GOF will have to provide financial support to FEA, and FEA should remain fully accountable for the management of corporate funds and its service operations. In the future, if FEA abuses its monopoly status, then GOF should make the appropriate changes and exercise stronger regulatory control over FEA.

4.26 Long-term Planning. In order to enable the company to formulate its strategies with adequate lead time, it is recommended that FEA pursue multi-year plans, including a three-year indicative budget. The longer term plans will give direction to, and complement, the rolling cash flow plan. However, at present, there is a need to improve the area of planning and development. It is recommended that FEA's system planning and development department be appropriately and adequately staffed, and be headed by a qualified and experienced person, who should hold a key senior management position reflecting the importance of the departmental functions. Further, given FEA's size, it is recommended that FEA engage a suitably qualified economist to work in the System Planning Department.

Rural Electrification

4.27 Fiji's rural electrification system has become increasingly strained because (i) FEA has clearly reached the economic limit of grid extensions for rural districts, and (ii) the number of stand-alone projects to be installed and administered by PWD and DOE has expanded well beyond the ability of either organization to administer and maintain.

FEA's grid extensions

4.28 The costs to FEA of rural electrification represent a significant burden on FEA's finances. An analysis of FEA's engineering cost estimates (HV and LV) in respect of the forthcoming EC-funded rural electrification program (see para 3.17) indicates an average cost of F$1515 per consumer connection, which is much higher than the typical cost of around F$300-400 per urban consumer. From FEA's perspective, this cost difference is magnified by two other

factors: first, the level of contribution from consumers, and second, the average level of sales per consumer.

4.29 For rural electrification projects, FEA requires prospective consumers to meet 25% of the estimated (direct labor and materials) cost. Further, under normal circumstances, FEA will not undertake projects for which the cost per consumer exceeds F$2,400. In contrast, for urban extensions, FEA offers the consumer (or property developer) the option of either paying a 75% non-refundable contribution or meeting the total cost of the project, which is refunded over five years by reducing the electricity bill by up to 50%.

4.30 The difference between the urban and rural connection costs is further exacerbated by the lower average electricity consumption in the rural areas, particularly in the newly electrified areas. For example, in September, 1990, the average consumption in FEA's predominantly rural supply areas was only 73 kWh/month, in contrast to the urban average of 177 kWh/month.

4.31 For these reasons, rural electrification is regarded by FEA as a non-commercial activity. At present, it is FEA's other consumers who ultimately pay the cost of such projects, apart from the contribution of prospective rural consumers.

Stand-alone projects

4.32 At present, two major stand-alone rural electrification projects are being contemplated, with a total investment of F$8.21 million (Lakeba, Gau, Koro, Moala and Rotuma) in stand-alone diesel systems, and F$3.5 million (Taveuni) for stand-alone hydro. These two projects nearly triple the number of consumers served by stand-alone systems, and represent a technical and administrative requirement far in excess of that existing within the responsible agencies: DOE, PWD, and the Ministry of Rural Development. Since each of these stand-alone projects is a mini-grid system encompassing many villages, the administration and maintenance systems that have been used for earlier stand-alone systems (which serve a single village) cannot be used.

4.33 To take care of the technical and administrative operations of all stand-alone rural electrification schemes that are primarily for social benefits and are not commercially viable, a specialist agency must be developed and provided an explicit budgetary subsidy. Hence, it is recommended that a Rural Electrification Authority be created, preferably using the PWD rural electrification group as the core staff. This Authority will design, install and manage these new projects as well as accepting all existing stand-alone rural electrification projects under its management umbrella. Alternatively, the responsibility could be given to PWD, with FEA providing technical assistance on a fee-for-service basis.

4.34 The proposal for the diesel project includes approximately F$800,000 for external consultants. If these funds are available, it is recommended that they be used to establish the Rural Electrification Authority, and to support expatriate and local engineers and technicians in the design and installation of these projects.

Desirability of Expansion of Rural Electrification

4.35 At present, given FEA's uniform national electricity tariff, rural electrification requires a subsidy, which is estimated to be in excess of F$1 million per year. This subsidy will be substantially higher if proper operation and maintenance capability is not present, as is the case with the proposed projects. It is likely the funds used to subsidize electricity production on these five islands would have greater economic and social development benefits for the people of these islands if the funds would be used for other purposes.

4.36 For example, in 1990 the 100 kW Bukuya project was completed as the first of several mini-hydro projects planned for hydro based rural electrification. Though complete, this project is not operating due to a lack of customer connections. It appears that this project was conceived and implemented without adequate market surveys or prior customer commitment. The favorable economic analysis of the project was based on an assumption that essentially all of the possible households would connect to the system and use at least minimal lighting. However, in the six months after the commissioning of the project, less than 20% of the possible households had agreed to connect, which would not produce sufficient revenues to pay even FEA's maintenance costs.

4.37 In order to ensure that the rural electrification investment programs are economically and socially justified, it is recommended that the proposals for the expansion of rural electrification be re-evaluated.

Renewable Energy

Solar

4.38 Nationally broadcast television is likely in the near future, and this is expected to create a strong demand for rural electrification. Fiji commercial interests and DOE are presently evaluating solar powered TV and video systems for use in the remote areas.

4.39 Though the market pressures may be strong for electrification through solar photovoltaics, the support for rural solar power is weak. Unless an organization is created with an adequate technical and administrative capability for solar based rural electrification, the past failure of solar photovoltaic projects will be repeated. The proposed Rural Electrification Authority could have this responsibility.

Wind

4.40 In Fiji, winds vary in direction and intensity on a seasonal basis, and energy quality wind is uncommon. The tall, irregular tree cover in many parts of Fiji and the rough topography in other parts make turbulence near the ground a serious technical problem. Further, the presence of high humidity and high ambient temperature, usually combined with air borne salt, make the maintenance of both mechanical and electrical systems costly, and failures are frequent. While wind powered electrical generators have been installed in Fiji, at present none of them are operational, and no new projects are expected. Since wind power for electrical generation is still experimental in the Pacific Islands environment, it is recommended that the GOF not consider investments in wind

power until these systems are proven to be technically and economically satisfactory in conditions similar to those in Fiji. Further, it is recommended that the use of local resources for general monitoring of wind other than at established meteorological stations be given low priority.

Biomass

4.41 Fiji's forestry program is soundly based and well managed. In particular, the legal and regulatory foundations are adequate to permit development of the forest resource without unacceptable environmental impact. However, the staff of the Forestry Department is insufficient to fully enforce the laws and regulations, so that violators are not always caught, and nor are those caught always prosecuted. In order to ensure that forestry rules are observed, it is recommended that the strength of the Forestry Department be increased.

Other Renewable Sources

4.42 Geothermal. There is some evidence of geothermal resources on Vanua Levu and Viti Levu (hot rocks and hot springs), and there is a proposal to develop the Viti Levu resource (in conjunction with the large Namosi copper resource). Since this resource is poorly understood, and the developments of hot rock sites are globally few in number and have not been uniformly successful, it is recommended that the GOF make no investment in the near term in geothermal development. However, in order to permit any successes that may occur, it is recommended that the GOF allow controlled commercial development of this resources, with guarantees of purchase of power at commercial rates. Further, continued investigation of the extent and quality of the Vanua Levu and Viti Levu resources is appropriate, but not of high priority.

4.43 OTEC. Fiji has a potential for OTEC development, and Japanese commercial interests have proposed the development of a pilot project on the south coast of Viti Levu. While the primary objective of this project is mariculture, it also includes approximately 100 kW of electrical generation capacity. Since OTEC is not a commercially proven technology for power generation, it is recommended that the GOF not invest in such projects nor incur significant costs in the administration of such projects. Further, the environmental impact of such developments must be assessed before any projects are approved. However, in order to enhance the possibility of future OTEC development, it is recommended that DOE, in association with CCOP/SOPAC 6/, continue to make low-level efforts to locate promising sites near high load density areas or near to existing FEA high voltage transmission lines, and that these sites be examined in detail through donor technical assistance programs.

4.44 Wave Energy. Although it is likely that wave energy is a potential resource, the quality and quantity of this resource has not yet been determined. Since commercial wave energy capability is likely within ten to twenty years, it is appropriate to start collecting data that will be useful in the future, particularly on sites close to population centers or to existing FEA transmission

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6/ Coordinating Committee for Ocean Prospecting/South Pacific Applied Geosciences Commission.

lines. It is recommended that DOE continue to seek donor technical assistance in these investigations, but with little direct DOE involvement. For example, some resource measurements are being funded by Norway on the south coast of Kadavu, and it is appropriate for DOE to incur small administrative costs for this effort without any significant expenditures of local resources.

V. INVESTMENT AND TECHNICAL ASSISTANCE PRIORITIES

Petroleum

5.1 Subsector Focus. There is no need for GOF to invest in the petroleum sector since the petroleum supply system is functioning adequately. Consequently, the focus in this subsector should be on strengthening the petroleum price monitoring and surveillance capabilities.

5.2 Finapeco. The proposed Finapeco arrangements will imply additional economic and financial costs for Fiji, as well as the long-term risk that the efficiency of the monopoly operation will decline. In order to avoid these costs and risks, it is recommended that the GOF should wind down Finapeco as soon as possible, before additional costs are incurred. Such a decision would also benefit neighboring countries that are linked to Fiji through the existing petroleum supply network of the international oil companies. (See paras 3.6-3.15)

5.3 Price Monitoring. The PIB price regulatory framework lacks transparency, clarity, regularity and standardization in the system, and the PIB Secretariat lacks adequate expertise in the areas of international petroleum product supply and pricing. In order to eliminate these problems, it is recommended that, in the short run, GOF develop a completely transparent price determination methodology, with technical assistance from experts provided by a regional energy agency. Later, once this system has been functioning for some years, it is recommended that GOF completely deregulate petroleum prices. (See paras 4.1-4.4)

Electricity

5.4 Subsector Focus. In this subsector, the focus should be on making better use of existing assets, with limited capacity expansion. The expansion plan for FEA calls for an annual average investment of approximately F$6.2 million over 1991-2000, with no capacity additions on VLIS. In view of FEA's precarious financial condition, it is recommended that FEA review its prospective capacity, subtransmission and distribution investments closely in the next few months. (See paras 3.17-3.32).

5.5 FEA's Capacity Needs. There are three possible ways for FEA to reduce the need for capacity expansion. First, FEA's capacity needs depend, in part, upon its reliability of service criteria. In view of the potential cost savings from a revision of FEA's reliability criteria, it is recommended that FEA relax its reliability of supply criteria and study alternative approaches for achieving a reasonable reliability of supply. (See paras 3.22-3.25). Second, FEA's capacity needs also depend upon the firm and average capacity available from the Monasavu reservoir. Since there are indications that the firm and average reservoir capacity may exceed the current estimates, it is recommended that the reservoir operating rule curve be developed. (See para 3.29) Third, there could be significant benefits to FEA if it could purchase power from FSC, the largest potential cogenerator. In view of these potential savings, it is recommended that FEA aggressively pursue the possibility of power purchases from FSC for VLIS. (See para 3.30).

5.6 Corporatization of FEA. In view of FEA's present difficult financial condition, it is recommended that no immediate major changes be made in the structure and form of FEA.

5.7 Regulating FEA. In view of FEA's past record of satisfactory service to its customers and of the likely costs of greater regulation of FEA, it is recommended that FEA's past relative autonomy be continued. (See paras 4.27-4.28).

5.8 Rural Electrification Policy. In order to ensure that the rural electrification investment programs are economically and socially justified, it is recommended that the proposals for the expansion of rural electrification be re-evaluated. If it is decided to pursue these projects, then it is recommended that a Rural Electrification Authority be created. (See paras 4.35-4.36).

Renewable Energy

5.9 Solar. Since the solar water heating market and the solar communications and marine marker systems are working well, no government attention is recommended. Given the failures in the solar domestic lighting systems, resulting from their inadequate maintenance, it is recommended that DOE's capabilities to design, install, and maintain these systems be strengthened. (See paras 2.21-2.23) Further, given the lack of adequate solar radiation data for the more remote islands, it is recommended that DOE, in coordination with the Fiji Meteorological Service and the Forum Secretariat Energy Division, collect and analyze such data, with donor assistance. (See para 3.37).

5.10 Bagasse. The efficiency of bagasse use for process heat and electricity production can be improved by better storage facilities and more efficient boilers, but these improvements require capital investments. In view of the benefits to FEA from purchasing cogenerated electricity, it is recommended that FEA provide further incentives for expanded bagasse-based electricity production. (See para 3.39).

5.11 Wood. In order to develop the potential use of indigenous hardwoods in small scale plant process heat and, in some cases, steam based electrical generation, it is recommended that DOE develop a program for technical and financial assistance, in association with donors. (See para 3.40).

5.12 Fuelwood. Fiji's sound forestry program is capable of providing continued convenient access to fuelwood, but the Forestry Department lacks adequate strength to fully enforce the laws and regulations. In order to ensure that forestry rules are observed, it is recommended that the strength of the Forestry Department be increased. (See para 4.43).

5.13 Wind power, geothermal energy, OTEC, and wave energy. Since these sources of energy are still experimental, particularly in the Fijian environment, it is recommended that no major investments be undertaken, but, in order to permit future development, low-priority data collection be undertaken. (See paras 4.42-4.46).

5.14 Since Fiji's hydro resources are being identified and investigated in an adequate and timely manner, no change in the existing programs is recommended. (See paras 3.33-3.35).

FIJI

ISSUES AND OPTIONS IN THE ENERGY SECTOR

Petroleum Products Consumption - Historical Data

	1985	1986	1987	1988	1989	1990	Growth rate per annum 1985-90
INLAND				MT			
LPG	3,900	4,350	4,350	4,600	5,400	6,372	10.3%
				kl			
LPG	6,783	7,565	7,565	8,000	9,391	11,082	10.3%
Avgas	1,323	1,392	1,593	1,663	1,684	1,795	6.3%
Motor Spirit	56,195	56,945	54,382	53,680	57,281	62,183	2.0%
Solvent	4,264	4,450	3,275	2,833	2,588	3,231	-5.4%
Kerosene	17,643	19,162	18,269	19,384	21,137	21,551	4.1%
ADO	87,423	85,556	84,469	84,962	97,633	106,350	4.0%
IDO (To FEA)	5,565	5,963	5,972	6,425	7,702	7,361	5.8%
IDO (To Industry)	25,134	35,325	20,442	24,043	19,524	26,424	1.0%
IDO (Total)	30,699	41,288	26,414	30,468	27,226	33,785	1.9%
IFO	5,830	4,689	4,474	4,055	5,082	6,556	2.4%
Lubes	4,237	4,411	4,132	4,399	4,920	5,234	4.3%
TOTAL INLAND	214,397	225,458	204,573	209,444	226,942	251,767	3.3%
INTNL AV & BUNKERS							
Jet A1	111,126	110,493	88,860	99,523	108,916	97,116	-2.7%
ADO	8,101	9,583	14,312	7,020	5,206	12,539	9.1%
IDO	872	6,489	15,199	11,595	9,604	6,310	48.6%
IFO	2,580	4,795	5,142	3,830	7,988	8,927	28.2%
TOTAL AV/BUNKERS	122,679	131,360	123,513	121,968	131,714	124,892	0.4%
TOTAL FIJI	337,076	356,818	328,086	331,412	358,656	376,659	2.2%

Source: Mission estimates based on GOF and oil company statistics.

FIJI

ISSUES AND OPTIONS IN THE ENERGY SECTOR

Petroleum Products Consumption - Forecast

	Forecast 1990-2000 per annum	1990 (actual)	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
INLAND		MT										
LPG	10.0%	6,372	7,009	7,710	8,481	9,329	10,262	11,288	12,417	13,659	15,025	16,527
		kl										
LPG	10.0%	11,082	12,190	13,409	14,750	16,225	17,847	19,632	21,595	23,755	26,130	28,743
Avgas	4.0%	1,795	1,867	1,941	2,019	2,100	2,184	2,271	2,362	2,457	2,555	2,657
Motor Spirit	3.0%	62,183	64,048	65,970	67,949	69,988	72,087	74,250	76,477	78,772	81,135	83,569
Solvent	0.0%	3,231	3,231	3,231	3,231	3,231	3,231	3,231	3,231	3,231	3,231	3,231
Kerosene	1.0%	21,551	21,767	21,984	22,204	22,426	22,650	22,877	23,106	23,337	23,570	23,806
ADO	4.0%	106,350	110,604	115,028	119,629	124,414	129,391	134,567	139,949	145,547	151,369	157,424
IDO (to FEA)	22.7%	7,361	12,960	17,393	22,080	26,598	31,313	36,169	41,111	46,278	51,614	57,148
IDO (to Industry)	1.0%	26,424	26,688	26,955	27,224	27,497	27,772	28,049	28,330	28,613	28,899	29,188
IDO (Total)	9.8%	33,785	39,648	44,348	49,304	54,094	59,085	64,219	69,441	74,891	80,513	86,337
IFO	2.0%	6,556	6,687	6,821	6,957	7,096	7,238	7,383	7,531	7,681	7,835	7,992
Lubes	4.0%	5,234	5,443	5,661	5,888	6,123	6,368	6,623	6,888	7,163	7,450	7,748
TOTAL INLAND	4.8%	251,767	265,485	278,393	291,932	305,698	320,082	335,052	350,579	366,833	383,788	401,506
INTNL AV & BUNKERS												
Jet A1	0.0%	97,116	97,116	97,116	97,116	97,116	97,116	97,116	97,116	97,116	97,116	97,116
ADO	4.0%	12,539	13,041	13,562	14,105	14,669	15,256	15,866	16,500	17,160	17,847	18,561
IDO	4.0%	6,310	6,562	6,825	7,098	7,382	7,677	7,984	8,304	8,636	8,981	9,340
IFO	4.0%	8,927	9,284	9,655	10,042	10,443	10,861	11,296	11,747	12,217	12,706	13,214
TOTAL AV/BUNK	1.0%	124,892	126,003	127,159	128,360	129,610	130,910	132,262	133,667	135,129	136,650	138,231
TOTAL FIJI	3.7%	376,659	391,488	405,552	420,292	435,308	450,991	467,314	484,247	501,963	520,438	539,737

Source: Mission estimates.

FIJI

ISSUES AND OPTIONS IN THE ENERGY SECTOR

FEA - VLIS Historical and Forecast System Power System Statistics

Year	Total Sales (GWh)	Stn. Use & Losses (%)	Total Generation (GWh)	Hydro Generation (GWh)	Diesel Generation (GWh)	Load Factor (%)	Peak Demand (MW)
			Historical (1985-90) Data				
1985	269.6	12.6	308.3			62.9	55.9
1986	295.6	12.2	336.6			63.9	60.2
1987	292.8	11.1	329.5			60.6	62.1
1988	304.1	11.0	341.8			63.3	61.6
1989	324.0	11.4	365.7			65.8	63.4
1990	346.6	8.6	383.9	379.24	4.61	64.6	67.3
			Projected Base Case (Medium Growth) Scenario (4% GDP Growth)				
1991	350.5	9.0	385.2			64.0	68.6
1992	362.6	9.0	398.5			64.0	70.9
1993	375.2	9.0	412.3			64.0	73.4
1994	388.3	9.0	426.7			64.0	76.0
1995	401.8	9.0	441.5			64.0	78.6
1996	415.8	9.0	456.9			64.0	81.3
1997	430.1	9.0	472.6			64.0	84.1
1998	444.9	9.0	488.9			64.0	87.0
1999	460.2	9.0	505.7			64.0	90.0
2000	476.1	9.0	523.2			64.0	93.1
			High Growth Scenario (5% GDP Growth)				
1991	352.2	9.0	387.0			64.0	69.0
1992	366.3	9.0	402.5			64.0	71.6
1993	381.0	9.0	418.7			64.0	74.5
1994	396.3	9.0	435.5			64.0	77.4
1995	412.3	9.0	453.1			64.0	80.7
1996	429.1	9.0	471.5			64.0	83.9
1997	446.2	9.0	490.3			64.0	87.3
1998	464.1	9.0	510.0			64.0	90.8
1999	482.9	9.0	530.7			64.0	94.5
2000	502.4	9.0	552.1			64.0	98.3
			Low Growth Scenario (3% GDP Growth)				
1991	348.7	9.0	383.2			64.0	68.2
1992	359.0	9.0	394.5			64.0	70.2
1993	369.5	9.0	405.5			64.0	72.2
1994	380.3	9.0	417.9			64.0	74.4
1995	391.5	9.0	430.2			64.0	76.6
1996	403.0	9.0	442.9			64.0	78.8
1997	414.6	9.0	455.6			64.0	81.1
1998	426.4	9.0	468.4			64.0	83.4
1999	438.7	9.0	482.1			64.0	85.8
2000	451.2	9.0	495.8			64.0	88.3

Source: Mission estimates based on FEA data.

FIJI

ISSUES AND OPTIONS IN THE ENERGY SECTOR

Existing VLIS Generating Plants

Set No.	Machine make and type	Speed (RPM)	Installed capacity (MW)	Actual capacity (MW)	Year commissioned
			Diesel Plants in Western Region		
VUDA					
1	Mirrlees KV16 Major	500	5.75	5.50	1976
2	Mirrlees KV16 Major	500	5.75	5.50	1976
3	Blackstone EVS 8	600	0.37	0.37	1977
NADI					
6	Blackstone EVS 8	600	0.30	0.10	1962
7	Mirrlees K6 Major	500	1.62	1.60	1968
8	Mirrlees K6 Major	500	1.62	1.60	1968
9	Mirrlees K7 Major	500	2.20	1.80	1970
10	Mirrlees K7 Major	500	2.20	2.20	1972
SIGATOKA					
1	English Elec. 5SRL	375	0.50	0.50	1951
2	English Elec. 5SRL	375	0.50	0.50	1951
3	Ruston 6ATC	600	1.14	1.14	1973
4	Ruston 6ATC	600	1.14	1.14	1974
Total			23.15	21.95	
			Diesel Plants in Central Region		
KINOYA					
1	Mirrlees AVSS16	375	5.00	5.00	1970
2	Mirrlees AVSS16	375	5.00	5.00	1971
3	Mirrlees KVSS16	428	2.84	2.84	1966
4	Mirrlees KV16 Major	500	5.07	4.50	1972
5	Mirrlees KV16 Major	500	5.07	4.50	1972
6	Pielstick 14PC3V	428	9.50	6.00	1977
7	Pielstick 14PC3V	428	9.50	9.50	1977
DEUBA					
1	Ruston 7VEB	500	0.25	0.25	1955
2	Ruston 7VEB	500	0.25	0.25	1954
3	Ruston 7VEB	500	0.25	0.25	1961
4	Ruston 6VEBC	600	0.51	0.50	1964
5	Ruston 6VEBC	600	0.51	0.50	1964
6	Niigata 6L28H5	375	0.40	0.40	1979
7	Niigata 6L28H5	375	0.40	0.40	1979
Total			44.54	39.88	
			Hydroelectric Plants		
WAILOA /a					
1	Tibb (Milano)	750	20.80	20.80	1983
2	Tibb (Milano)	750	20.80	20.80	1983
3	Tibb (Milano	750	20.80	20.80	1983
4	Tibb (Milano)	750	20.80	20.80	1983
Total			83.20	83.20	

/a Station peak output limited to approximately 72 MW.

Source: FEA.

Existing Generating Plants on the Isolated Systems

Set No.	Machine make and type	Speed (RPM)	Installed capacity (MW)	Rated capacity (MW)	Year commissioned
			Rakiraki Power Station		
1	Caterpillar 3412	1,500	0.37	0.37	1979
2	Caterpillar 3412	1,500	0.37	0.37	1979
3	Caterpillar 3406	1,500	0.16	0.16	1979
4	Caterpillar 3406	1,500	0.16	0.16	1979
Total			1.04	1.04	
			Labasa Power Station		
1	Ruston 6VCBX }to be	600	0.23	0.17	1968
2	National }retired	500	0.17	0.15	1940
3	Ruston 6ATC	500	1.14	1.14	1974
4	Eng. Electric 5SRL	375	0.50	0.50	1951
5	Ruston 6ATC	500	1.14	1.14	1974
6	Ruston 6ATC	500	1.14	1.14	1974
	New Labasa Station				
1	Ruston 6ATC	500	1.14	1.14	1972
2	Ruston 6ATC	500	1.14	1.14	1973
Total			6.60	6.52	
			Savusavu Power Station		
1	Caterpillar 3406	1,500	0.16	0.16	1980
2	Caterpillar 3406	1,500	0.16	0.16	1980
3	Caterpillar 3412	1,500	0.37	0.37	1980
4	Caterpillar 3412	1,500	0.37	0.37	1990
5	Mirrlees B/S EV58	600	0.37	0.30	1953
Total			1.41	1.34	
			Levuka Power Station		
1	Blackstone AV58		0.37	0.37	1958
2	Blackstone AV58		0.37	0.37	1958
3	Rolls Royce GS022		0.30	0.25	1982
4	Rolls Royce GS023		0.30	0.25	1982
5	Rolls Royce GS025		0.30	0.25	1982
Total			1.63	1.48	

Source: FEA.

FIJI

ISSUES AND OPTIONS IN THE ENERGY SECTOR

Assessment of Power Development Plans

Definitions and Assumptions

The following definitions and assumptions have been used in the preparation of the Power Development Plans:

Installed capacity	The nameplate rating of plant and equipment.
Capability	The maximum loading at which the equipment can be operated continuously, as determined by FEA.
System reserve allowance	The excess capability that should be available on the system to cater for the non-availability of plant due to maintenance or failure. The FEA reserve allowance for diesel plants is defined as (Capability of largest unit) + r (capability of balance of diesel plant) r = 0.2 for VLIS, r = 0.15 for isolated systems
System firm capacity	The difference between the total system plant capabilities and the system reserve allowance.
Firm diesel energy	The energy that a diesel plant will produce operating at 65 percent plant factor for one year. On the isolated systems, a plant factor of 70 percent is applied.
Firm hydro-energy	The energy that can be produced 95 percent of the time, based upon the hydrological data.
Firm hydro capacity	The capability with the largest unit unavailable. Note that if the hydro units are selected for peak operation rather than base load, then a higher peak capability for the firm energy available can be achieved. Operation in this manner requires adequate installed hydro capacity and reserve diesel capacity for the amount of peak capacity in excess of that available with the largest hydro unit out of service.
Costs	All costs are expressed in Fijian dollars at constant 1990 prices. The allocation of foreign and local costs is based on general previous experience, and is not based upon detailed estimates.

Power Development Plan - Viti Levu Interconnected System

Description		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
LOAD FORECAST											
Projected Generation	GWh	385	399	412	427	442	457	473	489	506	523
Projected Peak Demand	MW	68.6	70.9	73.4	76.0	78.6	81.3	84.1	87.0	90.0	93.1
POWER/ENERGY STATUS											
Installed Capacity											
Diesel capacity (start of year)	MW	67.7	67.7	67.7	70.5	70.5	70.5	70.5	70.5	70.5	70.5
Hydro capacity (start of year)	MW	83.2	83.2	83.2	83.2	83.2	83.2	83.2	83.2	83.2	83.2
Added diesel capacity	MW			2.8 (transferred from Suva)							
Total Installed Capacity	MW	150.9	150.9	153.7	153.7	153.7	153.7	153.7	153.7	153.7	153.7
FIRM CAPACITY											
Diesel capability	MW	61.8	65.3	68.1	68.1	68.1	68.1	68.1	68.1	68.1	68.1
Firm hydro capability	MW	61.0	63.0	64.0	65.0	67.0	68.0	70.0	72.0	72.0	72.0
Total Capability	MW	122.8	128.3	132.1	133.1	135.1	136.1	138.1	140.1	140.1	140.1
Reserve allowance	MW	20.0	21.72	24.2	25.2	27.2	28.2	30.2	32.2	32.2	32.2
System Firm Capacity	MW	102.8	106.6	107.9	107.9	107.9	107.9	107.9	107.9	107.9	107.9
FIRM ENERGY											
Firm diesel energy	GWh	352	372	388	388	388	388	388	388	388	388
Firm hydro energy	GWh	340	340	340	340	340	340	340	340	340	340
Total Firm Energy	GWh	692	712	7728	728	728	728	728	728	728	728
Expected Generation	GWh										
Expected generation - hydro		367	367	367	367	367	367	367	367	367	367
- diesel		18	32	45	60	75	90	106	122	139	156

Power Development Plan - Viti Levu Interconnected System (Continued)

Description	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
COST STREAMS										
	---constant 1990 F$'000---									
General Investment										
Repairs to foundations Kinoya	250									
Transfer 2.8 MW diesel from Suva to Kinoya			250							
Subtotal	250	0	250	0	0	0	0	0	0	0
Other System Investments										
Subtransmission and distribution reinforcement expansion and upgrading	6,465	4,842	5,837	2,600	4,090	4,050	3,100	3,960	3,600	3,600
Total Investment	6,665	4,842	6,087	2,600	4,090	4,050	3,100	3,960	3,600	3,600

Source: Mission estimates.

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ISSUES AND OPTIONS IN THE ENERGY SECTOR

Monasavu Reservoir Hydrological/Energy Review

Description

1. This project is an engineering study to review the energy capability of the Monasavu hydroelectric project reservoir.

2. The study is expected to consist of the investigation of hydrology and water balance of the Monasavu reservoir and simulation studies of the power system to give energy availability estimates and the corresponding probabilities.

Objectives

3. The objective of the project is to determine the energy availability of the Monasavu hydroelectric scheme. Review of the hydro and thus energy availability has become critical as a result of load growth taking electricity demand above the energy availability estimate use by the Fiji Electricity Authority (FEA) at present. That estimate is dated and based on limited information. Fourteen years of collected, and so far unutilized, relevant data exists to review the estimate.

4. Until 1991 the entire load on the FEA interconnected power system was supplied by the Monasavu hydroelectric scheme. Now that the load on the system has risen above the energy availability of the scheme, because of increase in electricity demand, diesel generation at considerably higher cost is required. If the analysis of hydrological data shows the energy capability of Monasavu to be higher than previously thought, diesel generation will be less than previously expected. Thus the potential benefit of the project is to reduce the level of diesel operation and to avoid excessive generation costs. Notwithstanding the findings of the study, FEA will have more secure knowledge of the capacity available from the Monasavu reservoir.

Terms of Reference

5. The energy availability assumptions, and the corresponding probability for the Monasavu hydroelectric scheme are based on derived and limited data. FEA now wish to analyze collected data from the past 14 years and review the energy capability of the reservoir.

6. The consultant will be required to undertake the following work program with all information and data provided by or through FEA:

(a) Collection, analysis and review of hydrological data, reservoir levels and electricity production data. The analysis of hydrological data should include rainfall comparisons between Monasavu catchment and Nadarivatu records.

(b) Update of hydrology and generation of streamflows for Monasavu scheme.

(c) Review of operation of Monasavu scheme to confirm diversion factors and water balance for Monasavu reservoir.

(d) Simulation studies to produce estimates of the energy/power capability, including probabilities, of the Monasavu reservoir.

(e) Submission of report, including databases.

7. The work is expected to be completed within three months at an estimated cost of approximately F$45,000.

FIJI

ISSUES AND OPTIONS IN THE ENERGY SECTOR

Schedule of Import Duties for Petroleum Products
(Effective November 21, 1990)

	Fiscal Duty (F¢/l)	Customs Duty (% CIF)
MOTOR SPIRITS	33.0	10.0%
AVIATION GASOLINE	33.0	10.0%
KEROSENE	0.5	0.0
AVTUR	0.5	0.0
ADO	14.0	10.0%
IDO	14.0	10.0%
IFO	2.5	10.0%
SOLVENT	1.5	10.0%
PRE-MIX <89 RON	4.0	10.0%
PRE-MIX >90 RON	29.0	10.0%
LPG (Per kg)	4.0	10.0%

Source: PIB.

FIJI

ISSUES AND OPTIONS IN THE ENERGY SECTOR

FEA's Past and Projected Financial Performance

Key Financial Indicators

Financial Year Ended December 31	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	---	Audited	---	Est.	---	---	---	---	Projections	---	---	---	---	---
Energy Sales (GWh)	310.5	322.9	344.7	366.0	351.4	353.2	355.6	356.8	361.9	374.9	387.9	401.4	415.5	429.9
Energy Sales - % increase/year	-0.3	3.8	6.3	5.8	-4.2	0.5	0.7	0.4	1.4	3.5	3.4	3.4	3.4	3.4
Electricity Sales Revenue (F$m)	46.5	52.5	56.4	65.1	64.6	66.1	67.7	69.1	70.9	73.5	76.1	78.8	81.7	84.5
Average Revenue (c/kWh)	15.0	16.3	16.4	17.8	18.4	18.7	19.0	19.4	19.6	19.6	19.6	19.6	19.7	19.7
Ave. Rev. - Constant Prices (c/kWh)				17.8	18.4	18.7	19.0	19.4	19.6	19.6	19.6	19.6	19.7	19.7
Ave. Rev. - % increase/year	5.6	8.5	0.7	8.7	3.4	1.8	1.7	1.8	1.2	0.0	0.1	0.1	0.1	0.0
Ave. Rev. - Index 1990 = 100				100.0	103.4	105.1	106.9	108.7	109.9	109.9	110.0	110.1	110.1	110.2
Net Profit/(Loss) (F$m)	(15.0)	(2.1)	0.1	6.4	(0.7)	(1.9)	(4.3)	(4.6)	(.59)	(8.8)	(12.7)	(18.3)	(24.0)	(30.1)
Debt Service - Interest (F$m)	30.7	29.0	27.0	24.9	28.6	28.4	27.9	26.9	26.5	26.0	25.9	27.0	27.6	27.8
- Principal (F$m)	18.8	21.7	19.8	43.5	26.0	23.1	35.6	38.9	35.2	53.7	48.3	562.8	49.6	42.6
- Total (F$m)	49.5	50.7	46.8	68.4	54.6	51.5	63.5	65.8	61.7	79.7	74.2	79.8	77.2	70.4
Capital Expenditure (F$m)	7.2	4.9	8.7	14.7	15.3	14.0	13.1	12.3	9.1	12.2	18.6	9.4	9.3	13.9
Total Cash Requirements (F$m)	56.6	55.5	55.5	83.1	69.9	65.5	76.7	78.0	80.8	91.9	92.8	89.2	86.5	84.3
Internal Cash Generation (F$m)	30.5	36.9	40.9	45.3	44.5	43.4	41.8	41.3	40.5	39.0	36.5	32.2	28.9	24.7
Government Equity (F$m)	3.9	5.0	4.6	5.5	0.8	4.8	1.7	1.0	0.0	0.0	0.0	0.0	C.0	0.0
External Borrowing Required (F$m)	23.7	11.0	13.0	29.0	24.6	17.3	33.2	35.8	30.3	53.0	56.3	57.0	57.5	59.6
Cum. Ext. Borrowing Req'd (F$m)					24.6	41.9	75.1	110.9	141.2	194.2	250.4	307.4	364.9	424.6
Cumulative Cash Position (F$m)	3.0	0.4	3.3	0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Rate Base - Revalued (F$m)	372.2	429.7	449.7	479.1	515.1	548.9	580.1	610.5	636.8	660.8	690.1	718.9	744.0	772.1
Rate of Return - Revalued (%)	5.3	6.3	6.0	6.5	5.3	4.6	3.9	3.4	3.0	2.4	1.7	1.0	0.3	-0.5
Self Financing Ratio - 3 yr. av.	(2.25)	(1.99)	(0.63)	(8.52)	(0.69)	(0.57)	(1.65)	(2.13)	(1.90)	(3.06)	(2.81)	(3.83)	(4.44)	(3.94)
Self Financing Ratio - Annual	(2.66)	(2.81)	(0.68)	(7.49)	(0.66)	(0.57)	(1.65)	(2.00)	(2.34)	(3.33)	(2.03)	(5.06)	(5.21)	(3.28)
Debt Service Ratio /a	0.7	0.7	0.9	0.3	1.0	0.9	0.8	0.9	0.9	0.9	0.8	0.7	0.7	0.6
Debt Service Ratio /b	0.6	0.7		0.9	0.3	0.9	0.9	0.6	0.7	0.5	0.5	0.4	0.4	0.4
Debt/Debt Plus Equity /c	81%	69%	62%	56%	52%	46%	44%	43%	40%	40%	39%	39%	39%	38%
Debt/Debt Plus Equity /d	82%	72%	66%	61%	58%	52%	50%	47%	43%	42%	39%	39%	39%	38%
Long-term Funding/Net Fixed Assets	1.1	1.1	1.1	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.1
Operating Ratio	51%	49%	52%	52%	58%	61%	66%	69%	72%	77%	84%	90%	96%	103%
Current Ratio	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.3
Accounts Receivable - Months	0.6	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Accounts Payable - Months	0.3	0.3	0.5	1.0	1.0	0.9	0.9	0.8	0.8	0.8	0.9	0.8	0.8	0.8

/a Net Debt Service Requirements.
/b Includes rollover of Bonds and Primissory Notes.
/c Long Term Debt/Long Term Debt plus Equity.
/d Long Term Debt plus Promissory Notes/Long Term Debt plus Promissory Notes plus Equity.

Note: These projections assume existing tariff (as of February 1991) with no increases, and no GOF equity contributions (1991-96).

Source: FEA.

Profit and Loss Account
(F$ million)

Financial Year Ended December 31	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Audited			Est.	Projections									
Total Generation (GWh)	346.9	361.7	385.4	410.3	393.7	395.8	396.5	400.1	405.8	420.4	435.2	450.5	466.3	482.6
Total Purchases (GWh)	2.5	1.5	3.0	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Units Gen. & Purchased (GWh)	349.4	363.2	388.4	412.5	396.0	398.1	400.7	402.3	408.1	422.7	437.5	452.7	468.5	484.8
Station Use/Losses (GWh)	38.91	40.34	43.76	46.51	44.53	44.90	45.15	45.50	46.21	47.78	49.56	51.26	53.06	54.88
Power Sold (GWh)	310.5	322.9	344.7	366.0	351.4	353.2	355.6	356.8	361.9	374.9	387.9	401.4	415.5	429.9
Average Revenue (Cents/kWh)	15.0	16.3	16.4	17.8	18.4	18.7	19.0	19.4	19.6	19.6	19.6	19.6	19.7	19.7
Income														
Electricity Sales	46.5	52.5	56.4	54.1	64.6	66.1	67.7	69.1	70.9	73.5	76.1	78.8	81.7	84.5
Other income	1.0	0.9	1.4	0.6	0.6	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Operating Income	47.5	53.4	57.8	65.6	65.3	66.9	68.5	69.9	71.7	74.3	76.9	79.6	82.5	85.3
Expenses														
Thermal Generation - Fuel & Oil	1.5	1.8	2.3	2.6	3.4	3.6	5.4	5.9	7.1	10.0	13.3	17.2	21.6	26.8
Thermal Generation - Other	1.4	1.5	2.0	1.9	2.3	2.5	3.1	3.5	3.9	4.8	5.8	6.6	7.9	9.2
Hydro Generation	0.2	0.3	0.5	0.6	0.6	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1
Distribution	2.2	2.6	3.2	3.4	3.7	3.9	4.1	4.3	4.5	4.8	5.0	5.3	5.6	5.8
Electricity Purchases	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
System Control and Telecoms.	0.6	0.6	0.8	1.0	1.0	1.0	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.6
Head Office Engineering	1.0	0.9	1.1	1.8	1.9	2.1	2.2	2.3	2.4	2.5	2.6	2.8	2.9	3.0
Civil Engineering	0.2	0.2	0.2	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8
Training	0.4	0.3	0.4	1.7	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.4
Commercial	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Royalties	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Management and General	3.3	3.8	4.5	4.7	5.7	6.5	6.9	7.2	7.6	7.9	8.3	8.7	9.2	9.6
Insurance	0.9	0.5	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.4
Depreciation	12.3	13.0	13.9	15.1	16.4	17.6	18.7	19.9	21.0	22.1	23.5	24.7	25.9	27.3
Total Operating Expenses	24.4	26.0	30.3	34.4	37.5	40.6	45.0	48.1	51.7	57.5	64.3	71.4	79.4	88.3
Net Operating Profit	23.1	27.4	27.5	31.2	27.7	26.3	23.4	21.8	20.1	16.8	12.6	8.2	3.0	-2.9
Nonoperating Income	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total	23.1	27.4	27.5	31.7	28.2	26.8	23.9	22.3	20.6	17.3	13.1	8.7	3.5	-2.4
Nonoperating Expenses														
Research and Development	1.6	0.3	0.0	-	-	-	-	-	-	-	-	-	-	-
R&M Cyclone - Prior Year	-	-	(0.0)	-	-	-	-	-	-	-	-	-	-	-
R&M Cyclone & Flood Damage	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Amort. of Training Expend.	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-
Amort. of SCC Goodwill	0.4	0.4	0.4	0.4	0.4	0.4	0.4	-	-	-	-	-	-	-
Stock Obsolescence	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Doubtful Debts	0.1	(0.1)	0.0	-	-	-	-	-	-	-	-	-	-	-
Total	3.6	0.6	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Profit/(Loss) Before Interest and Financing Charges	19.6	26.9	27.1	31.4	27.9	26.4	23.6	22.3	20.6	17.3	13.1	8.7	3.5	-2.4

Profit and Loss Account cont'd
(F$ million)

Financial Year Ended December 31	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Audited			Est.	Projections									
Nonoperating Expenses														
Research and Development	1.6	0.3	0.0	-	-	-	-	-	-	-	-	-	-	-
R&M Cyclone - Prior Year	-	-	(0.0)	-	-	-	-	-	-	-	-	-	-	-
R&M Cyclone & Flood Damage	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Amort. of Training Expend.	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-
Amort. of SCC Goodwill	0.4	0.4	0.4	0.4	0.4	0.4	0.4	-	-	-	-	-	-	-
Stock Obsolescence	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Doubtful Debts	0.1	(0.1)	0.0	-	-	-	-	-	-	-	-	-	-	-
	3.6	0.6	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net Profit/(Loss) Before. Interest and Financing Charges	19.6	26.9	27.1	31.4	27.9	26.4	23.6	22.3	20.6	17.3	13.1	8.7	3.5	-2.4
Interest														
Total Interest Payments	30.7	29.0	27.0	24.9	28.6	28.4	27.9	26.9	26.5	26.0	25.9	27.0	27.6	27.8
(Less) Interest Capitalized	0.4	0.0	0.0	0.0	0.0	0.0	00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest Charged to Operations	30.3	29.0	27.0	24.9	28.6	28.4	27.9	26.9	26.5	26.0	25.9	27.0	27.6	27.8
Net Profit/(Loss) After Interest Before Financing Charges	(10.7)	(2.1)	0.1	6.4	(0.7)	(1.9)	(4.3)	(4.6)	(5.9)	(8.8)	(12.7)	(18.3)	(24.0)	(30.2)
Financing Charges														
Real. Exch. Losses - Principal	-	-	(0.3)	-	-	-	-	-	-	-	-	-	-	-
Real. Exch. Losses - Interest	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-
Unreal. For. Exch. Losses/(Gains)	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(0.1)
Net Profit/(Loss) Before Extraordinary Items	(11.9)	(2.1)	0.4	6.4	(0.7)	(1.9)	(4.3)	(4.6)	(5.9)	(8.8)	(12.7)	(18.3)	(24.0)	(30.1)
Transfer to/(from) Reserves	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-
Net Profit/(Loss) for the Year	(15.0)	(2.1)	0.1	6.4	(0.7)	(1.9)	(4.3)	(4.6)	(5.9)	(8.8)	(12.7)	(18.3)	(24.0)	(30.1)
Rate Base (Ave. Rev. Net Fixed Assets)	372.2	429.7	449.7	479.1	515.1	548.9	580.1	610.5	636.8	660.8	690.1	718.9	744.0	772.1
Rate of Return (Net Opg. Profit/Rate Base) /a	5.3%	6.3%	6.0%	6.5%	5.3%	4.6%	3.9%	3.4%	3.0%	2.4%	1.7%	1.0%	0.3%	-0.5%

/a A rate of return of 8 percent has been covenanted.

Note: These projections assume existing tariff (as of February 1991) with no increases, and no GDF equity contributions (1991-96).

Source: FEA.

Balance Sheet
(F$ million)

Financial Year Ended December 31	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Audited			Est.	Projections									
Fixed Assets														
Gross Fixed Assets in Oper.	511.5	542.0	578.2	629.9	681.8	731.4	780.4	830.9	874.0	921.9	978.2	1,027.6	1,078.9	1,137.0
(Less) Accumulated Depreciation	90.5	103.5	117.4	132.5	148.9	166.4	185.2	205.1	226.1	248.2	271.7	296.3	322.2	349.5
Net Fixed Asses in Operation	421.0	436.5	460.8	497.4	532.9	565.0	595.2	625.8	647.9	673.7	706.5	731.3	756.7	787.5
Net Nonoperating Assets	1.3	1.2	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Work in Progress	7.3	7.0	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Total Fixed Assets	429.6	445.7	470.0	506.6	542.0	574.2	604.4	635.0	657.0	682.9	715.7	740.5	765.9	796.6
Investments	4.2	5.5	6.6	6.0	3.7	3.1	3.4	2.0	2.2	2.4	2.6	2.8	2.9	3.1
Current Assets														
Cash at Bank and in hand	2.3	(0.2)	2.5	(0.0)	0.0	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Inventories	6.6	7.6	8.3	8.8	9.3	9.8	10.4	11.1	11.7	12.4	13.2	14.0	14.8	15.7
Accounts Receivable - Elect.	2.2	2.9	3.4	3.2	3.2	3.3	3.3	3.4	3.5	3.6	3.8	3.9	4.0	4.2
Accounts Receivable - Other	0.3	0.7	1.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Prepayments and Other Debtors	0.7	0.5	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total Current Assets	12.1	11.4	16.4	13.3	13.8	14.4	15.1	15.8	16.5	17.3	18.2	19.1	20.1	21.1
Other Assets														
Intangibles	2.1	1.8	1.4	1.1	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prepayments	0.5	0.4	0.3	0.3	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
Deferred Unreal Exch. Losses														
Total Assets	448.4	465.9	494.7	527.2	560.7	592.4	623.3	653.3	676.2	703.0	736.9	762.8	789.3	821.3
Total Equity, Reserves and Liabilities														
Government Equity	58.5	62.5	66.1	71.6	72.4	77.2	78.8	89.8	79.8	79.8	79.8	79.8	79.8	79.8
Retained Earnings	(12.3)	(14.4)	(14.3)	(7.8)	(8.5)	(10.5)	(14.8)	(19.4)	(25.3)	(34.1)	(46.8)	(65.1)	(89.1)	(119.2)
Reserves	6.3	8.5	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
Revaluation Reserve	21.4	66.2	92.0	114.8	146.0	181.8	217.7	255.9	269.8	325.6	363.3	403.3	445.3	489.8
Total Equity and Reserves	73.9	122.6	154.4	189.1	220.4	259.0	292.3	326.9	354.8	381.8	406.8	428.6	466.6	460.9
Long Term Debt	312.0	273.8	253.6	236.6	240.0	220.7	230.0	244.1	235.7	255.4	261.8	269.2	283.9	277.4
Current Liabilities														
Promissory Notes	26.2	37.1	50.0	63.0	63.0	63.0	63.0	48.0	33.0	18.0	3.0	0.0	0.0	0.0
Trade Creditors	0.6	0.7	1.3	2.8	3.0	3.1	3.3	3.4	3.3	4.0	5.0	4.7	5.2	6.2
Other Creditors and Accounts	9.5	8.1	8.4	5.6	6.2	6.2	6.1	5.9	5.9	5.8	5.7	5.9	6.1	6.1
Consumer Deposits	0.9	0.9	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Loans due within one year	22.0	19.2	22.4	25.1	23.1	35.6	23.9	20.3	38.7	33.3	49.8	49.6	42.8	65.9
Total Current Liabilities	59.3	66.0	83.4	97.8	96.7	109.2	97.6	78.8	82.1	62.4	64.8	61.6	55.4	79.6
Other Liabilities														
Consumer Deposits	3.4	3.3	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Total Equity, Res. and Liab.	448.6	465.9	494.8	527.2	560.6	592.4	6523.4	653.3	6767.2	703.1	736.9	762.8	789.4	821.3
Debt/Debt plus Equity /a	80.9%	69.0%	62.2%	55.6%	52.1%	46.0%	44.0%	42.8%	39.9%	40.1%	39.2%	38.6%	38.9%	37.6%
Debt/Debt plus Equity /b	82.1%	71.7%	66.3%%	61.3%	57.9%	52.3%	50.1%	47.2%	43.1%	41.7%	39.4%	38.6%	38.9%	37.6%

/a Net Debt Service Requirements.
/b Includes rollover of Bonds and Promissory Notes.

Note: These projections assume existing tariff (as of February 1991) with no increases, and no GDF equity contributions (1991-96).

Source: FEA.

Source and Application of Funds Statement
(F$ million)

Financial Year Ended December 31	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Audited			Est.	Projections									
Internal Cash Generation														
Net Profit/(Loss) before inter. and Financing Charges	19.6	26.9	27.1	31.4	.27.9	26.4	23.6	22.3	20.6	17.3	13.1	8.7	3.5	-2.4
Depreciation	12.3	13.0	13.9	15.1	16.4	17.6	18.7	19.9	21.0	22.1	23.5	24.7	25.9	27.3
Other non-Cash Items	2.6	1.2	2.3	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Cash Flow	34.5	41.1	43.3	46.8	44.6	44.3	42.7	42.3	41.6	39.4	36.6	33.4	29.4	24.9
(Less) Working Capital Incr.	1.4	3.3	1.3	0.6	(0.4)	0.6	0.6	0.8	0.9	0.3	(0.1)	1.0	0.3	(0.0)
(Less) Consumer Deposits	0.6	(0.3)	0.1	-	-	-	-	-	-	-	-	-	-	-
(Less) Sinking Fund Investment	2.1	1.2	1.1	0.9	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cash Avail. for Debt Service	30.5	36.9	40.9	45.3	44.5	43.4	41.8	41.3	40.5	39.0	36.5	32.2	28.9	24.7
Debt Service														
Interest - Local	-	-	-	12.8	19.5	20.7	21.7	22.3	23.0	23.6	24.3	25.9	26.7	27.5
Interest - Overseas	30.7	29.0	27.0	12.1	9.1	7.7	6.2	4.6	3.5	2.4	1.6	1.1	0.8	0.3
Principal - Local Loans	-	-	-	91.7	0.5	3.7	5.8	6.7	7.1	7.7	10.8	12.2	12.4	10.6
Principal - Local Bonds	4.0	0.0	0.0	1.5	6.0	0.0	10.5	3.3	0.0	21.9	16.3	33.2	34.3	30.3
Principal - Overseas	14.8	21.7	19.8	37.3	19.5	19.3	19.3	13.9	13.1	2.0	6.2	4.4	2.9	1.7
Promissory Notes Repaid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	15.0	15.0	15.0	3.0	0.0	0.0
Total Debt Service	49.5	50.7	46.8	1565.4	54.6	51.5	63.5	65.8	61.7	79.5	75.2	79.8	77.2	70.4
Cash Avail. from Operations	(19.0)	(13.8)	(5.9)	(110.1)	(10.1)	(8.0)	(21.7)	(24.5)	(21.2)	(40.7)	(37.7)	(47.6)	(48.3)	(45.7)
Capital Investment														
Annual Capital Investment	7.2	4.9	8.7	14.7	15.3	14.0	13.1	12.3	9.1	12.2	18.6	9.4	9.3	13.9
Balance to be Financed	26.2	18.7	14.7	124.8	25.4	22.0	34.8	36.7	30.3	53.0	56.3	57.0	57.5	59.6
Sources of Finance														
Government of Fiji Equity	3.9	5.0	4.6	5.5	0.8	4.8	1.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Internat. Lending Agency Loans	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sinking Fund Redemption	4.0	0.0	0.0	1.5	2.7	1.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Bond Issues	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Promissory Notes	17.2	10.9	12.9	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Loans	0.0	0.0	0.0	101.6	21.9	16.3	33.2	34.3	30.3	53.0	56.3	57.0	57.5	59.6
Decreases in Prepayments	0.1	0.1	0.1	-	-	-	-	-	-	-	-	-	-	-
Total Finance	27.26	16.0	17.6	121.5	25.4	22.0	34.8	36.7	30.3	53.0	56.3	57.0	57.5	59.6
Cash Inc. (Decr.) for Year	1.4	(2.7)	2.9	(3.3)	0.0	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Opening Balance	1.6	3.0	0.4	3.3	(0.0)	0.0	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Closing Balance	3.0	0.4	3.3	(0.0)	0.0	0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Self Financing Ratio - 3-yr ave.	-2.2	-2.0	-0.6	-8.5	-0.7	-0.6	-1.7	-2.1	-1.9	-3.1	-2.8	-3.8	-4.4	-3.9
Self Financing Ratio - Annual	-2.7	-2.8	-0.7	-7.5	-0.7	-0.6	-1.7	-2.0	-2.3	-3.3	-2.0	-5.1	-5.2	-3.3
Debt Service Ratio /a	0.7	0.7	0.9	0.2	1.0	0.9	0.8	0.9	0.9	0.9	0.8	0.7	0.7	0.6
Debt Service Ratio /b	0.8	0.7	0.9	0.3	0.9	0.9	0.7	0.6	0.7	0.5	0.5	0.4	0.4	0.4

/a Net Debt Service Requirements.
/b Includes rollover of Bonds and Promissory Notes.

Note: These projections assume existing tariff (as of February 1991) with no increases, and no GDF equity contributions (1991-96).

Source: FEA.

FIJI

ISSUES AND OPTIONS IN THE ENERGY SECTOR

Statistical Appendix

TABLE 1
FIJI: SELECTED DEVELOPMENT INDICATORS

		1985	1986	1987	1988	1989	1990
GDP (million F$)[1]		1,178	1,326	1,310	1,377	1,755	1,726
Per capita (F$)		1,691	1,855	1,835	1,915	2,431	2,381
Total Imports[2] (million F$)		508	494	463	655	944	na
Total Exports[3] (million F$)		272	313	407	515	583	na
Inflation Rate[4]		4.4	1.8	5.7	11.9	6.1	7.9
Exchange Rate[5] (F$/US$)		1.15	1.15	1.23	1.42	1.48	1.40
Sea Area (100 sq. km)	2,300						
Land Area (100 sq. km)	183						
Wage & Salary Employment[6] ('000s)		81,100	79,800	78,200	77,700	88,200	89,000
Ave. Wage & Salary[7] (F$/hr)		1.49	1.49	1.57	1.55	na	na
Total Population[8] ('000s)		697,000	715,000	714,000	719,000	722,000	725,000[9]
Urban[10] (%)		39	39	39	39	39	39

Overseas Development Assistance

Annual ODA ('000 F$)[11]	36,685	48,875	33,456	38,913	50,742	na
Multilateral ('000 F$)	na	na	2,227	12,602	13,082	na
Bilateral ('000 F$)	na	na	31,229	26,311	37,660	na
% Bilateral	na	na	93	68	74	na
ODA (% GDP)	31.1	36.9	25.5	28.3	na	na
ODA (% Current Govt. Income)	na	na	na	na	na	na
ODA/Capita (F$)	53	68	47	54	70	na

Sources: Current Economic Statistics (October 1990).
UNDP Development Co-operation Reports.
Mission Estimates.

Notes:
(1) Current prices from Current Economic Statistics (October 1990). Value for 1990 estimated, using a growth rate of 4%.
(2) CIF actual figures from CES.
(3) FOB actual figures from CES.
(4) Based on 1985 CPI=100. 1985 rate based on 1979 CPI=100. From CES.
(5) Average throughout the year from CES.
(6) Mid-year.
(7) Mid-year estimates.
(8) Based on 1975 and 1980 Census data adjusted to mid-year.
(9) Mission estimate using annual growth rate of +0.4%.
(10) Main FEA Electrified Areas. Non Census years estimated.
(11) 1987-89 figures from Development Co-operation Reports.

TABLE 2

FIJI: SELECTED PROJECTIONS

	1990	1995	2000
Population[1]:			
urban	282,750	291,720	303,030
rural	442,250	456,280	473,970
Total	725,000	748,000	777,000
GDP (million US$)[2]:			
high growth (5%)	1,233	1,574	2,009
med. growth (4%)	1,233	1,500	1,825
low growth (3%)	1,233	1,430	1,657
GDP/Capita[3]:	1,701	2,006	2,349
Electricity Generation (GWh)[4]:			
with EGM[5]	408	414	505
without EGM	408	480	572
Fuel Consumption (kl):			
Gasoline	62,183	72,087	83,569
Kerosene	21,551	22,650	23,806
ADO	106,350	129,391	157,424
IDO	33,785	na	na
IFO	6,556	7,238	7,992
Lubes	5,234	6,368	7,748
Avgas	1,795	2,184	2,657
Solvent	3,231	3,231	3,231
LPG	11,082	17,847	28,743
Total Inland	251,767	260,996	315,170
Total Av/Bunkers	124,892	130,910	138,231
Total Fiji Trade	376,659	391,906	453,401

Source: MIssion Estimates

Notes:
(1) Mission estimates from 1986 census, assuming population growth approximately 3%. Urban population approximately 39% of total.
(2) 1990 data estimated from 1989 actual using a GDP growth of 4%.
(3) Assuming a medium growth scenario.
(4) Includes power purchased from Fiji Sugar Corporation.
(5) Emperor Gold Mines' service with FEA uncertain past 1991.

TABLE 3

FIJI: ENERGY BALANCE, 1990
(Original units)

	Fuel wood[2] (tonnes)	Bagasse[3] (tonnes)	Coconut Residues (tonnes)	Total Biomass (tonnes)	Hydro (GWh)	Total Electricity (GWh)	Gasoline (kl)	Jet A1 (kl)	Kerosene (kl)	Petroleum ADO (kl)	IDO (kl)	IFO (kl)	Avgas (kl)	LPG (kl)	Total Petroleum (kl)
Primary Supplies:															
Production	736,590	1,045,078	74,905	1,856,573	379										
Imports				0			62,183	97,116	21,551	118,889	39,203	15,483	1,795	11,082	367,302
Bunkering/Exports				0				(97,116)		(12,539)	(6,310)	(8,927)			(124,892)
GROSS AVAILABLE	**736,590**	**1,045,078**	**74,905**	**1,856,573**	**379**		**62,183**	**0**	**21,551**	**106,350**	**32,893**	**6,556**	**1,795**	**11,082**	**242,410**
Conversion:															
Power Generation[1]	(4,630)	(69,800)		(74,430)	(379)	497					(7,108)				(7,108)
Station use				0		(6)									0
Trans./Distrib. Losses				0		(43)									0
NET SUPPLIED	**731,960**	**975,278**	**74,905**	**1,782,143**	**0**	**448**	**62,183**	**0**	**21,551**	**106,350**	**25,785**	**6,556**	**1,795**	**11,082**	**235,302**
Final Consumption:															
Households	306,960		65,635	372,595		70			21,551					8,209	29,760
Transport				0			62,183			93,056			1,795		157,034
Government/Commercial	25,000			25,000		136								1,437	1,437
Industrial				0		154				13,294	25,785	6,556		1,437	47,072
Agro-industries	400,000	975,278	9,270	1,384,548		88									0
Others				0											0
TOTAL	**731,960**	**975,278**	**74,905**	**1,782,143**		**448**	**62,183**	**0**	**21,551**	**106,350**	**25,785**	**6,556**	**1,795**	**11,083**	**235,303**

Sources: Mission Estimates.
Fiji Sugar Corporation (March 1991).
Ministry of Primary Industries (1991).
Fiji Department of Energy (1990 Survey of Industries).
BP, Shell, Mobil (1991).
Fiji Electricity Authority (1991).

Notes: (1) FEA generation at 405 GWh. FSC generation from bagasse at 46 GWh. Assume other generation mainly from fuelwood at 47 GWh.
(2) Mission estimates used for indusrial/commercial production, power generation and consumption of fuelwood. Household fuelwood consumption estimated based on urban consumption of 146 kg/cap and rural consumption of 600 kg/cap as follows:
Urban = (725,000)(38.9%)(146) = 41,175,650 kg = 41,175 tonnes
Rural = (725,000)(61.1%)(600) = 265,785,000 kg = 265,785 tonnes
Total Household consumption = 306,960 tonnes
Govt/Commercial consumption is estimated at 25,000 tonnes from a 1989 Survey conducted by Fiji Dept. of Energy of commercial users.
(3) Bagasse production and consumption from 1990 FSC figures.

TABLE 4

FIJI: ENERGY BALANCE, 1990
('000 TOE)

	Fuel wood[2]	Bagasse[3]	Coconut Residues	Total Biomass	Hydro	Total Electricity	Gasoline	Jet A1	Kerosene	Petroleum ADO	IDO	IFO	Avgas	LPG	Total Petroleum	Total Energy
Primary Supplies:																
Production	309.4	198.6	24.7	532.7	94.8										0.0	627.4
Imports							50.2	85.3	18.5	106.0	37.8	15.3	1.4	6.6	321.1	321.1
Bunkering/Exports								−85.3		−11.2	−6.1	−8.8			−111.4	−111.4
GROSS AVAILABLE	309.4	198.6	24.7	532.7	94.8	0.0	50.2	0.0	18.5	94.8	31.7	6.5	1.4	6.6	209.7	837.1
Conversion:																
Public Power Generation	−1.9	−13.3		−15.2	−94.8	116.8					−6.9				−6.9	−0.0
Transformation Losses				0.0		−74.8									0.0	−74.8
Station use				0.0		−0.5									0.0	−0.5
Trans./Distrib. Losses				0.0		−3.6									0.0	−3.6
NET SUPPLIED	307.4	185.3	24.7	517.4		37.9	50.2	0.0	18.5	94.8	24.9	6.5	1.4	6.6	202.8	758.2
Final Consumption:																
Households	128.9		21.7	150.6		5.9			18.5					4.9	23.4	179.9
Transport				0.0			50.2			83.0			1.4		134.6	134.6
Government	10.5			10.5		11.5								0.9	0.9	22.8
Commercial				0.0		13.1				11.9	24.9	6.5		0.9	44.1	57.1
Agro−industries	168.0	185.3	3.1	356.4		7.4									0.0	363.8
Others				0.0											0.0	0.0
TOTAL	307.4	185.3	24.7	517.4		37.9	50.2	0.0	18.5	94.8	24.9	6.5	1.4	6.6	202.8	758.2

Sources: Mission Estimates (February 1991).
Fiji Sugar Corporation (March 1991).
Ministry of Primary Industries (1991).
Fiji Department of Energy (1990 Survey of Industries).
BP, Shell, Mobil (1991).
Fiji Electricity Authority (1991).

Notes: (1) FEA generation at 405 GWh. FSC generation from bagasse at 46 GWh. Assume other generation mainly from fuelwood at 47 GWh.
(2) Mission estimates used for indusrial/commercial production, power generation and consumption of fuelwood. Household fuelwood consumption estimated based on urban consumption of 146 kg/cap and rural consumption of 600 kg/cap as follows:
Urban = (725,000)(38.9%)(146) = 41,175,650 kg = 41,175 tonnes
Rural = (725,000)(61.1%)(600) = 265,785,000 kg = 265,785 tonnes
Total Household consumption = 306,960 tonnes
Govt/Commercial consumption is estimated at 25,000 tonnes from a 1989 survey conducted by Fiji Dept. of Energy of commercial users.
(3) Bagasse production and consumption from 1990 FSC figures.

TABLE 5

FIJI: PETROLEUM MARKET
SALES AND IMPORTS, 1985–1990

	1985			1986			1987			1988			1989			1990		
	Sales Volume (kl)	Import Volume (kl)	Import Value ('000F$)	Sales Volume (kl)	Import Volume (kl)	Import Value ('000F$)	Sales Volume (kl)	Import Volume (kl)	Import Value ('000F$)	Sales Volume (kl)	Import Volume (kl)	Import Value ('000F$)	Sales Volume (kl)	Import Volume (kl)	Import Value ('000F$)	Sales Volume (kl)	Import Volume (kl)	Import Value ('000F$)
Product:																		
Gasoline	56,195	79,900	22,511	56,945	79,300	14,507	54,382	92,300	20,225	53,680	66,400	13,916	57,281	73,000	18,820	62,183	62,183	19,284
Jet A1	111,126	139,700	37,919	110,493	154,000	27,114	88,860	84,000	17,734	99,523	152,700	30,913	108,916	155,600	41,766	97,116	143,700	39,561
Kerosene[1]	17,643	13,600	3,602	19,162	23,300	4,002	18,269	29,000	5,878	19,384	9,100	1,889	21,137	16,300	3,220	21,551	16,000	3,578
ADO	87,423	130,400	32,316	85,556	134,500	20,610	84,469	106,900	21,719	84,962	132,300	26,341	97,633	145,900	35,224	106,350	143,200	36,679
IDO	30,699	36,700	8,904	41,288	49,200	7,304	26,414	41,600	7,672	30,468	50,200	9,344	27,226	50,000	11,674	33,765	42,400	10,139
IFO	5,830	10,800	2,401	4,689	6,500	700	4,474	8,500	9,166	4,055	9,200	1,193	5,082	13,100	2,214	6,556	11,200	2,286
Lubes	4,237	3,800	3,202	4,411	4,000	3,402	4,132	4,300	4,085	4,399	6,200	4,672	4,920	7,400	4,931	5,234	8,100	4,970
Avgas/Avtur	1,323			1,392			1,593			1,663			1,684			1,795		
Solvents	4,264			4,450			3,275			2,833			2,588			3,231		
LPG	6,783			7,565			7,565			8,000			9,391			11,082		
Total Inland Trade	325,523	414,900	110,855	335,951	450,800	77,639	293,433	366,600	86,479	308,967	426,100	88,267	335,858	461,300	117,849	348,883	426,783	116,497
Bunkers:																		
Jet A1	111,126			110,493			88,860			99,523			108,916			97,116		
Avgas/Avtur		62,800	19,603		na	na		92,600	24,046		101,200	29,092		111,900	44,453		113,700	43,823
ADO	8,101	8,200	2,337	9,583	9,600	1,692	14,312	7,400	1,849	7,020	7,200	2,036	5,206	6,500	2,323	12,539	5,000	1,793
IDO	872	900	251	6,489	6,500	1,110	15,199	16,300	3,697	11,595	9,300	2,458	9,604	9,600	3,317	6,310	10,300	3,448
IFO	2,580	3,300	844	4,795	4,800	595	5,142	5,600	7,428	3,830	4,600	847	7,988	8,300	2,076	8,927	7,000	2,000
Total Bunkers	11,553	75,200	23,035	20,867	20,900	3,396	34,653	121,900	37,020	22,445	122,300	34,433	22,798	136,300	52,169	27,776	136,000	51,064
Total Trade		339,700	87,821		429,900	74,243		244,700	49,458		303,800	53,835		325,000	65,680		290,783	65,432

Sources: Mission Estimates (February 1991)
Sales volumes obtained from Mobil, Shell, BP, Fijigas statistics.
Import volumes from Department of Energy.

Notes: (1) Includes Jet A1.

TABLE 6

FIJI: NATIONAL PUBLIC ELECTRIFICATION SYSTEM

	1985	1986	1987	1988	1989	1990
Consumers[1]:						
Commercial/Industrial	8,096	8,321	8,025	8,000	8,282	8,908
Domestic	47,010	50,656	52,783	55,559	57,968	62,229
Street Lights	73	75	76	76	79	79
Institutional	947	1,028	1,074	1,135	1,199	1,282
Total	56,126	60,080	61,958	64,770	67,528	72,498
Capacity (MW):						
Installed hydro	83	83	83	83	83	83
Installed diesel[2]	79	75	74	76	66	77
Total	163	159	158	159	150	160
Firm Hydro	62	62	62	62	62	62
Firm Diesel[3]	55	53	na	54	42	67
Firm Total	118	115	62	116	105	129
Max Demand[4]	56	60	62	62	63	67
Output (MWh):						
Generation Hydro	303,820	331,884	329,647	340,298	365,615	379,240
Generation Diesel	18,505	19,691	17,284	21,156	19,826	26,073
FEA Total Generation	322,325	351,575	346,931	361,454	385,441	405,313
Purchases from Industry[5]	2,765	2,938	2,483	1,469	3,004	3,005
Station usage	3,710	4,531	4,342	3,901	4,857	4,863
Total sent out	321,380	349,982	345,072	359,022	383,588	403,455
Total Losses	36,345	38,513	34,569	35,417	38,900	34,513
Net Consumption[6]	285,035	311,469	310,503	323,605	344,688	368,942

Sources: FEA Annual Reports.
FEA Tariff Study (April 1991).
Mission Estimates (February 1991).

Notes:
(1) Listed by tariff group, based on FEA Tariff Study.
(2) Includes diesel sets installed at Rakiraki, Savusavu, Labasa and Levuka.
(3) Calculated as "site ready capacity" at all FEA stations.
(4) For Viti Levu Interconnected System (VLIS) only.
(5) Fiji Sugar Corporation (FSC).
(6) Includes sales and losses for FEA as a whole.

TABLE 7

FIJI: ELECTRIFICATION PERFORMANCE INDICATORS,[1] 1990
FIJI ELECTRICITY AUTHORITY (FEA)

Fixed Assets (million F$)	479.1
Average Revenue (F¢/kWh)	17.8
Average Cost (F¢/kWh)	
Capital	6.2
Fuel	0.6
Other operating	8.4
Estimated ROI[2] (%)	6.5
Fuel Consumption[3] (l/kWh)	
Main system	0.3
Outer islands	0.3
Households Electrified[4] (%)	45.0
kWh/year/consumer[5]	5,946
kWh/year/employee	388,910
Employees/MW installed	6.5
Outages[6]	
Number	368.0
Ave. duration (hrs)	2.4
Voltage drop/increase	na

Sources: FEA Tariff Study (April 1991).
Mission Estimates.
FEA Unplanned Outage Statistics for 1990 (April 1991).

Notes:
(1) 1990 except where indicated.
(2) Rate of Return on Revalued fixed assets.
(3) Automotive diesel oil (ADO) only.
(4) Percentage of total national population.
(5) Electricity generation.
(6) Generation, Transmission and Distribution on Viti Levu Interconnected System. FEA outage statistics.

TABLE 8

FIJI ELECTRICITY AUTHORITY TARIFF STRUCTURE 1/

1. Domestic Tariff

All units at 22.51 (20.46) cents per unit (kWh).
Minimum charge of $ 4.51 ($ 4.10).

2. Commercial and Industrial Tariff

All units at 23.72 (21.56) cents per unit.
Minimum charge of $ 9.48 ($8.62).

3. Maximum Demand Tariff

Demand charge: $ 19.60 ($ 17.82) per kilowatt per month
Energy charge: 15.25 (13.86) cents per unit

Maximum demand meters will be reset after the meter reading for that month.

Note: Available on application to all commercial and industrial consumers with a maximum demand in excess of 75 KW.

Minimum charge $ 1,470.00 ($1,336.50).

4. High Voltage Supply

For maximum demand and commercial and industrial consumers who elect to take a supply at high voltage direct from the Authority's mains, a reduction of 4% in the monthly accounts on this tariff will be allowed.

5. Reactive kVarh Tariff

14.04 (12.76) cents per unit.

Note: Consumers are required to maintain a power factor of not less than 0.85 and the Authority reserves the right, if a consumer's power factor as determined by the Authority's recording instruments is less than 0.85, to charge for all excess reactive units of kVarh at (14.04) 12.76 cents per unit. This charge for reactive units will be in addition to the charge for ordinary kWh units used.

1/ As of August 1, 1991. The old rates are shown in parentheses.

6. Institution Tariff

22.51 (20.46) cents per unit.

For premises used wholly or principally as:

(i) Private schools owned and operated by a Management Board.
(ii) Churches, temples and mosques.

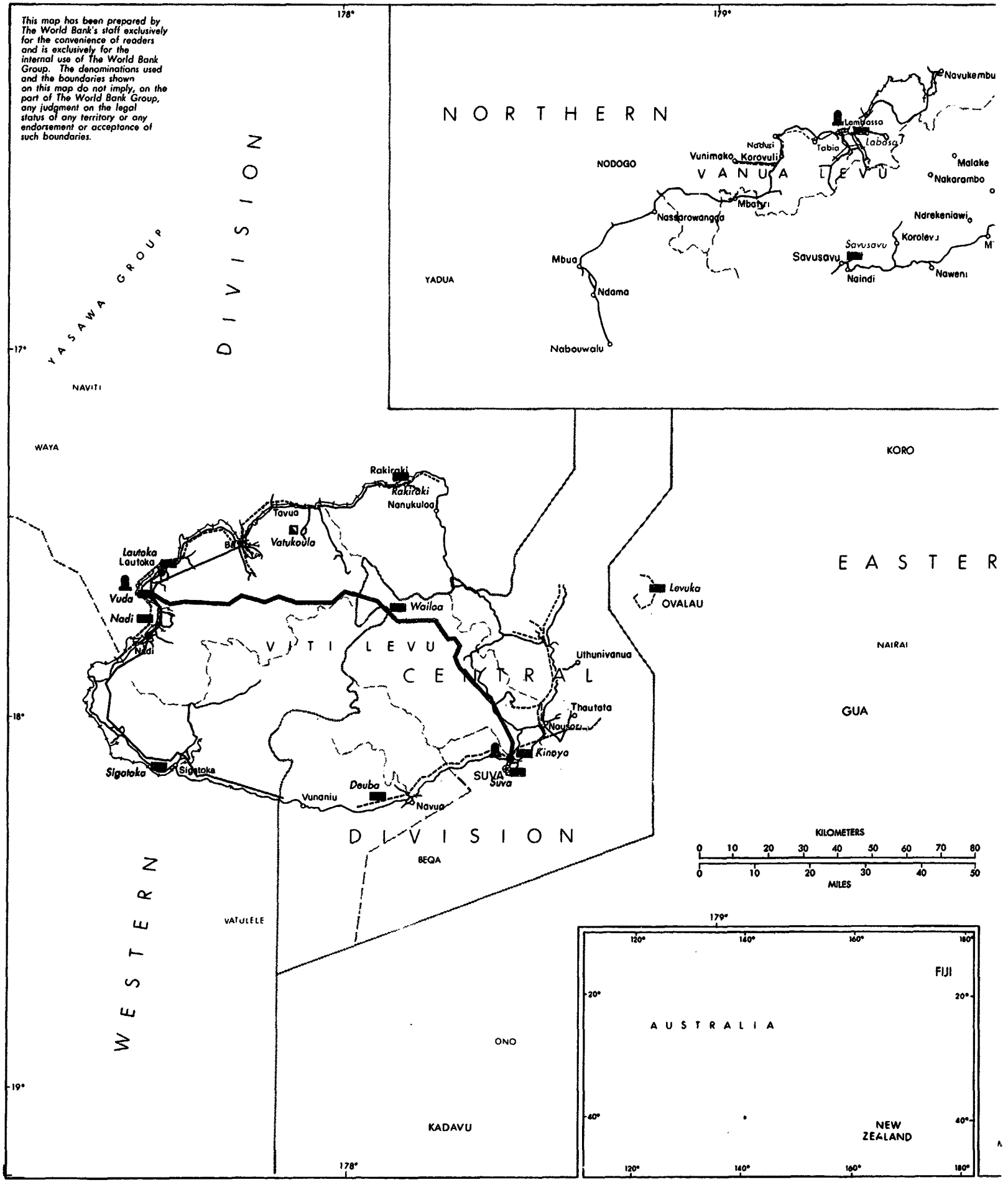
7. Street Light Tariff

18.15 (16.50) cents per unit.

8. Special Discount

Special discounts may be negotiated with consumers supplied on the Maximum Demand Tariff who can comply with the following conditions:

(i) Manufacturing industry.
(ii) Regularly consuming a minimum of 200,000 units each month between the hours of 9:30 p.m. and 6:00 a.m.
(iii) Willing to accept an interruptible supply.
(iv) Any discount negotiated will include the high voltage supply discount where supply is taken at high voltage.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178°
179°
17°
18°
19°
NORTHERN
DIVISION
YASAWA GROUP
NAVITI
WAYA
NODOGO
YADUA
VANUA LEVU
Navukembu
Lambasa
Labasa
Tabia
Nadwi
Vunimaka
Korovuli
Mbatyri
Nassarowangga
Mbua
Ndama
Nabouwalu
Malake
Nakarambo
Ndrekeniawi
Korolevu
Savusavu
Naindi
Naweni
KORO
EASTERN
Levuka
OVALAU
NAIRAI
GUA
Rakiraki
Nanukuloa
Tavua
Vatukoula
Lautoka
Vuda
Nadi
Wailoa
VITI LEVU
CENTRAL
Uthunivanua
Thautata
Nausori
Kinoya
SUVA
Suva
Sigatoka
Deuba
Vunaniu
Navua
DIVISION
BEQA
WESTERN
VATULELE
ONO
KADAVU
KILOMETERS
0 10 20 30 40 50 60 70 80
0 10 20 30 40 50
MILES
120° 140° 160° 180°
20°
40°
FIJI
AUSTRALIA
NEW ZEALAND

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