



Technical Assistance Consultant's Report

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Republic of the Fiji Islands: Rural Electrification Project (Financed by the Japan Special Fund)

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For the Department of Energy, Fiji Islands

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Asian Development Bank

CURRENCY EQUIVALENTS

(at 30 September 2004)

Currency Unit
F\$1.00 =
US\$1.00 =

Fiji Dollar (F\$)
US\$0.57
F\$1.75

ABBREVIATIONS

AAC	All Aluminium Conductor
AAAC	All Aluminium Alloy Conductor
ABC	Aerial Bundled Cables
ABS	Air Break Switch
ACSR	Aluminium Conductor Steel Reinforced
ADB	Asian Development Bank
ADMD	Average Daily Maximum Demand
BoQ	Bill of Quantities
CFS	Corporate and/or Consolidated Financial Statements
CRF	Component Replacement Fund
CSP	Country Strategy and Program
DO	Drop-Out Fuses; Cut-Outs
DOE	Department of Energy
EIRR	Economic Internal Rate of Return
EU	European Union
FEA	Fiji Electricity Authority
FYP	Five Year Plan
GEF	Global Environmental Facility
GoF	Government of Fiji Islands
HH	Households
HV	High Voltage
ICB	International Competitive Bidding
IDA	International Development Assistance
IPP	Independent Power Producer
IPSA	Initial Poverty and Social Assessment
IEE	Initial Environmental Examination
kV	kilovolts
kVA	kilovolt amperes
LA	Lightning Arresters; also Surge Diverters
LV	Low Voltage (430V; 240V)
M&E	Monitoring & Evaluation
MOF	Ministry of Finance
MOU	Memorandum of Understanding
MV	Medium Voltage (11kV and 33kV)
MWE	Ministry of Works and Energy
O&M	Operation and Maintenance
PAP	Project Affected Person
PCR	Project Completion Report
PMU	Project Management Unit
PPA	Power Purchase Agreement
PPME	Project Performance Monitoring and Evaluation
PWD	Public Works Department
RAP	Resettlement Action Plan
RPF	Resettlement Policy & Framework
RRA	Rapid Rural Appraisal
RE	Rural Electrification
RESCO	Rural Electrification Service Company

ROW	Right of Way, for power line
SHS	Solar Home Systems
SMEC	SMEC International Pty Ltd, the Consultant
SWER	Single Wire Earth Return
TA	Technical Assistance
TOR	Terms of Reference, for TA Project
WACC	Weighted Average Cost of Capital

WEIGHTS AND MEASURES

A (ampere)	unit of electric current
V (volt)	unit of voltage
kV (kilovolt)	1,000 volts
kVA (kilovolt-ampere)	1,000 volt-amperes
kWh (kilowatt-hour)	1,000 watt-hours
GWh (gigawatt-hour)	1,000 megawatt-hours
MW (megawatt)	1,000,000 watts
MVA (megavolt-ampere)	1,000,000 volt-amperes

NOTES

- (i) The fiscal year (FY) of the Government and its agencies ends on 31 December.
- (ii) In this report, "\$" refers to US dollars; F\$ refers to Fiji dollars.

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- 3 Initial Social and Poverty Assessment
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- 6 Rural Electrification Sub-Project Plans and Location Maps
- 7 Supplementary Technical Data and Policy Documentation
 - Sample technical specifications, FEA
 - FEA list of villages electrified by grid extension over past 10 years
 - FEA rural extensions policy (extract)
 - Mini-hydro data summary, DOE
 - DOE list of solar home systems applicants
 - DOE Strategic Development Plan 2005-07 (extract)
 - Bills of Quantities, Grid Extensions and Solar Projects
 - List of Possible DoE Hydro Projects

“The TA will identify and carry out a feasibility study and develop a rural electrification project suitable for financing by ADB and other external funding agencies, and assess its long-term sustainability.”

I. PROJECT SUMMARY

Country	The Republic of Fiji Islands
Classification	Poverty Intervention Thematic: Economic growth
Environmental Assessment	Environmental category: B An initial environmental evaluation was undertaken (Appendix 10).
Project Description	The Project will (i) extend the Fiji Electricity Authority (FEA) 11 kilo-Volt (kV) and low-voltage (LV) distribution grid to approximately 170 rural villages and settlements; (ii) support the pilot installation of 3,200 solar home systems in approximately 75 remote rural villages to further the Government of Fiji's (GoF's) program of renewable energy-based rural electrification (as a pilot project leading to wider implementation under separate funding); (iii) support possible development of three mini-hydro projects; and (iv) support the detailed feasibility studies, training, and public awareness required to develop renewable energy sources for general application in rural Fiji.
Rationale	<p>About 56 percent of Fiji's estimated population of 827,000 is rural, spread sparsely in about 1,500 villages and settlements, comprising in total about 460,000 people. Approximately 25 percent of the total rural population is poor and 50 percent of rural villages and settlements lack electricity. The nation's isolated location and sparse settlement result in high costs of social service delivery and rural development.</p> <p>The GoF will integrate electrification programs with other initiatives for rural development, including roads construction and improved support to rural health and education services. Bringing electricity to rural areas, especially poor villages, is key to promoting rural development. In the non-electrified areas, costs for household energy are extremely high compared to urban electrified areas. Rural electrification, mainly through grid extensions, will increase the availability of affordable energy in poor rural areas. The expected benefits of the Project include reduced cost of basic energy services, lower environmental and health risks, improved income opportunities, and improved access to social services. The Project will directly benefit about 1,500 poor households.</p>
Objectives and Scope	<p>The Project objectives are to improve living standards and economic conditions by increasing the supply of rural electricity through: (i) extending the existing grid distribution system in rural areas nearby to existing networks, and (ii) providing support to the implementation of renewable energy-based rural electrification (RE) in remote areas.</p> <p>The Project scope includes: (i) extension of the FEA 11 kV and low</p>

	<p>voltage distribution systems with associated substations into additional rural areas; (ii) installation of 3,200 household solar home systems in rural areas of Viti Levu and Vanua Levu; (iii) provision of consulting services to assist DOE/FEA in project implementation, supervision, consumer awareness and capacity building activities; and (iv) support for detailed feasibility study and design of 3 village minihydro schemes.</p>
Cost Estimates	<p>The total estimated cost is \$18.5 million (including IDC and taxes and duties), comprising \$12.9 million in foreign exchange costs and \$5.60 million equivalent in local currency costs.</p>
Executing Agency	<p>The Fiji Department of Energy (DOE), an agency of the Fiji Department of Public Works</p>
Implementation Arrangements	<p>Under the DOE as the Executing Agency, there will be two implementing agencies for the Project. Engineering and construction work will be carried out under supply and construction contracts to be administered (i) by DOE for solar home systems utilising private sector companies (Renewable Energy Service Companies (RESCOs)) and (ii) by FEA for grid extensions utilising the internal construction resources of the FEA and the Public Works Department (PWD), and private electrical construction contractors.</p> <p>After construction, the DOE will be responsible for administering and supervising the management, operation, and maintenance of solar home systems by RESCOs, while FEA will manage, operate, and maintain grid extension schemes.</p>
Consulting Services	<p>(i) Grid Extension Projects</p> <p>A total of approximately 26 person-months of international consulting services, with 20 person-months of local consulting services, for project implementation will assist FEA in project engineering, procurement, construction supervision, including final installation testing and commissioning and capacity building.</p> <p>(ii) Off-Grid (Alternative Energy) Projects</p> <p>Five hundred thousand dollars have been budgeted for international/local consultancy support for the solar home systems component, including training and capacity building.</p>
Project Benefits and Beneficiaries	<p>(i) The grid extension project will benefit about 7,000 households in approximately 170 rural villages and settlements with a total population of 36,000, greatly increasing the availability of affordable electricity and increasing services that depend on electricity;</p> <p>(ii) The solar project will benefit approximately 3,200 households in remote and inaccessible areas; and</p> <p>(iii) The DOE's and FEA's project and financial management capacities will be strengthened.</p>
Risks and Assumptions	<p>The major risks and assumptions of the Project are the following: (i) close co-ordination of work by the two implementing agencies (DOE and FEA) is accomplished by DOE as the Executing Agency; (ii) adequate field construction capacity is available in the private sector and the FEA and PWD construction sections, to maintain scheduled rates of progress for all site installation works; and (iii) poor households can afford connection charges, including internal</p>

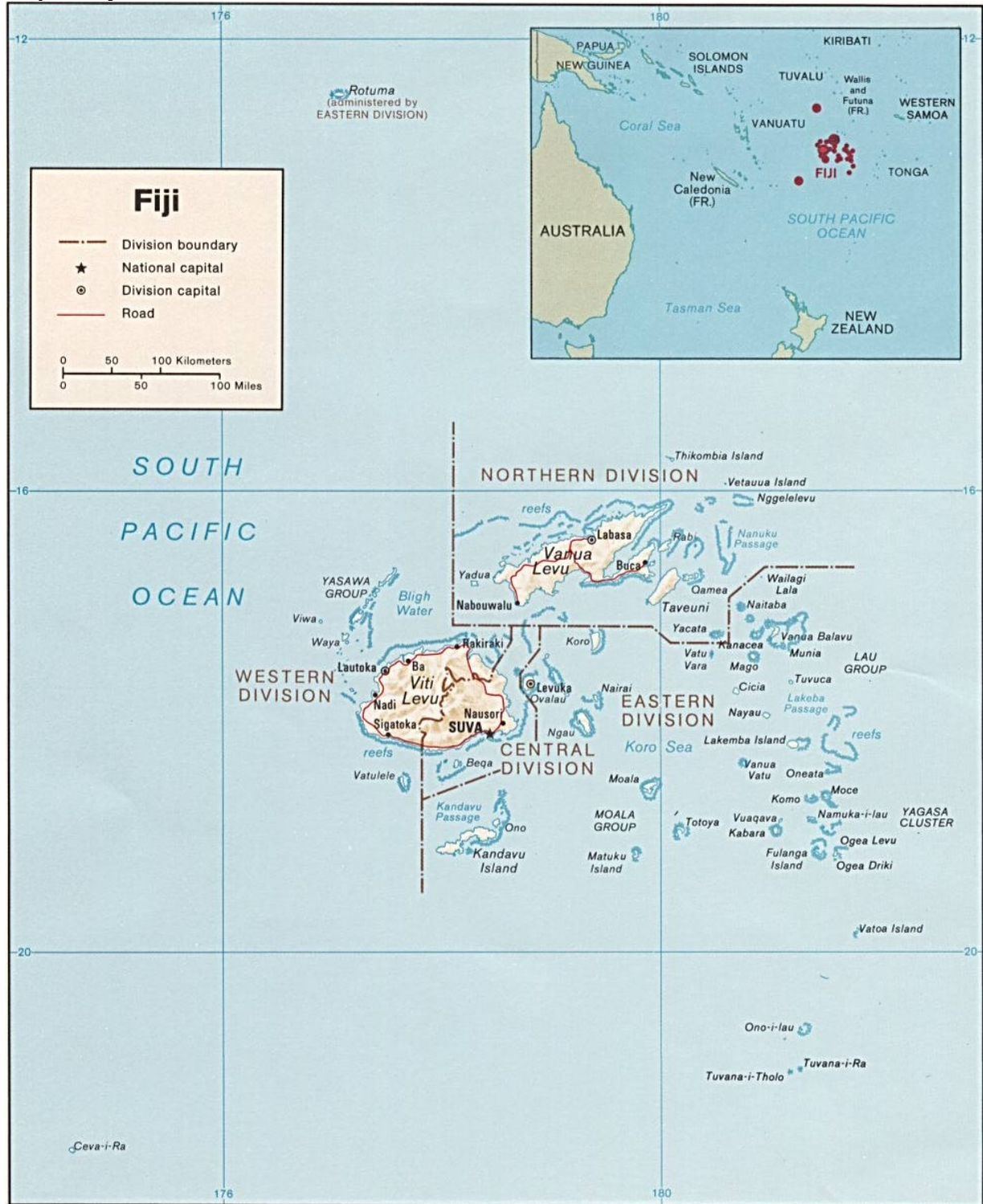
house wiring costs and subsequent monthly electricity bills.

These risks are mitigated by relevant assurances and through the commitment of the GoF, the DOE, and FEA to rural electrification.

Technical Assistance

Technical assistance (TA) in the amount of \$400,000 will be attached for Preparation of Potential Minihydro Projects and Capacity Building for the DOE in Project Management. The TA will provide assistance to the DOE in (i) detailed feasibility study of three identified mini-hydro schemes in rural areas, including data collection, design and engineering, and preparation for development; and (ii) procurement, installation, and training for operation of a computerised digital mapping and database capability for rural energy project planning, management, and performance monitoring.

Map of Fiji



II. THE PROJECT

1. The Project provides for the construction of 11 kV and low voltage extensions of the Fiji national grid networks to rural villages on the main islands and installation of 3,200 solar home systems in villages in remote areas. The project framework is in **Appendix 1**. The report also describes complementary technical assistance (TA) for developing mini-hydro resources for rural electrification in remote areas, and for the development of a computerised rural mapping and database system for project management and performance monitoring to help ensure that the full economic benefits of the Project are realized.

III. RATIONALE: SECTOR PERFORMANCE, PROBLEMS, OPPORTUNITIES

A. Performance Indicators and Analysis

1. Overview

2. Fiji consists of about 320 islands with a total land area of 18,300 km². Fiji's population in 2004 is estimated to be approximately 820,000, 75% of whom live in the main island of Viti Levu, with another 15% on the second-largest island, Vanua Levu¹. Per capita income was estimated to be F\$4,318 (about US\$2,160) in mid-2002². Fiji's Gross Domestic Product (GDP) is composed largely of services (27%), wholesale and retail trade (19%), agriculture, forestry, and fishing (15%), manufacturing (15%), and transport and communications (13%). The largest export sectors are garments, sugar, and tourism.

3. About 56% of Fiji's population lives in rural villages and settlements, with about half of rural households lacking access to electricity. Poverty in Fiji is concentrated in the rural sector³, where isolation and lack of access to markets, social services, and amenities are leading causes.

4. The existing FEA power grid system is on the three main islands of Viti Levu, Vanua Levu and Ovalau and serves about 128,000 customers. Rural households and communities with no access to the grid either have no electricity supply at all, or rely on more expensive and limited power supplies (e.g., small diesel generators), which constrains household energy services and economic activity in the areas concerned. The proposed Project is designed to bring the convenience and economic and social benefits of electricity to poor rural areas. This will contribute to development and poverty reduction through Government investment in areas where private sector investment has been notably sparse due to a lack of established markets and limited productive capacity.

5. The power sector is administered by two agencies under the Ministry of Works and Energy (MWE): the Department of Energy (DOE) and the Fiji Electricity Authority (FEA). The DOE (i) appraises all forms of alternative energy for Fiji and prepares promising sources for future development; (ii) prepares and reviews power sector development plans and regulations and recommends rural tariff levels to the GoF; (iii) administers the construction of subsidised electricity works, including stand-alone⁴ diesel electrification schemes, grid extension schemes that do not meet FEA's financial criteria for commercial investments, and stand-alone renewable energy-based rural electrification schemes, in particular solar home systems, and (iv) is responsible for the operation and maintenance of stand-alone rural electrification schemes, either directly or through appointment of private sector contractors and village management committees in accordance with the government's rural

¹ The most recent Census was conducted in 1996. Recent population trends have been unstable due to outmigration stemming from political instability beginning in 1987.

² Reserve Bank of Fiji, *Quarterly Review*, March 2003

³ *Fiji Participatory Poverty Assessment*, ADB, 2003

⁴ i.e., not grid-connected

electrification policy (1993). The DOE promotes electrification by grid extension (for operation by FEA) in areas that are accessible to the grids and by renewable energy-based stand-alone electrification in remote areas, and discourages further implementation of stand-alone diesel schemes as unsustainable.

6. The Fiji Electricity Authority (FEA) is a wholly state-owned, corporatised entity, which manages and operates Fiji's urban generation, transmission and distribution assets, as well as distribution assets that extend into rural areas. The FEA receives financial support from the DOE for the construction of subsidised grid extension schemes, i.e., those which the FEA would not otherwise undertake in its own commercial interests. Once commissioned, the schemes become part of FEA's assets and are operated and maintained as such by FEA. The national uniform tariff is applied to electricity consumers connected to such schemes.

7. Under the proposed implementation arrangements, the DOE will be the Executing Agency of the Project and implementing agency for solar home systems subprojects, while the FEA will be the implementing agency for grid extension subprojects. The organization structures of DOE and FEA are in **Appendix 2**.

8. Under the current government policy for rural electrification, the government subsidises up to 90 percent of the initial cost of an electrification scheme in a rural area, provided that the beneficiary community provides the remaining 10 percent. Once the community's contribution is received, and subject to the government's budget and availability of construction personnel and equipment, the scheme is scheduled for implementation. After commissioning, the scheme assets become the property and responsibility of (i) the FEA in the case of grid extensions or (ii) the DOE (with operation and maintenance carried out by private sector Renewable Energy Service Companies (RESCOs, discussed below)) in the case of remote-area stand-alone schemes. No operational subsidies are provided in either case (except that, in the case of existing stand-alone diesel schemes, the DOE funds maintenance expenditures for the first three years of operations).

2. Poverty Alleviation

9. Due to political instability and a weak economy, the incidence of poverty in Fiji has increased in recent years⁵. Poverty is prevalent among all ethnic groups, urban and rural, and across all geographic areas of the country. Increased poverty is related to limited employment opportunities, non-renewal of land leases and loss of livelihoods, weakening of traditional family support systems, weak governance and inadequate social safety nets. Increasing poverty is indicated by proliferating slum dwellings, increasing crime rates and prostitution, and decreased participation of the poor in formal employment.

10. The government's national goals, as expressed in the Strategic Development Plan for 2002-2004, are to reverse these trends through a private sector-driven economic recovery of the country by, first, restoring democratic rule and good governance to promote stability and social cohesion and, secondly, providing for the equitable distribution of wealth and the restoration of confidence in the economy, promoting investment. The private sector has a prominent role in this strategy, not only in investment but, in many instances, through participation in the provision of services that have traditionally been under the public sector.

11. ADB's strategy in Fiji supports these goals⁶. The country strategy is focused on the overarching goal of poverty reduction, accomplished through programs to promote sustainable economic growth, infrastructure investments to lower costs and improve the

⁵ Fiji Participatory Poverty Assessment, ADB, 2003.

⁶ Country Strategy and Program Update (2003-2005), Republic of the Fiji Islands, ADB, 2002.

quality of services, and capacity building programs. It is designed to support economic growth by (i) improving essential public services, supported by appropriate institutional arrangements, regulatory capacity, and tariffs; (ii) broadening opportunities for livelihoods and resolution of constraints on livelihoods such as land issues; (iii) strengthening policy formulation and reform in the public sector; and (iv) supporting enabling conditions for private sector growth and partnerships with the government in revenue-generating projects. Rural electrification, by directly enhancing productivity, consumption possibilities, and opportunities for livelihoods in rural areas where poverty is concentrated, is a key component of the ADB's and GoF's complementary approach.

B. Analysis of Key Problems and Opportunities

1. Key Problems and Constraints

12. Shared prosperity with economic growth is the essence of poverty alleviation and social development. Fiji has good economic potential, particularly in mining, fishing, forestry and agriculture, however, impediments are: (i) poor access to markets in many rural areas and low participation in the national economy, (ii) remoteness and sparse scatter of islands spread over 500,000 km² of ocean; (iii) shortage of skilled human resources; (iv) limited transport, power and communication infrastructure serving the small and widely dispersed population.

13. Lack of access to electricity in rural areas in general, and especially in poorer villages, is a key constraint on their development. A common means of providing electrification in the past has been the construction of stand-alone diesel schemes in remote villages, of which about 450 have been installed around the country since the 1970s. However, the high costs of fuel delivery and maintenance have resulted in the lengthy shutdown or abandonment of many of these schemes, prompting the government to seek alternative and more sustainable means to electrify rural areas. Current government priorities are to accelerate the extension of distribution from the national grid systems into rural areas wherever feasible, and to introduce renewable energy-based stand-alone schemes (mainly solar home systems which convert sunlight to electricity stored in household batteries for use at night) in remote areas, involving private sector companies in operation and maintenance of the latter.

14. The GoF has given high priority to power sector development to achieve economic and social goals and improve the distribution of services and income into rural areas. In coordination with other investments in rural development such as roads, power sector policy is to maintain and extend low-cost, reliable and sustainable electricity to as many households as possible, by expanding and improving the main grids. Off-grid electrification in remote and isolated areas is also implemented by GoF through DOE, with subsidies to applicants. A detailed analysis of the power sector is in **Appendix 3**.

2. Opportunities

a. Electrification of Road-Accessible Areas

15. FEA is gradually extending the national networks (in Viti Levu, Vanua Levu, and Ovalau), but limiting self-investment to projects which show a base economical gross return on investment of at least 15%, before taxation. Since 1994, FEA has connected 243 villages, totalling 10,877 customers. DOE (with FEA as the implementing agency) plans to supply on-grid electricity to additional rural households in villages with road access. This effort will be co-ordinated with other rural infrastructure development, especially roads, the impact of which will reinforce the benefits of rural electrification.

b. Electrification of Remote Areas

16. Stand-alone renewable energy-based energy village electrification (chiefly solar) is the only option for communities remote from distribution networks at this time. Demonstration solar home systems (SHS) have been installed in Fiji since the late 1980s with support from the European Union (EU), France, and Japan, providing lighting and basic entertainment services to households. Institutional concept and demonstration work has recently been completed with support from the United Nations Development Programme and the Global Environment Facility (UNDP and GEF), resulting in an analytic, policy, and legislative framework for the direct involvement of the private sector in remote-area RE operation and maintenance.

17. The most recent projects, involving about 250 SHS in Bua and Cakaudrove Provinces in Vanua Levu, emulates operation by a private energy service company (Renewable Energy Service Company, or RESCO) with users paying F\$14/month for lighting and basic entertainment power, with maintenance provided by the RESCO. This project has thus far worked well both technically and institutionally. The SHS component of this Project follows the institutional and technical design developed under the UNDP/GEF project and tested in the Vanua Levu pilot project.

IV. THE PROPOSED PROJECT

A. Objectives

18. The Project will facilitate DOE and FEA programs to extend the grid networks and increase the number of renewable energy off-grid schemes as a sustainable means to rural electrification of Fiji.

19. The Project's objective is to improve living standards and local economic conditions in rural, low-income areas by: (i) extending the distribution system in the three islands which have FEA grids, Viti Levu, Vanua Levu and Ovalau; (ii) increasing the number of renewable energy electricity supply schemes (solar home systems), on a village household basis; (iii) helping to protect the environment by promoting less reliance on the use of kerosene, paraffin and wood for rural energy; and (iv) improving the engineering, project management and customer service capabilities of DOE and FEA by support to project implementation, capacity building, and consumer awareness.

1. Main Component

20. The main component of the Project will comprise the following:

- (i) Extensions of FEA's 11 kV and LV networks to rural areas of Viti Levu (12 subprojects), Vanua Levu (3 subprojects), and Ovalau (1 subproject), and construction of associated substations. Approximately 360 km of 11 kV and 360 km of LV distribution works with 322 11 kV/LV substations will be installed;
- (ii) Installation of 3,200 solar home systems in Viti Levu (1,725 systems) and Vanua Levu (1,475 systems) to support a 'Proof of Concept' demonstration project of solar implementation institutional arrangements with private sector participation for sustainable remote-area rural electrification;
- (iii) Support for rural project management within the FEA and rural consumer awareness of the benefits, costs, and proper use of electricity.

21. In addition, technical assistance (**Appendix 5**) will build capacity in the DOE by (i) supporting the detailed feasibility study and preparation for development of rural minihydro schemes and (ii) procuring, installing, and providing training for a computerised database and digitised mapping capability for the DOE to employ for rural project planning, construction management, and project monitoring.

2. Reserve Projects

22. The proposed reserve projects include the following:

- (i) Additional extensions of 11 kV and LV networks in Viti Levu (4 subprojects), Vanua Levu (1 subproject), and Ovalau (1 subproject);
- (ii) 800 additional solar home systems (400 each in Viti Levu and Vanua Levu);
- (iii) at least 3 minihydro schemes (1 each in Viti Levu, Vanua Levu, and Taveuni), which could be implemented based on the detailed designs and cost estimates resulting from the technical assistance (para 22).

B. Lessons Learned

23. Lessons learned from past RE projects in Fiji and the Pacific region include the following.

- (i) Though grid extension schemes are generally the least-cost means of providing urban-quality power (i.e., 24-hr/day, alternating current (AC) power suitable for all applications) to rural areas, they are capital intensive and strictly limited in terms of economic range and suitable terrain. Sites for grid extensions must be carefully selected to ensure reasonable investment and operation and maintenance (O&M) costs, and adequate load density.
- (ii) Securing adequate rights-of-way for grid extensions has been an important constraint, both in securing land for construction and in providing for affordable access along the lines for maintenance. For this reason, construction along existing roadways is almost always required, which further limits the potential scope for grid extensions in any country.
- (iii) Stand-alone diesel schemes have not been a successful approach to rural electrification in Fiji and many other countries. The fuel and maintenance requirements are difficult to meet in remote areas where transport costs are high and technical training levels are low.
- (iv) Previous stand-alone renewable energy-based rural electrification schemes in the Pacific region, especially in regard to solar home systems, have been subject to
 - a. unreliable or delayed maintenance;
 - b. no training for management or operation of installed plant;
 - c. ineffective payment systems in villages;
 - d. no allowance for sinking fund for repairs and replacements and hence lack of spare parts;

- e. poor record-keeping and lack of detailed data on extent of failed schemes;
- f. loss of continuity due to staff turnovers.

24. The proposed grid extension schemes have been selected in accordance with criteria described in Supplementary Appendix 1, and all are characterised by adequate rural load densities, feasible distances from the existing national grids, and rights-of-way along roads.

25. The GoF and DOE will not pursue new rural electrification with stand-alone diesel systems, but rather have adopted renewable energy, especially solar, as a solution for the electrification of remote rural areas in Fiji. The DOE has developed a new approach to implementation of remote area rural electrification utilising the private sector to install, operate, and maintain systems, as described in detail in Supplementary Appendix 2. The approach is well founded on the lessons of the past, gained from approximately two decades of experience with solar home systems. Under this approach, private sector companies will receive technical and management training and will operate under franchises granted by the DOE and utilise equipment leased from the DOE to provide sustainable rural electrification services in remote rural areas.

C. Engineering and Technical Aspects

1. Grid Extensions

26. The proposed RE works comprise MV network extensions to the existing 11 kV and LV systems and new LV connections to households, with individual service wires. Under TA 3961-FIJ, voltage levels and circuit capacities in the subproject areas were checked to ensure that voltages would remain within FEA standards after the extensions are commissioned. Voltage chart recorders were installed by FEA at remote ends of the network, to check local supply voltages and associated loads.

27. Based on FEA analysis of rural customers' billing records, estimated load per rural household is 400 watts After Diversity Maximum Demand (ADMD), with 77% of consumers using less than 150 kWh/month. Details of projected consumption rates and of the villages and households to be connected are detailed in Supplementary Appendix 1 and in Supplementary Appendix 4, Sub-Project Maps.

28. Land acquisition will be avoided for the grid extensions as all lines will be located on roadways, and transformers will be pole mounted. There will be no ground transformer stations. Subproject selection and design took into consideration (i) appropriate terrain, (ii) the existing rural road system, (iii) village and population densities, (iv) minimisation of line angle structures, where possible, and (v) FEA and local private sector capacity for construction works. After construction and commissioning, the FEA will own the assets and operate and maintain them as an integral part of the national grid system. All customers connected to the grid extension subprojects will be metered and will be subject to the current FEA tariff.

29. The FEA already has several years' worth of approved projects in its present construction program pipeline. The Project would add another three years' of work to the FEA program. FEA management have indicated that sufficient additional construction resources, including from the private sector, will be employed to ensure that the grid extensions component of the Project is completed within the five-year implementation period. To support this, Project implementation arrangements will include support to potential private sector contractors in business management and technical skills training in order to increase the private sector's capacity to participate in the construction program.

2. Solar Home Systems (SHS)

30. The proposed renewable energy-based component of the Project is the installation of 3,200 SHS: 1,725 in Viti Levu and a further 1,475 in Vanua Levu (to add to the 250 systems already installed there). The solar home systems work via the technology of photovoltaics (PV), consisting of panels installed on each domestic residence that absorb sunlight, converting it to an electric current and storing the electricity in a battery for later use by the household. The specific households to be electrified with this technology will be selected from districts based on market surveys to be undertaken by DOE as part of the Project. This component supplements the DOE's RESCO development project completed in 2003 (supported by UNDP/GEF) with the drafting of a detailed regulation charter and legislation to develop a public-private partnership for rural electrification. Under this approach, the DOE will purchase SHS units and will lease them at a subsidized rate to private companies, Renewable Energy Service Companies (RESCOs), to install and maintain in return for user fees adequate to cover all O&M costs. The SHS component is described in detail in Supplementary Appendix 2.

31. The RESCO-based institutional approach follows over 20 years of experience with small projects using solar energy for rural electrification. Successfully in use in Kiribati for 10 years and with RESCO-type pilot projects successfully operated in Fiji for the past 4 years, the RESCO structure addresses the problems found with earlier projects and promises full financial and technical sustainability. The RESCO structure includes:

- Capital investment by Government in solar home systems, with DOE retaining ownership after installation (assists the private sector or individuals to overcome the financial barrier of substantial initial costs of installations);
- DOE leases the systems to private businesses who are selected competitively to install and maintain the PV systems (allows the lease amount to be subsidized in accordance with DOE policy and allows private businesses to access SHS at a low cost);
- Private companies, RESCOs, install and maintain the PV systems with monitoring and regulation by DOE to ensure that proper installation and maintenance procedures are followed (ensures professional installation and maintenance);
- For each system leased from DOE, the RESCO must make a monthly deposit into a Component Replacement Fund (CRF) for the replacement of major components (the controller and battery) that have limited life (ensures that sufficient funds will be available for major component replacement when they fail);
- Customers pay a fixed monthly fee established annually through negotiation between the RESCO and customer representatives with binding arbitration by DOE (ensures transparency in tariff structure and ensures that the RESCO will receive a fair payment for services);
- Each RESCO is assigned an exclusive franchise for SHS leased from DOE in a district for their operations (however other modes of electrification including FEA grid, private PV sales, etc., will be allowed in franchised districts).

32. As the DOE's SHS RESCO type pilot project in Vanua Levu has functioned well for nearly 4 years, DOE is ready to move to a full scale Proof of Concept project of 3,200 SHS⁷

⁷ The DOE's original specification for the Proof of Concept pilot project for SHS called for 4,000 systems (2,000 each on Viti Levu and Vanua Levu), but available co-financing resources are sufficient for only 3,200 systems.

operated by two RESCOs, one on Vanua Levu incorporating the existing pilot projects and expanding to around 1,600 systems and one on Viti Levu of around 1,600 SHS, as a Proof of Concept to field-test the proposed RESCO-based structure for rural electrification and to refine associated cost estimations and tariff arrangements. The Proof of Concept will be a 5 year project that will fully test the RESCO concept and allow optimization of regulatory and institutional structures and fully test the technical systems being used. Upon completion of the Proof of Concept, a second phase with a 5 year goal of 16,000 SHS installations is expected to follow.

33. Based on pilot project experience, the 3,200 connections will have a total installation and materials cost of about \$4.2 million, including capacity building within DOE (\$0.5 million), investment by RESCO companies (\$0.16 million) and installation.

34. The Department of Energy will purchase all components through international tender (indicative specifications are in Supplementary Appendix 2) and make them available to RESCOs for installation. The private RESCOs will develop installation teams for installation of SHS with the DOE monitoring the quality of installations and ensuring that they meet standards set by the DOE as established under the capacity building component. Renewable energy companies in Fiji have installed and maintained more than 300 SHS and have participated in RESCO technical and business training provided by DOE under the UNDP/GEF RESCO project.

3. Mini-Hydro Projects

35. DOE has developed a list of 42 potential rural mini-hydro schemes, ranked in order of merit (Supplementary Appendix 7). The indicative investment costs of the potential mini-hydro projects per household vary from F\$3,324 to F\$26,009 (US\$1,894-\$14,825). Several proposed schemes are in the F\$3,300-F\$3,800 (\$1,894-\$2,166) range of costs per household and appear to be promising for further development. Under technical assistance, it is proposed that a minimum of ten projects proceed to detailed feasibility study and design for future implementation. Additional potential projects from the DOE's list could be included for detailed feasibility study, subject to resource availability.

D. Special Features

1. Project Impact on the National Networks

36. In the course of preparation of the Project, all potential grid extension projects were examined with respect to essential geographical attributes, particularly road access and feasible distance from the existing FEA grid networks. Household and other census data were then applied to rank-order the potential projects in terms of capital cost per household connected and potential of each subproject to support social services. DOE's expressed priority ranking of grid extension projects was also taken into account.

37. When the grid extension subprojects are commissioned, the total annual energy sales in the project grid extension areas is estimated at 6,000 MWh/year, with a peak load of 3 MW, equating to an increase of about 1% in FEA's total energy sales and 3% in maximum load. The FEA has provided assurances that the additional demand from the grid extension subprojects can be readily absorbed without straining existing capacity. The operation, maintenance, and management (OMM) costs of the proposed grid extension subprojects under FEA management have been assessed (Supplementary Appendix 6) and cost recovery of these costs under the current FEA tariff appears assured. The conventional FEA

Additional co-finance will be sought to enable 4,000 systems to be installed; however, the TA 3961-FIJ has determined that 3,200 systems would be sufficient to achieve the aims of the Proof of Concept pilot project and recommends proceeding on that basis even if additional co-finance is not secured.

standard, three-phase, three-wire and two-wire 11 kV distribution systems will be used to supply all rural villages in the grid extension areas under the Project. To accommodate constraints in construction capacity of the FEA and local private contractors, the Project will be implemented over a five-year timeframe.

38. It is understood that an FEA system development plan will shortly commence formulation as preparation for major loan-financed investments designed to upgrade FEA's capacity and reduce costs through displacement of reliance on diesel generation with renewable energy sources, and through improvements in the FEA's transmission and distribution systems. Completion of this plan will greatly contribute to assurance that the FEA can reliably absorb additional rural electrification load throughout the Project period and beyond. The Project implementation consultants will maintain dialogue with FEA management on capacity and investment issues as implementation proceeds.

2. Connections to the Poor

39. The current rural electrification policy under which the Project will be implemented provides that 10% of the capital cost of a subproject in a rural village or settlement, whether grid extensions or solar home systems, be provided by the community concerned⁸, paid to the DOE and administered through subproject accounts created for the purpose.

40. In addition to the community contribution, each household is required to purchase internal wiring and fixtures to enable it to use electricity. In the case of grid extensions, current FEA policy is that all equipment beyond the meter box (i.e., all internal wiring, fuses, and fixtures) is the responsibility of the household and is not provided as part of the FEA connection. Wiring and fixture costs will vary by size and configuration of the house, but current estimates range between F\$150-\$350 (US\$85-\$200). Under project implementation arrangements, the government will assure that sufficient finance will be available to assist poor households to meet house wiring costs. It is proposed that the FEA offer financial assistance (upon application) to poor households, by which the utility would pay the initial costs of internal wiring and fixtures and recover the cost progressively through payments added to the monthly bills.

41. In the case of solar home systems, the estimated cost of internal wiring and fixtures is F\$100 (US\$57) per household. Under DOE policy, this cost is included in the total project cost and is recovered through the monthly tariff.

3. Capacity Building

42. Technical assistance will be provided to FEA to (i) conduct and manage implementation of the grid extension subprojects including detailed design and engineering, bid evaluation and award, supervision, system testing, and commissioning; (ii) train staff through focused training seminars and project work; (iii) improve social and environmental assessments, management and monitoring of projects, and (iv) train private sector contractors to build their capacity to carry out an increasing share of the equipment procurement and installation work. The Project will also support FEA's ongoing consumer awareness program, which focuses on safe use of electricity, avoidance of waste, and FEA conditions of supply including connection costs, tariffs, billing, and disconnection policy.

43. The DOE's institutional capacities will be strengthened with additional skilled staff and with appropriate support training in engineering planning and design, financial

⁸ As an up-front contribution in the case of grid extensions, and as progressive monthly payments in the case of solar home systems.

management, social and environmental management, contract management, consumer awareness and benefits monitoring.

E. Cost Estimates

44. Under the Main Component, the estimated cost of the grid extension subprojects is US\$12.45 million equivalent, comprising \$8.82 million equivalent (70%) in foreign exchange cost, and \$3.63 million equivalent (30%) in local currency cost. The solar home systems are estimated to cost a total of \$4.17 million comprising \$3.73 million equivalent (91%) in foreign exchange cost, and \$0.43 million equivalent (9%) in local currency cost. The solar home systems component of the Project is exempt from taxes and duties under current government policy supporting renewable energy-based rural electrification.

45. The cost estimations are based on 2004 price levels for base costs including physical and price contingencies but excluding taxes and duties for the grid extensions subprojects (US\$0.37 million).

46. Cost estimations and the financing plan for the grid extensions and solar home systems subprojects of the Main Component are summarised below, with detailed cost estimates in **Appendix 6** and in Supplementary Appendices 1 and 2.

**Cost Estimates (US\$ million)
(Main Component)**

	Cost Estimates		
	Foreign	Local	Total
I. Grid Extensions			
IA. Base Costs			
1. Technical Component	7.01	2.99	10.00
2. Consultant Services	0.52	0.10	0.62
Subtotal, IA	7.53	3.09	10.62
IB. Contingencies			
1. Physical (10%)	0.75	0.31	1.06
2. Price (7.2%)	0.54	0.22	0.77
Subtotal, IB	1.30	0.53	1.83
Total, Grid Extensions	8.82	3.63	12.45
II. Solar Home Systems			
IIA. Base Costs			
1. Technical Component	2.60	0.29	2.89
2. Consultant Services	0.58	0.08	0.66
Subtotal, IIA	3.18	0.37	3.55
IIB. Contingencies			
1. Physical (10%)	0.32	0.04	0.36
2. Price (7.4%)	0.24	0.03	0.26
Subtotal, IIB	0.55	0.06	0.62
Total Solar Home Systems	3.73	0.43	4.17
Interest During Construction	0.30	1.20	1.50
Taxes and Duties (VAT, 12.5%)	-	0.37	0.37
Total Project	12.86	5.64	18.49
Percent	69.52	30.48	100.00

F. Implementation Arrangements

1. Project Management

47. DOE will be the Project's executing agency. The DOE and the FEA will be the implementing agencies for the solar home systems and the grid extensions subprojects respectively. The DOE Director will be responsible for overall project management, releasing funds to FEA for construction of the grid extension works. It is important for a successful Project that a close, mutually supportive working relationship be established and maintained between DOE and FEA for efficient project coordination and control. A separate Project Management Unit (PMU) will be established within each implementing agency, responsible for (i) project implementation planning, budgeting, finance and accounting; (ii) recruitment of consultants; (iii) supervision and coordination of detailed project design; (iv) procurement of plant and materials; (v) implementation, supervision, commissioning of all project components; (vi) organization of the project performance monitoring system; and (vii) preparation of periodic progress reports and the project completion report.

48. A team of international and local consultants will assist the PMU within FEA in its project operations. Consultant services and construction work will be carried out under contracts administered by the respective agencies. As construction capacity in both the FEA and the DOE is limited, much of the construction work will be carried out through contracts with the private sector. Assistance in preparation of quality bids for the construction work will be provided to potential private sector bidders by the implementation consultants.

2. Implementation Period

49. Both the grid extension and the solar home systems subprojects will be implemented over 5 years beginning in the first quarter of 2005. Physical works are expected to be completed by the second quarter of 2010, with loan closing in December 2010 (ie, 6 months after completion of all works).

50. Though lengthy, the 5-year implementation period is practical, given: (i) a considerable backlog in the current FEA works program and the need to reallocate construction resources in conjunction with building capacity in the private sector to take on more of FEA's line extension work; (ii) the need by DOE to prepare RESCOs and prospective communities to absorb the planned Proof of Concept pilot programs for solar home systems. The implementation schedule is presented in **Appendix 7**.

3. Procurement

51. To enhance local expertise, local companies would be encouraged to bid for equipment supply contracts, to develop Fijian capacity to supply certain equipment, such as charge controllers, DC converters and lamps, as well as importantly to service such equipment during the operational life.

52. Indicative procurement packages are in **Appendix 8** for both grid extension and solar home systems subprojects.

4. Consulting Services

53. The procurement of plant and materials, as well as on-site construction/installation works will be implemented and managed by FEA and DOE in their respective areas of authority and expertise, under the control of the Executing Agency (DOE) for coordination, disbursement control, and reporting purposes.

54. The international and local consultants (26 person-months and 20 person-months respectively) will provide support in all areas of implementation, including design/engineering, project management, training and public awareness. The detailed TOR of the Project implementation consultants is in **Appendix 9**.

55. In addition, technical assistance will be provided to the DOE for mini-hydro feasibility studies and procurement, installation, and training for a computerised database and digital mapping system (**Appendix 5**), as discussed below.

5. Project Performance Monitoring and Evaluation

49. The DOE will be responsible for a comprehensive program for project performance monitoring and evaluation (PPME), which is to be carried out during implementation and subsequent construction/installation works for (i) the grid extension and (ii) the solar home systems subprojects. In consultation with local communities, the FEA PMU, in close liaison with the DOE, will develop a set of PPME indicators at the commencement of the Project. The PMU will carry out the PPME, including initial baseline physical and socioeconomic surveys, data collection and analysis. To set a benchmark to monitor and evaluate social and economic benefits, a baseline socioeconomic survey will be carried out before connections are made in project areas. A second socioeconomic survey will be carried out 3 years after the first connections to evaluate project effectiveness in targeting the poor and enhancing the welfare of households and communities. The surveys will cover electrified and un-electrified areas.

V. TECHNICAL ASSISTANCE

56. A TA of \$400,000 for Preparation of Potential Minihydro Projects and Capacity Building for the DOE in Project Management will assist the DOE in preparing potential minihydro projects in remote rural areas for implementation including detailed site investigations, soils analysis, stream flow characteristics and seasonal variability, detailed design/engineering and specification, socio-economic analysis, cost estimation, and bid document preparation. It is expected that minihydro schemes that are selected for development will be implemented under the RESCO approach to private sector management and operation that is being developed for implementation of solar home systems. The TA will also assist the DOE to specify, procure, install, and train staff in the effective use of a computerised project management database and digital mapping system, to enhance the efficiency and effectiveness of DOE's rural project planning, management, and performance monitoring. The total cost of the TA is estimated to be \$500,000 equivalent, with a foreign exchange component of \$375,000. The details of the TA are in **Appendix 5**.

VI. PROJECT BENEFITS, IMPACTS AND RISKS

A. Poverty Intervention

57. Approximately 25% of the project beneficiaries are poor. Many more live just above the poverty line and are in danger of falling below it. They live mainly by engaging in subsistence agriculture and are thus vulnerable to external shocks such as natural disasters and poor national or district economic growth. While energy is a major input into the livelihoods of the poor, they rely on high-cost sources such as diesel for lighting and batteries for radios and manual energy. Fuel poverty is a major burden, especially for women in the household. Fuel poverty also constrains the education of children and the rural population's income levels and opportunities to diversify income sources.

58. The most immediate and direct Project impact on the poor is in reducing cash expenditure on traditional and high-cost forms of commercial energy, such as kerosene and dry-cell batteries. Un-electrified households are found to spend more on all sources of energy than households with electricity from any source. This is despite the fact that households with electricity are likely to use a number of electrical appliances that cannot be used without electricity. Connecting poor households will immediately reduce cash expenditure so that scarce cash income can be diverted to other more beneficial expenditure items. As poor households' electricity consumption is likely to increase as appliances become more affordable, expenditure on electricity will increase also.

59. Other poverty-reducing impacts of village and settlement electrification include a reduction and considerable shift in housework for women that will be less onerous and give them more time for leisure and income-generating pursuits. There will be more time to help children with homework, make more comfortable living conditions or produce handicrafts. Access to electricity will also improve social services, especially education, allowing children to study under good light at night and schools to have more equipment including computers, printers and audio-visual teaching aids. Health services will benefit also as vaccines and other medications requiring refrigeration can be stored safely. In household surveys, villagers indicated that they put high priority on television and other forms of electronic communication to receive more information about other parts of the country and the world. Gainful employment, in the form of cottage industries of small business, will increase, e.g., shops (extending the range of goods sold in a shop such as frozen goods), mechanics' workshops, or welding businesses. To villagers, electricity represents an improved quality of life and savings in money, energy and time. The summary results of the poverty impact assessment are detailed in **Appendix 12**.

B. Financial Assessment

60. In recognition of the poor financial performance of rural electrification in Fiji (and in most other developing member countries) but high economic and social value, current rural electrification policy in Fiji provides for a 90 percent capital subsidy to rural electrification subprojects throughout the country (contingent upon the remaining 10 percent to be paid by the beneficiary communities). However, OMM (operations, maintenance, and management) costs, under the same policy, are not subsidised and must be fully recovered from users. The proposed Project fully supports and is consistent with the government's policy in this regard. The financial analysis is detailed in Supplementary Appendix 6 and summarised below.

1. Grid Extension Subprojects

61. At the FEA national uniform tariff, the financial internal rate of return (FIRR) of the rural grid extension subprojects, based on its capital and O&M costs and the revenue generated from new connections and energy sales, is below the weighted average cost of capital. The average cost recovery ratio (financial benefit-cost ratio) is only 95 percent which means that 95% of the Project's combined capital and operating costs are recovered from sales revenue.

62. One problem in full recovery of costs including capital costs is the current level of retail tariffs, which were last adjusted, *downward*, in 1999, and have not been raised since about 1994. An external tariff review has been commissioned by the FEA, however, with results to be submitted to government before the end of 2004. It is likely that a substantial upward adjustment (with possible introduction of a lifeline block structure to protect low-income customers) will be introduced in 2005 as a result.

63. The full financial condition and background financial statements of the FEA have not been disclosed by FEA management, citing confidentiality, despite requests. The FEA have provided assurances that the proposed subprojects will be accommodated within the technical and financial capacity of the FEA. Under the implementation arrangements of the proposed loan, the Government will assure that the project implementation consultants have access to such information and are enabled to maintain a policy dialogue with FEA management throughout the implementation period on financial and tariff issues to ensure that the proposed grid extension subprojects can be fully absorbed and sustainably operated and maintained by the FEA throughout their useful life.

64. A larger issue pertains to the effectiveness of delivering sustained economic benefits to target communities through rural electrification, and is common in the rural electricity sectors of many member developing countries. Without cross-subsidisation from other (urban) consumer groups, rural electrification is rarely financially viable. In the present case, as the government will not on-lend loan proceeds to FEA for this Project but will retain full responsibility for the debt, the cross-subsidy will not come from urban electricity consumers but from taxpayers in general. Funding of the grid extension subprojects is, in effect, government's subsidy to FEA to implement a portion of the government's rural electrification objectives. The assets, once commissioned, will become the property and responsibility of the FEA, which will collect revenues that fully recover the OMM costs. Under these considerations, the Project will be sustainable despite marginal financial performance.

2. Solar Home Systems

65. At the currently-proposed tariff for SHS systems of F\$15/month (see Supplementary Appendix 2), the FIRR for the solar home systems is negative. The Phase I installations will provide the means to test real costs and the tariff requirement for sustainability under RESCO operation in the field, and is designed to allow for adjustments in the tariff as the subproject proceeds.

66. Sensitivity tests on current cost estimates show that the FIRR for the SHS component becomes non-negative at a monthly tariff per household of about F\$19. At such a rate, the average cost recovery ratio is approximately 93 percent, i.e., 93% of the Project's combined capital and operating costs are recovered from sales revenue. However, the comments above, in regard to the common need for cross-subsidy in rural electrification, apply strongly to the SHS subprojects, which target rural areas remote from markets and which are therefore under relatively depressed economic conditions. Issues of affordability in remote areas suggest that the 'optimum' tariff for SHS, which recovers OMM costs to ensure sustainability but does not deter potential users from connecting to the systems, will be below the full cost recovery level and will permanently depend on cross-subsidy.

C. Economic Assessment

67. The economic analysis evaluates the economic performance of the proposed subprojects by comparing the With and Without project scenarios, i.e., the economic value of the incremental and non-incremental supply of electricity that the subprojects will provide in comparison with the existing patterns of energy use in non-electrified areas. The economic analysis is detailed in Supplementary Appendix 7 and summarised below.

1. Grid Extension Subprojects

68. The measurement of the economic value of the grid extension subprojects is based on a distinction between non-incremental and incremental inputs and outputs (electricity supply), as they are valued differently. Non-incremental electricity (the amount consumed without the subproject, which will be entirely replaced by supply with the project) is valued on

the basis of resource cost savings, whereas incremental electricity (increased electricity supply with the project) is valued on the basis of the average demand price with and without the subproject as a proxy for willingness to pay. The analysis is carried out for poor and non-poor households separately.

69. Non-incremental demand among poor households consists of expenditure on 'traditional' commercial petroleum fuels (e.g., kerosene and benzine) and batteries, standardised to consumption of equivalent litres of kerosene (converted to equivalent kWh of electricity). Incremental electricity demand among poor and non-poor households is the difference between the calculated non-incremental electricity demand and the average electricity demanded by each type of household under the current FEA tariff after electrification occurs, as indicated by FEA rural household billing distribution data from recently-electrified villages.

70. The EIRR measures the economic benefits of non-incremental and incremental electricity supply of the subproject against the economic resource costs. The grid extension subprojects are extremely robust with an EIRR of 69.88%, with an NPV calculated with a 12% discount rate of F\$165.2 million (US\$94.2 million). The subprojects remain strongly viable under reasonable assumptions of adverse changes to the underlying cost and benefit parameters. An increase in capital costs of 20% reduces EIRR to 61.95%, a decrease in economic benefits by 20% reduces EIRR to 59.93%, and a combined increase in capital costs and decrease in economic benefits reduces EIRR to 52.89%.

71. Strong economic performance of the grid extension subprojects stem from grid extensions' capacity to bring urban-quality power at the urban tariff to rural villages that otherwise face high costs for low quality energy services. On average, the proposed grid extension subprojects will allow households to consume nearly 23 times the electricity equivalent than they had access to under a similar household budget without the subprojects. Compared to transmission/distribution projects in large Asian developing countries, the technical requirements of the grid extension subproject in Fiji are low, and components will be installed in compact geographic areas of relatively high population density.

2. Solar Home Systems (SHS)

72. The methodology of economic analysis is the same for SHS as for grid extensions (see above), and is based on measurement of non-incremental and incremental benefits for poor and non-poor households. The chief difference between grid extensions and SHS is related to the respective target areas: whereas communities for which grid extensions are feasible generally have good road access (necessary for the right-of-way of the power line), communities selected for SHS are remote and lack road access; the cost of delivered goods including fuel in such communities is relatively high, and non-incremental consumption of fuel (in kWh equivalent) is relatively low. Also, due to the technical characteristics of SHS, 24-hour-per-day power cannot be supplied with the systems, i.e., their per-household output is constrained well below the per-household capacity of a grid extension system, such that incremental supply will also be constrained. The most common configuration of SHS (proposed for the Project) provides 240 Wh of direct current (DC) electricity per household per day, enough for lighting and radios, but not sufficient to operate heavier electrical equipment.

73. Due to higher fuel costs prevalent in SHS communities, in comparison with grid extension communities, without the project consumption of commercial fuels (kerosene) is lower, and the gross economic values per unit of non-incremental and incremental electricity supply are higher.

74. The EIRR for 3,200 solar home systems is 17.56%, with an NPV calculated with a 12% discount rate of F\$2.2 million (US\$1.3 million). The subproject is fairly robust under reasonable assumptions of adverse changes to the underlying cost and benefit parameters. An increase in capital costs of 20% reduces EIRR to 14.87%, a decrease in economic benefits by 20% reduces EIRR to 12.84%, and a combined increase in capital costs and decrease in economic benefits reduces EIRR to 10.70%.

75. The Proof-of-Concept (Phase I) SHS installation program will result in valuable operational and management experience that is likely to result in implementation improvements, while the much larger Phase II program (16,000 systems) will likely yield some economies of scale. These developments will likely lower costs and improve the economic performance of the SHS program in the long term.

D. Environmental Impact

76. A summary initial environmental examination (SIEE) has been prepared (**Appendix 10**). The major environmental impact of the Project is concentrated in the construction period, when soil disruption and some noise pollution may occur. However, these impacts will be mitigated by contractual requirements for good construction practices. The IEE concludes that, overall, only minor and mitigable potential impacts may be expected because: (i) the distribution lines will be located on public roadways; (ii) routes are selected to avoid environmentally sensitive areas and areas with social, historical and cultural value; (iii) potential for resettlement impact is very low; and (iv) unforeseen impacts may be mitigated by simple re-designs to avoid or mitigate them if they occur.

E. Resettlement Impact

77. The Project will have no involuntary resettlement and only minor potential land acquisition impacts. The involuntary resettlement plan incorporates the Government's national policy on land acquisition and compensation and rights for electricity installations. The short resettlement plan is summarized in **Appendix 11** and, if required, will be updated after the detailed design and layout surveys.

78. In Project design, every effort has been made to minimize land acquisition impacts by avoiding agricultural land, trees and sites of cultural, historical and biological significance. For grid extensions, electric power poles and lines will be adjacent to existing roads between villages (within the roadway area) and along roads and pathways in villages. The location of poles and lines will be determined during detailed design. The short resettlement plan provides for compensation for any losses. Any compensation for a subproject will have to be completed and the contract area free of all encumbrances before award of the construction works contract commences for that subproject.

79. The construction of low and medium voltage distribution systems will be subject to height restrictions to 3 meters for adjacent trees and structures, requiring some trees to be cut. There will be some minor vegetation damage during the construction phase. Within villages and settlements, any land that is not on a public right-of-way that is required for pole installation, or any vegetation that needs to be removed, will be voluntarily provided by the communities before the subproject proceeds. The location of poles within villages will be by agreement with landowners and at no cost to the electricity authority or the government, in accordance with the Electricity Act.

80. For solar home systems, there will be no land acquisition or losses, and no negative effects are anticipated. No stand-alone diesel systems are included in the Project due to financial unsustainability, maintenance and operational management difficulties, and noise and pollution effects.

81. DOE has developed a comprehensive public awareness program for communities that will benefit from current and future subprojects, but requires assistance (to be provided under implementation assistance for the solar home systems) to fully implement the program. The FEA has a similar capability. Public awareness efforts by both implementing agencies will assist resolution or avoidance of potential land acquisition and resettlement issues in the future.

F. Project Risks

82. The major risks facing the Project are the following: (i) inadequate construction and subproject installation resources, both within FEA and in the private contracting industry, to implement the grid extension subprojects; (ii) inability of potential private sector companies (RESCOs) to fulfil the roles envisaged for them by the government in implementation and O&M of renewable energy-based rural electrification in Fiji; and (iii) inability of poor households to pay connection and/or house wiring charges to benefit from the Project.

83. Implementation assistance has been designed to reduce these risks, as follows:

- (i) The implementation period of the Project is five years, designed to allow enough time for adequate resources to be allocated by FEA, making optimum use of the private sector, to implement the grid extension subprojects. In addition, the Project implementation consultants will provide training to potential contractors in order to boost their capacity to undertake subproject installation work with the FEA;
- (ii) The Proof-of-Concept solar home systems project component has been designed based on a clear application of lessons learned from similar projects in the past, in Fiji and elsewhere in the Pacific region, and is implemented over a sufficient timeframe (5 years) and with sufficient flexibility to adapt the approach appropriately to avoid or mitigate unforeseen risks as they occur;
- (iii) For the solar home systems subprojects, house wiring and connection costs are built into the SHS tariff arrangements and are paid off progressively by the beneficiary households. For the grid extension subprojects, it is proposed that a mechanism be established whereby a household, on application to FEA, could receive financial assistance for house wiring, which could be paid back in monthly amounts attached to the household's FEA bill.

G. Overall Assessment

84. The subprojects comprising the Project scope are technically sound and appropriate to the social and physical environment of Fiji. The Project's physical components are readily integrable with the GoF's rural development planning, while the electricity technologies are proven, tested and reliable. The Project overall, and each of its major components (grid extensions and solar home systems), provide a significant poverty intervention impact for the rural population of Fiji.

85. The grid extension subprojects (**Appendix 6** and Supplementary Appendix 1) in both the main component and reserve project list have been endorsed by DOE and FEA. Subprojects can be shifted between the main component and the reserve list.

86. Actions have been proposed to minimize and mitigate potential project risks and potential social and environmental impacts. The technical requirements of the subprojects are such that risk areas can be avoided through design adjustments.

87. Economic analysis has also shown that the Project will provide robust economic returns and is financially sustainable under the proposed institutional arrangements. The Project will therefore be technically and economically sustainable.

APPENDICES

- 1 Project Framework
- 2 Organisation Charts of the Executing and Implementing Agencies
- 3 Sector/Subsector Analysis
- 4 External Assistance
- 5 Nonlending Technical Assistance
- 6 Cost Estimates, Financing Plan, and Detailed Project Description
- 7 Implementation Schedule
- 8 Indicative Procurement Packages
- 9 Terms of Reference for Project Implementation Consultants
- 10 Summary Initial Environmental Examination
- 11 Summary Short Resettlement Plan
- 12 Summary Poverty Reduction and Social Strategy

PROJECT FRAMEWORK

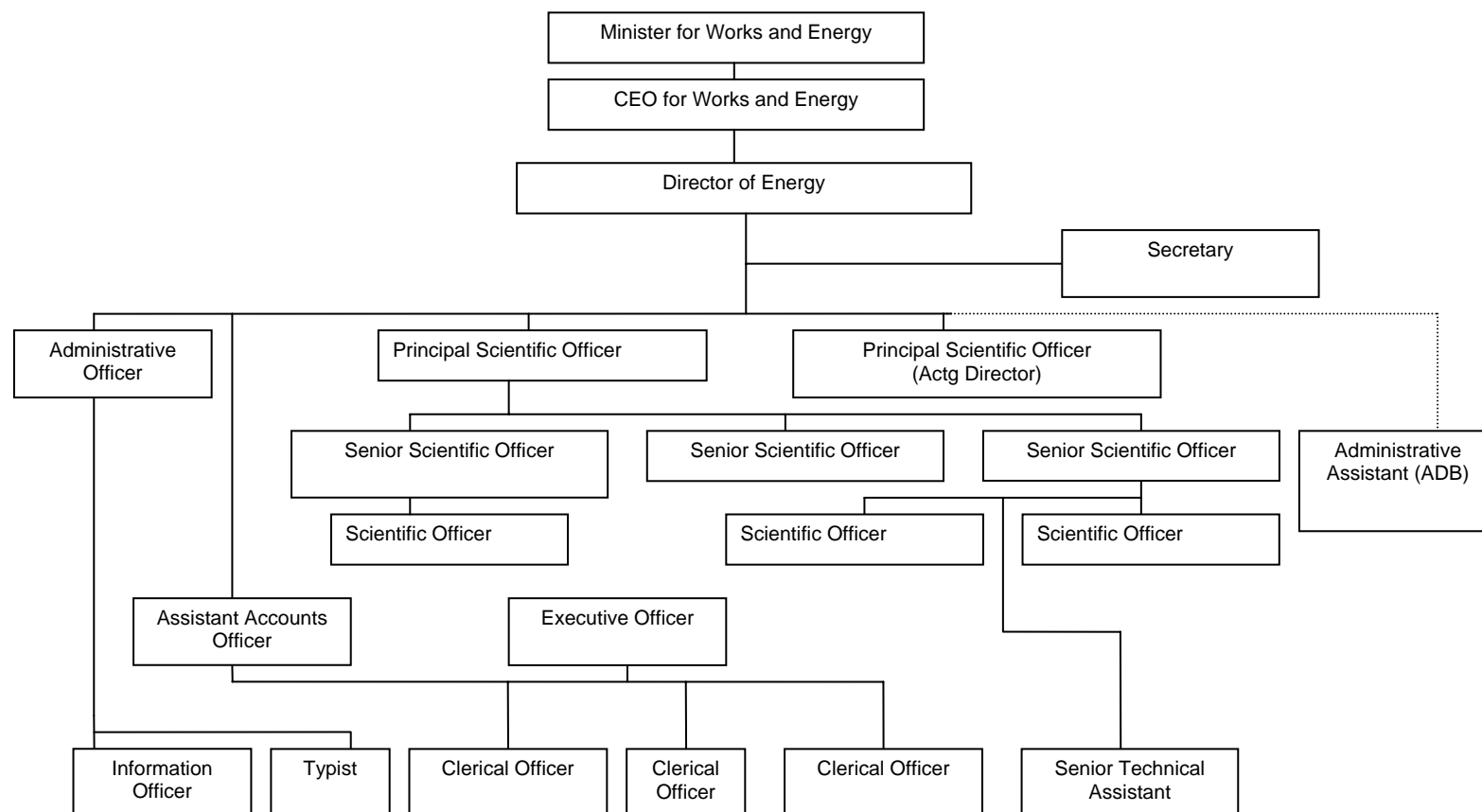
Design Summary	Performance Targets	Monitoring Mechanisms	Assumptions and Risks
Goals (3 years after project completion: 2013)			
► Improved rural living standards and economic conditions in selected rural areas of the Fiji Islands	► Increased consumption of electricity in the selected rural areas by 8 GWh ► At least 1,000 additional remote rural households have access to electric lighting ► At least 7,000 additional rural households have access to electric lighting and refrigeration	► Census ► Surveys on Household Income and Expenditures ► Department of Energy (DOE) and Fiji Electricity Authority (FEA) Reports ► Project Performance Audit Report (PPAR)	
Purpose (at project completion: 2010)			
► Increased coverage of reliable and affordable electricity supply in selected rural areas of Fiji	► At least 1,000 additional remote rural households get access to affordable power ► At least 7,000 additional rural households get connection to the power grid ► DOE and Renewable Energy Service Companies (RESCOs) achieve full capacity to implement renewable energy-based rural electrification in accordance with current government policy	► Socioeconomic Surveys at project inception and completion ► Project Completion Report (PCR) ► Consultation with stakeholders	► The macroeconomic and political environment are stable ► The Government is committed to poverty reduction and rural electrification ► Sufficient capacity in DOE and FEA ► Users can pay for the energy consumed ► Inability of the private sector (RESCOs) companies to implement the operation and maintenance of the stand-alone systems
Outputs			
1. Grid extensions completed 2. 'Proof of Concept' stand-alone solar home systems installed 3. Institutional capacity of appropriate DOE and FEA officials in place	► The power grid is extended to more than 7,000 new customers by 2010 ► More than 3,200 pilot/demonstration stand alone solar home systems are provided to households in Viti Levu and Vanua Levu ► At least 12 FEA officials are trained in project management and benefit evaluation ► At least 6 DOE officials are trained in project management and project performance	Periodic project reviews Project Completion Report FEA and DOE technical and financial reports	► The Government gives rural electrification a long term high priority ► Potential customers have capacity to pay for the connections ► DOE and FEA collect sufficient financial resources from users to operate and maintain the systems ► DOE and FEA trained officials are retained

Design Summary	Performance Targets	Monitoring Mechanisms	Assumptions and Risks
4. Awareness increased on safe and efficient use of electricity	<p>and monitoring evaluation</p> <p>► At least 80% of the new customers are briefed on safe use of electricity, electrical efficiency, connection costs, internal wiring, tariffs, billings and payments</p>	Project Completion Report	
Activities			
<p>1.1 Selection and engagement of consultants</p> <p>1.2 Preparation and execution of detailed design and tendering</p> <p>1.3 Procurement of equipments and materials (LH and LV distribution lines and service connections)</p> <p>1.4 Erection of medium and low voltage distribution facilities</p> <p>1.5 Supervision and monitoring</p>	<p>► Consultant selected and engaged <u>by 2005</u></p> <p>► Detailed project design completed <u>by 2006</u></p> <p>► 328 km of 11 kV and LV distribution line and 290 sets of distribution transformers completed <u>by 2010</u></p> <p>► Institutional strengthening of FEA on project engineering, procurement, construction supervision, installation and testing completed <u>by 2006</u></p>	<p>► Regular PMU progress reports</p> <p>► Project review missions</p> <p>► Executing agency quarterly progress reports</p>	<p>► Sufficient implementation capacity in DOE and FEA</p> <p>► Competent and motivated project management unit</p> <p>► Cooperation of involved agencies and local communities</p> <p>► Availability of human and financial counterpart resources</p> <p>► Competent contractors</p> <p>► Cooperation of labor unions</p>
<p>2.1 Selection and engagement of consultants</p> <p>2.2 Preparation and execution of detailed design and tendering</p> <p>2.3 Procurement of equipments and materials (panels, batteries, wiring and fixture)</p> <p>2.4 Installation of alternative energy systems</p> <p>2.5 Supervision and monitoring</p> <p>3.1 Conduct of capacity building for FEA officials in design/engineering, power project management, procurement, on-site construction and installation, and benefit evaluation</p> <p>3.2 Conduct of capacity building for DOE</p>	<p>► 1000 PV systems installed <u>by 2008</u></p> <p>► Institutional strengthening of DOE on project preparation, procurement and installation completed <u>by 2006</u></p> <p>► Capacity building of RESCO officials completed <u>by 2007</u></p> <p>► Power project performance and monitoring evaluation training completed <u>by 2005</u></p> <p>► Consumer awareness program completed <u>by 2009</u></p> <p>► At least 12 FEA officials are trained in project management and benefit evaluation <u>by end 2005</u></p> <p>► At least 6 DOE officials are trained in project management and</p>		

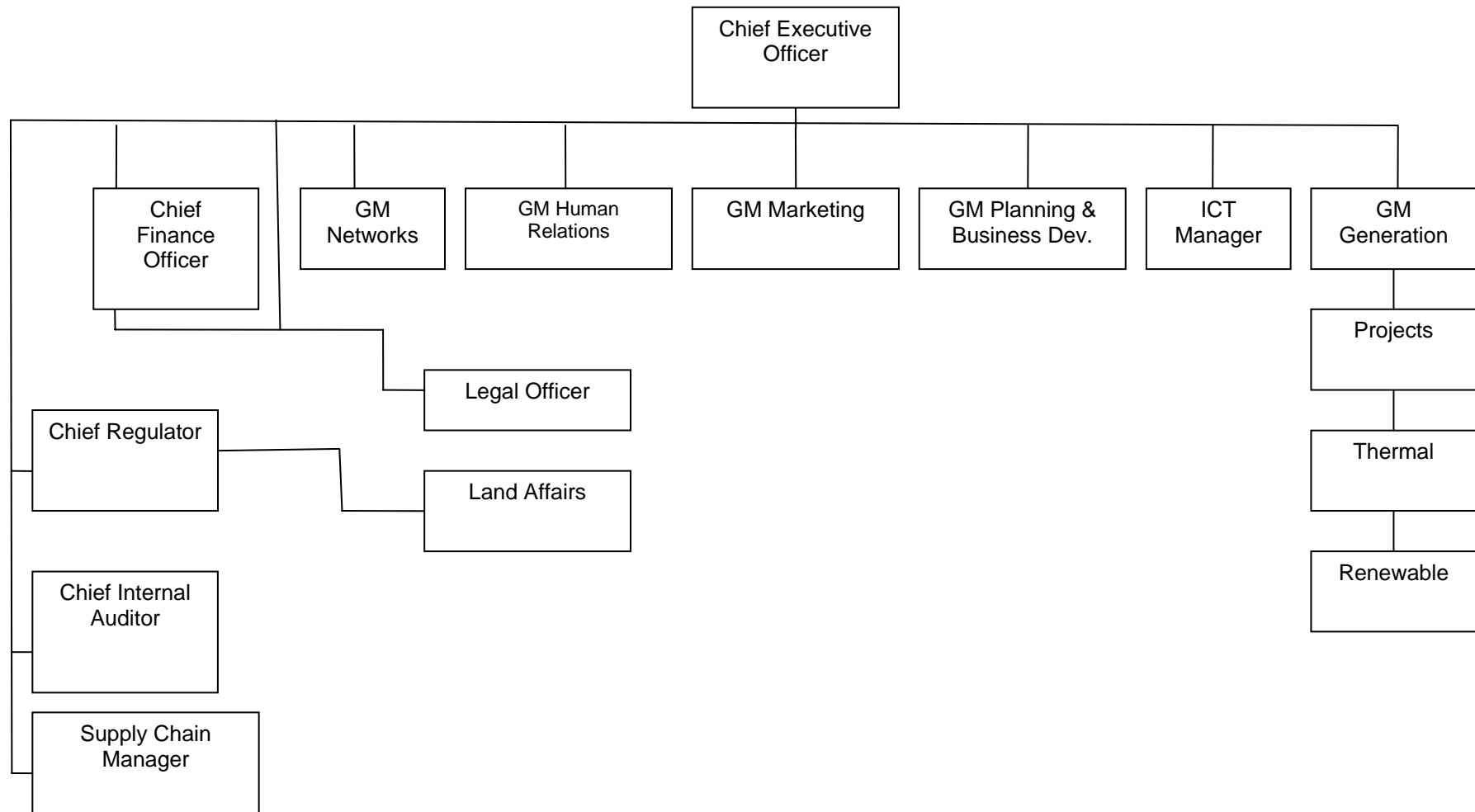
Design Summary	Performance Targets	Monitoring Mechanisms	Assumptions and Risks
officials in project management, project performance and monitoring evaluation, procurement and on-site construction and installation	project performance and monitoring evaluation <u>by end 2005</u>		
4.0 Design and implementation of the Consumers' Awareness Campaign	► At least 80% of the new customers are briefed on safe use of electricity, electrical efficiency, connection costs, internal wiring, tariffs, billings and payments, <u>by end 2007</u>		
Inputs			
► Consulting Services ► Civil works ► Equipment and supply ► Total Project	► \$620,000 ► \$1.5 million ► \$11.4 million ► \$18.5 million	► Project disbursement documents ► Project accounts and records	► Contracts negotiated and awarded in timely manner ► Government counterpart resources and other funding contributions are committed and allocated

ORGANIZATIONAL CHARTS OF THE EXECUTING AND IMPLEMENTING AGENCIES

Executing Agency: Department of Energy (DOE)



Implementing Agency: Fiji Electricity Authority (FEA)



SECTOR/SUBSECTOR ANALYSIS

Background

1. At present, only about half of households in Fiji have access to electricity. The power sector has a role in attaining the Government's social and economic development objectives by expanding the availability of low-cost, reliable electricity within the country. Government policy for the sector encourages optimal use of the country's natural resources, such as in hydro, wind, wave, geothermal generation, solar energy, promotion of efficiency in power sector institutions, and creating an environment for appropriate private investment.

Power System Facilities and Operations

2. The FEA power system grid network exists on the three main islands of Viti Levu, Vanua Levu and Ovalau, serving about 128,000 customers. The largest island of Viti Levu is supplied mainly from the Wailo Hydro Station and also by diesel power stations; about 55%⁹ of the power supply was generated by the hydro station in 2003/2004 versus about 75% in the recent past, due to drought conditions.

3. In addition to the Monasavu (Viti Levu) and Wainiqueu (Vanua Levu) hydropower stations, two large hydro stations are in advanced planning/construction stages: (i) Wainikasau, 6MW, due for completion at end of 2004; and (ii) Vaturu, 3MW, due for completion in mid-2005. The existing main Fiji power stations and transmission/distribution (T/D) capacity are summarised below.

FEA Power Stations

No	Power Station	Region	Type	Installed Capacity (MW)	Generation in 2003 (GWh)	Commissioning Year
1	Wailoa	Viti Levu	Hydro	83.20	340.00	1983
2	Kinoya	Viti Levu	Diesel	35.50	158.00	1972-2001
3	Vuda	Viti Levu	Diesel	24.00	78.50	1976-2001
4	Nadi	Viti Levu	Diesel	8.00	8.10	1962-'70
5	Sigatoka	Viti Levu	Diesel	8.80	2.40	1951-2003
6	Deuba	Viti Levu	Diesel	5.70	0.33	1954-'79
7	Rakiraki	Viti Levu	Diesel	1.00	1.72	1997
8	Korovou	Viti Levu	Diesel	1.24	-	1999-2001
9	Savusavu	Vanua Levu	Diesel	2.46	6.47	1995-2004
10	Wainiqueu	Vanua Levu	Hydro	0.80	0.07	1992
11	New Labasa	Vanua Levu	Diesel	14.34	50.97	1974-2004
12	Levuka	Ovalau	Diesel	2.00	16.84	1998
13	Rokobilli	Viti Levu	Diesel	3.30	6.25	-
14	Others	Viti Levu	-	3.70	29.20	-
Totals				194.04	698.85	

FEA Transmission and Distribution Facilities

132 kV (km)	33 kV (km)	11 kV (km)	0.4 kV (km)	Transformer Capacity (MVA)
62	107.4	949	959	501
78	187.2	2,079	3,040	470

Source: FEA Annual Report 2002

⁹ FEA

4. Recent growth in the demand for electricity has been high, despite a drop-off in 2003 due primarily to drought conditions and an aggressive public campaign to promote conservation of energy by consumers.

Electricity Consumption, 2001-2003 (GWh)

Customer Category	2001	2002	2003	Annual Growth Rate (%)	
				2001-2003	2002-2003
Domestic	144.0	160.0	154.0	3.4	(3.8)
Commercial	220.0	248.0	241.0	4.7	(2.8)
Industrial	151.0	160.0	164.0	4.2	2.5
Institutions	5.2	5.7	5.4	1.9	(5.3)
Total	520.2	573.7	564.4	4.2	(1.6)

Source: FEA

5. Electricity generation grew at an average annual rate of 6% between 2000 and 2002, albeit with a gradually increasing proportion supplied by diesel, due to demand growth exceedance of hydro capacity. (As a demonstration, FEA operates a small number of solar panels connected to an inverter that supplies energy to the Viti Levu grid.)

Electricity Generation (GWh), 2000-2002

Category	2000	2001	2002	Average Annual Growth Rate
Hydro	414	462	450	4.3%
Diesel	109	106	153	18.5%
Solar	11	14	10	-4.7%
Total	534	582	613	7.1%
Percentages				
Hydro	77.5%	79.4%	73.4%	
Diesel	20.4%	18.2%	25.0%	
Solar	2.1%	2.4%	1.6%	

Source: FEA Annual Report 2002

Power Sector Development

6. Throughout Fiji, electricity is supplied both centrally through grid networks (on the islands of Viti Levu, Vanua Levu, and Ovalau only) and by stand-alone schemes, which are mainly small diesels supplying villages or government administrative centers. The Fiji Electricity Authority (FEA), the state-owned national power utility, operates and maintains the centralized grid networks and invests in new generation to augment supply to the grids and in grid extension projects, whenever commercially viable. The Public Works Department (PWD) manages power generation at Government stations, one of which (at Nabouwalu in Vanua Levu) is an alternative energy/diesel hybrid demonstration project. Rural electrification that requires State subsidy is administered by the Department of Energy (DOE), with the FEA (for grid extensions) and the PWD (for stand-alone diesel schemes) as implementing agencies. Renewable energy-based stand-alone electrification schemes, especially solar home systems, are implemented directly by the DOE, with private sector participation in the form of Renewable Energy Service Companies (RESCOs, Supplementary Appendix 2). A breakdown of DOE expenditures on electrification in 2002 is given below.

7. The main FEA centralized generation sources are hydro and diesel power stations (producing 628 GWh in 2003). Independent Power Producers (IPPs) – private sector companies that invest in generation and sell power to FEA for resale – are encouraged. Under FEA sponsorship, studies are underway at Sigatoka for possible wind generation

and at Savusavu for development of geothermal generation (3.5 MW). DOE is pursuing a study of for wave generation at Muani.

8. The GoF has restructured and commercialised the FEA to enhance its management and operational efficiencies. A Loss Reduction Unit has been established within FEA and investments are being made to reduce system losses. The FEA is organized into regional profit centres, with formal cost accounting and internal transfer pricing for each. External auditing of the FEA is carried out annually.

9. In August 1999, the GoF decreased the FEA domestic tariff by 6.7% and froze tariff adjustments until September 2004. The current domestic tariff, at F\$0.2059 per kWh (US\$0.117) before VAT is quite low by regional standards and the financial strain on the utility is increasing. A tariff review is underway at FEA with external consultants, and the results are expected to be presented to government towards the end of 2004. The current FEA tariff structure and charges by customer category is shown below.

FEA Tariff Schedule, 2004

Note: All tariffs subject to 12.5% VAT

Domestic energy charge, Fc/kWh	20.59
Domestic Min Charge, F\$/month	4.12
Small Commercial & Industrial energy charge, Fc/kWh	20.71
Maximum Demand Tariff	
Capacity Charge, F\$/kW	18.35
Energy Charge, Fc/kWh, 75-500 kW	14.00
Energy Charge, Fc/kWh, 500-1000 kW	13.50
Energy Charge, Fc/kWh, > 1000 kW	12.00
Energy Charge, Fc/kWh, > 5000 kW	Negotiated
Excess Reactive Energy Penalty Rate, Fc/kvar	13.14
Institutional Tariff, Fc/kWh	20.59
Street Light Tariff, Fc/kWh	17.98

Source: FEA, 2004.

10. The DOE expends a budget of approximately F\$5 million per year for rural electrification, as shown below for 2002. Despite substantial expenditure on diesel electrification in the recent past, the DOE discourages the continued implementation of stand-alone diesel schemes for rural electrification. The DOE Strategic Development Plan 2005-2007 (extracts are provided in Supplementary Appendix 3) establishes a strong focus on renewable energy-based rural electrification, to be implemented and administered with a high degree of participation by the private sector.

DOE Expenditures on Rural Electrification Projects, 2002

Description	Allocation (%)	Allocation (F\$ million)
Diesel projects	42	\$ 2.10
FEA grid extensions	39	\$ 1.95
Upgrade diesel schemes	8	\$ 0.40
Maintenance of schemes	6	\$ 0.30
Safety inspections; repairs	2	\$ 0.10
Hydro	1	\$ 0.05
Solar	1	\$ 0.05
Training	1	\$ 0.05
Total	100	\$ 5.00

Source: DOE Report to Parliament, 2003

Key Development Challenges

11. Rural Electrification power projects are developed to enhance rural communities' well being and standards of living, employment opportunities, and support for social services including education, health and the water supply. However, new electricity supplies in remote areas are costly, rural electricity markets are generally not strong enough to justify commercial investment in supply¹⁰, and diesel technology, which has traditionally been the mainstay of RE programs in Fiji, has been found to be beyond the means of most communities to support operation and maintenance. In 1993, the government adopted a policy designed to accelerate rural electrification throughout rural Fiji by providing a subsidy of 90 percent of the initial cost of a project to any village or settlement that applied for electricity supply and was willing to provide the remaining 10 percent of cost. However, lack of budget resources to support the subsidy for all who have applied, and lack of construction capacity, have significantly constrained the rate that RE projects have been built in the past 10 years. In addition, many of the diesel schemes that were built have failed due to the non-affordability of fuel and maintenance in the recipient communities.

12. The Project, in conjunction with completion of installation of 20,000 solar home systems in remote communities over the next ten years, will ensure that electrification is accessible to all communities and households that desire it.

¹⁰ FEA requires a minimum 15% return on investment for grid extension schemes and does not undertake RE projects without subsidy.

EXTERNAL ASSISTANCE

Sector	ADB Strategy/Activities	Relevant Activities, Other Donors
A. Economic and Public Sector Reform	Ongoing <ul style="list-style-type: none"> TA 3242-FIJ: Public Enterprise Reform Program (Phase II) TA 3391-FIJ: Strengthening Debt Management 	<ul style="list-style-type: none"> Institutional strengthening for customs and revenue authority (AusAID)
B. Private Sector Development	Ongoing <ul style="list-style-type: none"> TA 2680-FIJ: Capital Markets Development Authority TA 3436-FIJ: Fiji Development Bank Review Programmed <ul style="list-style-type: none"> IT Policy Regulatory Framework (2003) 	<ul style="list-style-type: none"> Private Sector Training (NZL) Centre for the Development of Enterprises (EU) Business Assistance Scheme (EU) Youth Business Program (ILO)
C. Gender	Ongoing <ul style="list-style-type: none"> TA 3360-FIJ: Women's Plan of Action 	<ul style="list-style-type: none"> Humanitarian and social development assistance (NZL) Fiji council for social services (NZL)
D. Infrastructure 1. Transport and Communication 2. Energy 3. Water Supply and Sanitation	Programmed <ul style="list-style-type: none"> Airports Rehabilitation and Upgrading (2003) Outer Island Small Infrastructure Development (2004) Road Infrastructure Development, FRUP IV (2005) Programmed <ul style="list-style-type: none"> Rural Electrification (2003) Programmed <ul style="list-style-type: none"> Suva-Nausori Water Supply and Sewerage Project (2002) Capacity Building in Water and Sewerage Services (2002) 	<ul style="list-style-type: none"> Nadi-Lautoka Water Supply and Sewerage Project (NZL) Rewa Bridge Construction, and Kinoya Sewerage outfall Development (EU) Relocating of Lami Dumpsite (EU)
E. Environment	<ul style="list-style-type: none"> Environmental management including marine biodiversity conservation Environmental mitigation measures in ADB projects 	<ul style="list-style-type: none"> Local government environment program (EU)
F. Agriculture, Forestry and Resources	Programmed <ul style="list-style-type: none"> Alternative Livelihoods (2002) 	<ul style="list-style-type: none"> Small rural community development projects (Japan) Sugar prices support (EU) Conservation of indigenous medicinal plants (UNDP)
G. Governance	Ongoing <ul style="list-style-type: none"> TA 3408-FIJ: Preparation of a Medium –Term National Development Plan TA 5895-REG: Pacific Judicial Training Programmed <ul style="list-style-type: none"> Strengthening the Implementation of the Financial Management Act (2003) Strengthening and Capacity Building in Policy Analysis (2003) Strengthening Local Government Systems (2004) Pension Reforms (2004) 	<ul style="list-style-type: none"> Information services to parliamentarianism (UNDP) Governance support for Sustainable Development (UNDP) Support for legal aid (NZL) Human Rights Commission (NZL) Citizen's Constitution and Forum (NZL)

TECHNICAL ASSISTANCE FOR PREPARATION OF POTENTIAL MINIHIDRO PROJECTS AND CAPACITY BUILDING FOR THE DOE IN PROJECT MANAGEMENT

1. A TA of \$400,000 will assist the DOE in preparing potential minihydro projects in remote rural areas for implementation including detailed site investigations, soils analysis, stream flow characteristics and seasonal variability, detailed design/engineering and specification, socio-economic analysis, cost estimation, and bid document preparation. It is expected that minihydro schemes that are selected for development will be implemented under the RESCO approach to private sector management and operation that is being developed for implementation of solar home systems. The TA will also assist the DOE to specify, procure, install, and train staff in the effective use of a computerised project management database and digital mapping system, to enhance the efficiency and effectiveness of DOE's rural project planning, management, and performance monitoring. The objectives of the two TA components are outlined below. An outline TOR for the minihydro development component is available as Supplementary Appendix 8.

Preparation of Potential Minihydro Projects

2. The aim of the study is to investigate and report on the feasibility of selected minihydro power sites in Fiji islands on behalf of DOE. The consultancy will cover all relevant issues pertaining to the development of the sites. The study will include the following: (i) collection of all relevant hydrological, electrical and operational data; (ii) design of technically and economically viable hydro power development configurations where significant resource potential and potential demand for electricity exist; (iii) evaluation of environmental issues and impacts in accordance with government regulatory guidelines, including hydrological and relevant water-use issues; (iv) detailed cost estimates of the design and construction supervision, supply, installation and commissioning of proposed plant; (v) preparation of implementation arrangements based on a detailed assessment of risks; (vi) review of land acquisition issues and development of recommendations to resolve them; and (vii) preparation of detailed economic and financial analysis. This component is estimated to cost approximately \$480,000.

Capacity Building for the DOE in Project Management

3. Due to the advanced stage of digitized mapping of Fiji, it is possible to access detailed digitized maps of all areas of project interest in Fiji. Under the system that has been developed by the Bureau of Mapping, digitised maps are linked to a database of user-input detailed information on projects and project sites. This capability would be of substantial benefit to the DOE for the specification and design of future rural electrification projects and for current project management purposes, including project monitoring, scheduling, and resource allocation. It is proposed that funds under the nonlending assistance be used to (i) specify the relevant database and digitized map interpretation software requirements; (ii) purchase the software and a comprehensive set of digitised maps for the entire country from the Mapping Bureau; (iii) specify and purchase a computer and peripheral hardware dedicated to running the system; and (iv) in cooperation with the Mapping Bureau, conduct training of DOE staff in its operation; and (v) assist the DOE to utilize the system for implementation of the current Project. This component is estimated to cost approximately \$20,000.

COST ESTIMATES AND DETAILED PROJECT DESCRIPTION

Cost Estimates

1. Cost estimates for (i) grid extensions and (ii) solar home systems and the Project financing plan are shown in the following tables.

**Grid Extension Subprojects: Main Component
Project Cost Breakdowns (Financial Prices, US\$m)**

	Foreign Exchange Costs	Local Currency Costs				Total Subproject Costs
		Services	Materials	Labour	Total	
Capital Costs						
Technical Components						
HV distribution lines	2.65		0.38	0.90	1.28	3.93
LV lines and service connections	3.53		0.51	1.20	1.71	5.23
Substations	0.83					0.83
Subtotal, Technical Component	7.01		0.90	2.09	2.99	10.00
Consultant Services						
Engineering Design & Supervision	0.42	0.09			0.09	0.51
Benefits Monitoring/Consumer Awareness	0.08	0.03			0.03	0.11
Subtotal, Consultant Services	0.50	0.12			0.12	0.62
Physical Contingency (10%)	0.75				0.31	1.06
Price Contingency (7.2%)	0.54				0.22	0.77
Total Capital Costs	8.80	0.12	0.90	2.09	3.65	12.45

**Solar Home Systems Subprojects: Main Component
Project Cost Breakdowns (Financial Prices, US\$m)**

	Foreign Exchange	Local Currency Costs				Total Subproject
		Services	Materials	Labour	Total	
Capital Costs						
Technical Components						
Panels	1.77		0.06	0.14	0.20	1.97
Batteries	0.26		0.01	0.02	0.03	0.29
Wiring and Fixtures	0.57		0.02	0.04	0.06	0.64
Subtotal, Technical Component	2.60		0.09	0.20	0.29	2.89
Consultant Services						
Design, Supervision, Monitoring and Consumer Awareness	0.40	0.10			0.10	0.50
Institutional Preparation, RESCOs	-	0.16			0.16	0.16
Subtotal, Consultant Services	0.40	0.26			0.26	0.66
Physical Contingency (10%)	0.30				0.05	0.36
Price Contingency (7.4%)	0.22				0.04	0.26
Total Capital Costs	3.53	0.26	0.09	0.20	0.65	4.17

2. In total, foreign costs comprise about 70 percent of the total project costs, and local costs the remaining 30 percent.

Cost Estimates (US\$ million)
(Main Component)

	Cost Estimates		
	Foreign	Local	Total
I. Grid Extensions			
IA. Base Costs			
1. Technical Component	7.01	2.99	10.00
2. Consultant Services	0.52	0.10	0.62
Subtotal, IA	7.53	3.09	10.62
IB. Contingencies			
1. Physical (10%)	0.75	0.31	1.06
2. Price (7.2%)	0.54	0.22	0.77
Subtotal, IB	1.30	0.53	1.83
Total, Grid Extensions	8.82	3.63	12.45
II. Solar Home Systems			
IIA. Base Costs			
1. Technical Component	2.60	0.29	2.89
2. Consultant Services	0.58	0.08	0.66
Subtotal, IIA	3.18	0.37	3.55
IIB. Contingencies			
1. Physical (10%)	0.32	0.04	0.36
2. Price (7.4%)	0.24	0.03	0.26
Subtotal, IIB	0.55	0.06	0.62
Total Solar Home Systems	3.73	0.43	4.17
Interest During Construction	0.30	1.20	1.50
Taxes and Duties (VAT, 12.5%)	-	0.37	0.37
Total Project	12.86	5.64	18.49
Percent	69.52	30.48	100.00

Description of Main Component and Reserve Projects

The proposed subproject components under the Main Component (grid extensions and solar home systems) and under Reserve Projects (grid extensions, solar home systems, and minihydro schemes) are detailed in the tables below. Full feasibility studies and design preparations for the proposed minihydros will be carried out under technical assistance (Appendix 5), following which they can be transferred to the Main Component for implementation provided that additional co-financing or resource savings in the Main Component have been identified.

Proposed Project: Main Component										
Project Description	Province	House-holds	Villages	Settle-ments	Pop-ulation	Schools	Health Centres	Line Length (km)	Total Cost (F\$)	Cost per Household (F\$)
Grid Extensions										
Ovalau										
Natokalau - Lovoni – Buresala – Viro, Levuka	Lomaiviti	585	7	11	2,618	3	2	25.9	\$ 1,712,193	\$ 2,927
Total Ovalau		585	7	11	2,618	3	2	25.9	\$ 1,712,193	\$ 2,927
Vanua Levu										
Nacodreudreu – Naviavia	Cakaudrove	520	7	2	2,602			39.7	\$ 1,766,124	\$ 3,396
Hibiscus Highway Mumu Resort – Nagigi – Naweni	Cakaudrove	389	5	3	1,938	2	0	7.9	\$ 292,212	\$ 751
Seagaqa – Dreketi	Macuata	680	8	8	3,184	5	1	38.4	\$ 2,258,188	\$ 3,321
Total Vanua Levu		1,589	20	13	7,724	7	1	86.0	\$ 4,316,524	\$ 2,717
Viti Levu										
Natadola – Sanasana Village - Malomalo – Naidiri Junction	Nadroga/ Navosa	220	3	2	1,095	2	1	23.8	\$ 581,720	\$ 2,644
Sigatoka Valley Road (Tonga (Tikina Naqalimare) – Keiyasi	Nadroga/ Navosa	220	7	4	1,095	5	3	21.8	\$ 1,281,992	\$ 5,827
Queen Victoria School – Dawasamu – Nasinu – Matainanau - Delaiyadua	Ra & Tailevu	554	10	7	2,770	4	2	28.5	\$ 1,370,285	\$ 2,473
Ra High School – Dama Village – Nayavu	Ra & Tailevu	210	4	-	1,050	5	2	5.4	\$ 199,881	\$ 952
Barotu Circular Road - Nalaba Primary School	Ra	176	3	4	880	1	0	18.6	\$ 764,688	\$ 4,345
Loqi – Vagadra - Vunamoli – Uto – Nawaqadamu	Ba	244	4		1,917			31.8	\$ 1,193,421	\$ 4,891
Naqali – Navurevure – Wainawaqa – Nadakuni – Delailasakau – Waivaka – Naraiyawa	Namosi & Naitasiri	509	18	-	2,545			58.9	\$ 3,463,732	\$ 6,805
Laselevu – Narokorokoyawa – Nasalia – Naitauvoli	Naitasiri	196	12	2	978			15.0	\$ 882,105	\$ 4,501
Serea – Naivucini Village	Naitasiri	200	3	6	978	2	0	16.0	\$ 653,035	\$ 3,265
Nairukuruku – Nakorosule	Naitasiri	330	4	5	1,651	4	1	11.3	\$ 490,655	\$ 1,487
Nasi – Nacokaika - Muaniweni	Naitasiri	384	1	3	1,918			3.2	\$ 188,182	\$ 490
Navatuvula – Naqali-Nawaqabena-Nadua	Naitasiri	227	4	2	1,133			10.6	\$ 623,354	\$ 2,746
Total Viti Levu		3,470	73	35	18,010	23	9	245	\$ 11,693,050	\$ 3,370
Fiji Totals, Grid Extension Schemes		5,644	100	59	28,352	33	12	356.8	\$ 17,721,767	\$ 3,140
Project Implementation and Contingencies									\$ 3,929,825	
Total including Implementation & Contingencies									\$ 21,651,592	\$ 3,836
Grid Extensions Component, US Dollar Equivalent									\$ 12,341,407	\$ 2,187
Solar Home Systems (SHS) Pilot Implementation										
Vanua Levu		1,475							\$ 2,336,400	\$ 1,584
Viti Levu		1,725							\$ 2,732,400	\$ 1,584
Fiji Totals, SHS		3,200							\$ 5,068,800	\$ 1,584
US Dollar Equivalent									\$ 2,889,216	\$ 887
Project Implementation and Contingencies									\$ 2,035,088	
Total including Implementation & Contingencies									\$ 7,103,888	\$ 2,220
Solar Home Systems Component, US Dollar Equivalent									\$ 4,049,216	\$ 1,243
Total Main Component Projects (US dollars)									\$ 16,390,623	

Proposed Project: Reserve Project List										
Project Description	Province	House-holds	Villages	Settle-ments	Pop-ulation	Schools	Health Centres	Line Length (km)	Total Cost (F\$)	Cost per Household (F\$)
Grid Extensions										
Viti Levu										
Tagitagi-Tulahewa	Nadroga/Navosa	179	1	3	896			23.7	\$ 1,393,725	\$ 7,786
Mataisuva Settlement – Delaiwaimale-Vatukorosia Primary School – Lomaivuna Agricultural Sector	Naitasiri	457	1	8	2,286	4	1	19.1	\$ 1,024,668	\$ 2,242
Naiyala School – Natokala – Soa - Nayavu	Tailevu	92	8	12	459			14.2	\$ 835,059	\$ 9,077
Naqali – Viria Road	Naitasiri	276	1	-	1,382			7.4	\$ 435,171	\$ 1,577
Total Viti Levu		1,004	11	23	5,023	4	1	64	\$ 3,688,623	\$ 3,674
Vanua Levu										
Wainikoro - Nakelikoro Loop Road – Mouta Village & Boca Settlements	Macuata	606	2	3	3,029			14.4	\$ 846,820	\$ 1,397
Total Vanua Levu		606	2	3	3,029			14.4	\$ 846,820	\$ 1,397
Ovalau										
St John's Cawaci – Rukuruku Village, Levuka	Lomaiviti	253	4	1	1,764	2	0	11.4	\$ 709,222	\$ 2,803
Total Ovalau		253	4	1	1,764	2	0	11.4	\$ 709,222	\$ 2,803
Project Implementation and Contingencies									\$ 1,206,273	
Total including Implementation & Contin									\$ 6,450,938	\$ 3,463
US Dollar Equivalent									\$ 3,677,035	\$ 1,939
Solar Home Systems (SHS) Pilot Implementation and Microhydro Schemes										
Solar home systems										
Vanua Levu		400							\$ 887,986	\$ 2,220
Viti Levu		400							\$ 887,986	\$ 2,220
Fiji Totals, SHS (incl imp & contin)		800							\$ 1,775,972	\$ 2,220
Microhydro Schemes										
Vanua Levu		50							\$ 166,186	\$ 3,324
Viti Levu		51							\$ 126,056	\$ 2,472
Taveuni		70							\$ 262,238	\$ 3,746
Fiji Totals, Microhydro		171							\$ 554,480	\$ 3,243
Hydro Project Implementation and Contingencies									\$ 110,896	
Total Hydro including Implementation & Contin									\$ 665,376	\$ 3,891
Fiji Totals, SHS and Microhydro Schemes		971							2,441,348	\$ 2,514
US Dollar Equivalent									\$ 1,391,568	\$ 1,408
Total Reserve Projects (US dollars)									\$ 5,068,603	

IMPLEMENTATION SCHEDULES

		GRID EXTENSION PROJECTS																							
ID	Task Name	2005				2006				2007				2008				2009				2010			
1	Loan Effective																								
2	Appoint Consultants																								
3	Site Visits																								
4	Line Route Designs, Layouts																								
5	Revise Bill of Quantities (BoQ)																								
6	Approve Designs and Layouts																								
7	Prepare and Issue Bid Documents for Plant and Materials																								
8	Bidding Period																								
9	Evaluate Bids																								
10	Award Supply Contracts																								
11	Manufacture and Deliver Equipment and Materials																								
12	Prepare Construction Bid Documents																								
13	Update and Approve RFP for Line Construction																								
14	Detailed Site Line Surveys																								
15	Construction																								
16	Tests and Commissioning																								
17	Consulting Services																								
	- Engineering Designs, Layouts																								
	- Bid Documents																								
	- Bid Eval/Contract Awards																								
	- Construction Supervision																								
	- Capacity Building (non-engineering)																								

		SOLAR HOME SYSTEMS PROJECTS																							
ID	Task Name	2005				2006				2007				2008				2009				2010			
1	Detailed assessment of the market, capacity building, development of training capability, RESCO development																								
2	Design and purchasing of SHS, two rural electrification districts created, selection of a RESCO operator for the each district																								
3	System installation by RESCOs																								
4	Operation of installed systems by RESCOs, monitoring by DOE																								
5	Evaluation of the technical and institutional performance of the project and preparation of PHASE II design																								

APPENDIX 8

I. INDICATIVE PROCUREMENT PACKAGES

I. INDICATIVE PROCUREMENT PACKAGES							
		Type of Contract	No. of Contracts	Mode of Procurement	Cost Estimation (US\$ million)		
					Foreign	Local	Total
I. Grid Extension Subprojects							
IA.	Supply of MV and LV Distribution Plants and Materials	Goods supply					
IA.1	MV/LV Conductors		1	ICB	2.24		2.24
IA.2	Line & Materials Fittings; Poles; Cross Arms; Insulators; Switches; Line Hardware		1	ICB	3.55		3.55
IA.3	Distribution Transformers		1	ICB	1.13		1.13
IA.4	Tools, Construction Plant		1	IS	0.08		0.08
IB.	MV and LV Distribution; Installation; Testing; Commissioning	Construction	10	LCB		2.99	2.99
II. Solar Home systems Subprojects							
IIA.	Supply of Solar Panels, Batteries, Controllers, Ancillaries	Good supply	1	ICB	2.6		2.6
IIB.	Installation and Miscellaneous Works	Installation	Multiple	LCB		0.29	0.29
TOTAL					9.61	3.28	12.89

TERMS OF REFERENCE FOR PROJECT IMPLEMENTATION CONSULTANTS**Introduction**

1. The Government of the Republic of Fiji Islands, through the Ministry of Works and Energy, Department of Energy (DOE) and the Fiji Electricity Authority (FEA), intends to provide an expanded electricity supply to selected areas of the Fiji islands, using both MV and LV grid extensions and stand-alone (off-grid) alternative energy schemes.
2. The Project consists of (i) construction of about 360 km of medium voltage (11 kV) distribution lines and 320 distribution substations; (ii) construction of approximately 360 km of low voltage distribution lines, including connections to about 5,700 households; (iii) purchase and installation of 3,200 x 100 Wp solar home systems to suit about 3,200 households; and (iv) miscellaneous work, including benefits monitoring and consumer awareness programs.
3. DOE will be the Executing Agency for the Project and will be responsible for implementation of off-grid schemes, while FEA will be responsible for implementation of grid extension schemes, with works coordinated by a Project Management Unit (PMU) located within the FEA.
4. A team of international and local consultants will be recruited to assist FEA to implement the Project and to support FEA's institutional and project management capacities. Consultants will focus on design and supervision of the proposed works, capacity building, training of FEA in project management, socio-economic evaluation, environmental monitoring, and consumer awareness, and training of private contractor staff in bid preparation, costing, and resource management. The team will include specialists in institutional strengthening, MV/LV distribution engineering, and social/environmental management and monitoring.

Scope of Work**Engineering Services**

5. The consultant will be responsible for assistance to FEA in preparation of detailed engineering designs and layouts; preparation of bid documents; assistance in bid evaluation and contract awards; supervision of quality of installation work; and final testing and commissioning. Specifically, the consultant will perform the following, through the FEA project management unit and associated local staff:
 - (i) Assist in the collection of all engineering and layout data required to design project facilities, in conformance with agreed Standards and local practices;
 - (ii) Assist FEA to conduct engineering surveys and soil investigations, where necessary;
 - (iii) Prepare detailed layout designs for medium and low voltage distribution lines and distribution substations, taking into account the design practices used by FEA and relevant international standards;

- (iv) Assist FEA with computerised distribution planning and layouts to minimize losses, consistent with costs, plant standardisation, and acceptable supply quality and reliability;
- (v) Consolidate the above tasks into a design report giving project details, costs, implementation schedule and recommendations to mitigate any adverse environmental and sociological impacts;
- (vi) Assist FEA to prepare bid documents for all plant, materials and construction services required to implement the Project, suitable for international competitive bidding, international shopping and local competitive bidding, where applicable;
- (vii) Assist FEA to invite and evaluate bids and award contracts;
- (viii) Approve the contractors' design drawings and nominate witness tests of plant, if necessary;
- (ix) Supervise the construction of project works; ensuring that contractors and in-house construction staff perform all work in conformance with the specifications;
- (x) Assist FEA to establish and maintain cost control records, project accounts and quality assurance mechanisms; check contractors' claims for FEA approval;
- (xi) Witness sub-projects' commissioning, guarantee and acceptance tests and assist FEA in the take-over of the completed installations;
- (xii) Review and compile 'as-built' drawings and review the operation and maintenance manuals for accuracy and adequacy;
- (xiii) Assist FEA to establish and maintain accurate works programs; and
- (xiv) Prepare a project completion report providing details of project implementation, problems encountered and solutions adopted; with a detailed summary and explanation of any variations in projects costs and implementation times from the original estimations.

Social and Environmental Management

- (i) Optimize route locations of lines to minimize any adverse social or environmental impacts;
- (ii) Assist FEA's Environmental and Social Management Unit to revise and update the approved resettlement plan for each project subcomponent after detailed design is completed; implement and monitor the approved updated resettlement plans;
- (iii) Provide on-the-job training in resettlement, survey and preparation of social analysis, social impact assessment and other social impact monitoring, and gender and social development related to power distribution projects to ensure transfer of expertise to FEA, provincial

and district staff, and other members of the project team, as well as relevant external monitoring agencies;

- (iv) Monitor compliance with the updated resettlement plans and ensure that all information dissemination, consultation, disclosure, compensation and resettlement activities have been satisfactorily completed in accordance with the approved resettlement plan and Loan Agreement;
- (v) Before award of construction works contracts, verify and confirm that all affected persons, if applicable, have been satisfactorily compensated and resettled, with rehabilitation measures in place, in accordance with the requirements of the approved updated resettlement plans, Government procedures on involuntary resettlement; and that the contract area is free of all encumbrances.

Capacity Building for Socioeconomic Assessment

6. FEA has a developing socioeconomic section, to improve coordination of electrification data collection, maintain a consumer database and monitor benefits. Project implementation assistance will support training of two FEA staff in economic modeling for subproject evaluation.

7. FEA will appoint two staff from the socioeconomic unit to be trained under the program. Additionally, a number of field staff will be trained to collect subproject data for the model. The consultants will establish and refine the computerized model, as well as a system for systematic data gathering, including standardized questionnaires for socioeconomic surveys and staff training. The system will ensure that benefits monitoring directly supports subproject design, layout and evaluation.

- (i) Set up a standardized spreadsheet model to evaluate economic feasibility and social and poverty impacts of sub-projects;
- (ii) Design standardized survey questionnaires and data sheets for sub-project evaluation;
- (iii) Establish and test criteria for sub-project definition;
- (iv) Train staff in economic analysis, sub-project evaluation, data gathering, running and updating the spreadsheet model; and
- (v) Train field staff to use survey questionnaires and collect data;

Project Performance Monitoring and Evaluation

- (i) Design a benefits monitoring and evaluation (BME) system to assess the social, poverty and economic impacts of electrification; the BME will be used in the evaluation of future electrification sub-projects;
- (ii) Develop indicators to assess social, poverty and economic benefits of electrification; develop impact indicators to assess affordability of tariffs and cost of connection and internal house wiring and

willingness to pay; design corresponding standardized survey questionnaires;

- (iii) Train staff in field survey techniques and data imputation;
- (iv) Implement the baseline survey and conduct a distributional analysis of expected impacts of electrification; assess potential impacts of tariff changes and the ability of poor to pay for upfront charges and costs associated with connection;
- (v) Prepare a comprehensive report on the BME.

Consumer Awareness Campaign

8. The consultants will assist FEA to design and implement an information and awareness campaign on safe use of electricity and avoidance of waste. The awareness campaign will also inform consumers of connection costs, tariffs, interpretation of billing statements, timing of bills, and disconnection policy. The campaign will be commenced at least 2 months before local connections are made and take into account local languages and education levels.

- (vi) Assess the most effective means to disseminate information to consumers;
- (vii) Assist FEA to design and implement a campaign to disseminate consumer information on safe use of electricity, avoidance of waste, connection costs, internal wiring, tariffs, billings and payments.

Reporting Requirements

9. In addition to the design report, the consultants will provide a brief inception report within four weeks of the commencement of the assignment, a quarterly progress report within 15 days of the end of each quarter and a report on completion of land acquisition and resettlement activities before the instruction is issued for commencement of construction works and a project completion report at the end of the assignment.

10. Before submission of the inception report, the consultant will conduct a workshop, to include all stakeholders, to introduce the Project and to review implementation activities and schedules. A second workshop will be held promptly after dissemination and review of the draft final report.

Expertise Required and Person-Month Estimations

11. About 26 person-months of international consulting over approximately five years will be used for consulting services for grid extension planning, design and construction of low-and-medium voltage lines and substations; loss reduction and environmental and sociological aspects of infrastructure development. (For alternative energy projects implemented directly by DOE, an estimated 20 person-months of international and local consulting services under co-finance arrangements are required.)

12. The international consulting team (26 person-months) will comprise the following:

- Team leader and MV/LV Distribution Engineer (12 person-months)

- Economist (7 person-months)
- Public Awareness Specialist (3 person-month)
- Social Development Specialist (5 person-months)

13. The local consulting team (20 person-months) will comprise the following:

- Distribution Engineer (9 person-months)
- Economist (5 person-months)
- Public Awareness Specialist/Interpreter (3 person-months)
- Social Development Specialist (3 person-months)

14. The consultants will have experience in training and capacity building in economic modeling. Experience in the region, preferably in Fiji, is required. The economists will have experience in project evaluation of power projects and have a background in economic, social, and poverty impact assessment and evaluation of rural electrification projects with a focus on end-consumers. The economists will conduct tasks related to capacity building for socioeconomic assessment and benefit monitoring.

15. The public awareness specialists/interpreter will have experience in developing and implementing effective communication, media, and information dissemination programs in developing countries, preferably in the region and Fiji. The public awareness specialists/interpreter will be familiar with issues related to rural electrification, end-consumer preferences, barriers for low-income groups, cultural diversity and possess effective communication skills.

16. The social development specialists will have experience in designing and implementing resettlement projects in the region and in designing and delivering formal and on-the-job training in resettlement and social development.

Support Facilities

17. DOE, the executing agency, will provide office space at its headquarters or will arrange to provide office space at FEA, with secretarial support, fax and telephone facilities (connection fees and bills payable by the consultants) and additional interpreters as required.

SUMMARY INITIAL ENVIRONMENTAL EXAMINATION

1. An initial environmental examination (IEE) for the Project was undertaken as part of the project feasibility study. The IEE is based on an analysis of the impacts of the proposed works and a visual assessment of the project area. The IEE's main findings are summarized below.

Description of the Project

2. The Project will extend the distribution grid system in up to 22 sub-project areas accessible by road to the national grids on the three islands where grid systems exist¹¹, and introduce new solar home systems in remote areas. Project details are given in the main text of the report and in maps in Volume 2.

Description of the Environment

Physical Resources

3. Fiji is made up of some 330 islands, of which those larger than 0.5 hectare (ha) comprise 18,300 sq kilometres, and many smaller islands. The Fiji islands form part of an arc of volcanics between the plates of Australia and the Pacific. Fiji's larger islands are dominated by mountainous country incised by rivers and streams.

4. Soils are in three topographical groups. Of the land surface, around 15% is made up of soils on relatively flat land, around 20% is of soils on rolling to hilly land, and approximately 65% is of soils on steep slopes. Erosion of most of Fiji's soils is expected to be low because most are moderately well developed and drained.

5. Fiji has a tropical maritime climate with no great extremes of heat or cold. Trade winds from the east or southeast are the predominant winds, the most persistent being from July to December. The cyclone period is November to April and around 10-15 directly affect Fiji per decade. Earthquakes are a major hazard for the country. Flooding and multiple landslips affect the economy and infrastructure. Average temperatures vary from 2-4 degrees between the coldest (July / August) and warmest (January / February) times of the year. Rainfall is highly variable but generally increases steadily inland from coastal areas. The wetter season is November to April and the dryer season May to October, with a distinct "dry zone" on the western and northern sides of the main islands.

Biological Resources

6. Fiji has very rich biota. Over half (56%) of Fiji's 1,594 plant species are archipelagic endemics, many displaying limited ranges within Fiji. Several plants are almost unique to Fiji (24 species of palms which are all endemic, 76 species of Psychotria, 95% of which are endemic). Of Fiji's 57 breeding land birds, 46% are endemic. The island of Kadavu has been identified as the Endemic Bird Area (EDB) with the world's highest number of endemic bird species per land area. There are 476 plant genera native to Fiji. With habitats, most concentrations of endemic plants and invertebrates occur within moist forests and particularly within moss or cloud forests on the highest peaks. Also endemic to Fiji is the plant family Degeneriaceae, the Pteralopex acrodonta fruit bat and a genus of ants Myrmecina.

¹¹ Viti Levu, Vanua Levu, and Ovalau

7. Fiji has some highly distinctive taxa such as a relict group of iguanids, primitive shining parrots, a petrel, an elapid snake, the plant family Degeneraceae, several species of gymnosperms, and many invertebrates with links to ancient Gondwanaland faunas. The ant genus *Camponotus*, the iguanids and the *Chrysoenas* doves have some distinctive features also.

8. Of Fiji's forests, over 40% still have natural forest cover although much of this is restricted to higher and wetter parts of the islands. Although some of Fiji's forest wildlife has become extinct, there are still large areas of forest that have big populations of pigeons, parrots and fruit bats. There are several larger islands that do not have the imported mongoose, including Taveuni, which as a result have abundant populations of native birds, amphibians, reptiles and invertebrates. Biological phenomena specific to Fiji are entire forested watersheds (where forest goes from mountaintops to the sea). They exist at Taveuni on almost the entire windward side, on Vanua Levu at the three locations of Waileva West, Saqani and Wainunu districts, on Kadavu, Koro, Gau in smaller areas, and on Viti Levu at Nabukavesi and Nakorotumbu as fragmented areas.

9. Ninety species of globally threatened species in Fiji have been identified in the IUCN Red List of which around half are endangered and the other half critically endangered. However this list is far from complete. To overcome the deficiencies in the lists the Critical Ecosystem Partnership Fund (CEPF) has prepared additional lists (excluding marine priorities) to include:

- the globally threatened species from the Red List and other species of conservation concern for Fiji of which 102 species have been identified (70 plants, five insects, 13 birds, four mammals, nine reptiles and one amphibian);
- native Fijian plants with global ranges under 1600 square kms (that are restricted range species of conservation concern) of which there are 48 families;
- sites and landscapes of national biological significance (NBSAP) the 85 of which are listed by division; and
- CEPF Workshop priority sites and landscapes of which 33 are of priority and seven of highest priority.

10. In addition, a preliminary register of 140 mapped sites of national significance has been prepared for the National Trust of Fiji. The register is of natural sites and includes sites of biological, ecological, geological, geomorphological and landscape interest. It includes some sites that are currently used for recreation but does not include cultural and archaeological sites. The museum of Fiji holds records of sites of historic and cultural significance also.

11. The above four lists, register of sites and museum records are important tools that have been used for screening the sub-projects areas for any environmental effects.

The Economy

12. Fiji, with a population of around 820,000, is an agricultural economy with heavy reliance on one crop – sugar cane. Manufacturing grew in the late 1980s while agriculture, forestry and fisheries contracted. Contributions to the economy in the mining and services sectors increased. Garment and sugar industries were the main growth sectors in manufacturing whilst tourism was the main contributor to growth in

the wholesale and retail sector. The tourism sector has largely recovered from the May 2000 crisis but is still affected by the legacy of political instability.

Screening of Potential Environmental Impacts and Mitigation Measures

13. The following potential impacts have been identified from examination of the subproject areas. Mitigation measures as appropriate are noted:

Natural Vegetation and Wildlife

14. The 11kV and LV Low Voltage lines will be sited along existing roads to minimize impacts on natural resources. FEA will maintain the corridor by trimming vegetation and not by using herbicide. Vegetation beneath the distribution lines will be maintained in an early stage to provide minimum clearance of 3 meters from the conductors.

15. Project construction will entail minimal excavation that could contribute to some soil erosion and sedimentation of water sources.

Encroachment on Biological, Historical and Cultural Sites

16. There are no biological, historical or cultural sites in the sub-project distribution system corridors, although there are some historical and cultural sites nearby (to be listed). The distribution lines will avoid these.

Land Use and Resettlement

17. Selection of the alignments, using dedicated existing roadways, wherever possible, ensures the avoidance of existing villages and settlements; private and community structures; agricultural land; mature forest; areas of social, historical, and cultural value; and environmentally sensitive areas. During the detailed alignment survey, village chiefs and village and settlement leaders will be consulted to ensure any sensitive areas within villages and settlements are avoided. A short resettlement plan has been prepared (**Appendix 11**). However there is no involuntary resettlement and land acquisition is highly unlikely to be required. If compensation is required for any losses, the resettlement plan will be reviewed and updated after detailed project design before implementation.

Institutional Requirements and Environmental Monitoring Program

18. Throughout project implementation, the FEA as an implementing agency and the DOE as both an implementing and Executing Agency will be responsible for ensuring that the Project fully complies with the Government's environmental regulations, and meets the IEE's mitigation and monitoring requirements. Project resources will be allocated to implement mitigation measures.

19. The environmental manager will prepare monthly environmental management reports for submission to DOE during construction and early operation. DOE will prepare quarterly summaries also for inclusion in the quarterly progress report.

Findings and Recommendations

20. Overall environmental impacts of the Project (inclusive of the grid extension and solar home systems subprojects) are deemed to be minor and mitigable because of the following:

- The selection of roadways as the preferred distribution line routes for all grid connections avoids environmentally sensitive areas and areas of social, historical and cultural value;
- No involuntary resettlement or compensation is required;
- Effects from grid connections are minor (though some minor tree cutting and vegetation damage may occur during construction), and from solar home systems are negligible;
- Diesel systems are not included in the Project, on DOE's request, because of their environmental effects, and maintenance problems;
- Monitoring will be undertaken by DOE to ensure that adverse effects are kept to a minimum and managed.

Conclusions

21. Based on field investigations for the RE Project, the overall environmental impact of the project will be minimal and will not affect any nationally or internationally endangered wildlife or flora. Therefore, this IEE is considered adequate for meeting Government requirements regarding environmental assessment. A full EIA is not required.

SUMMARY SHORT RESETTLEMENT PLAN

Scope of the Resettlement Plan

1. A social analysis carried out in the project area concluded that the Project would not require involuntary resettlement. There would be minimal effects and land acquisition is highly unlikely to be required. A short resettlement plan has been prepared for the Project. The 22 sub-project sites in the main component and reserve projects identified for grid extension will incur minimal losses from vegetation and soil disturbance. Distribution line alignments will be generally within dedicated roadways, the specific locations of poles being identified during detailed design. As alignments will be selected to avoid all social, environmental, economic and historical sites of significance, any land acquisition impacts will be insignificant. Installation and operation of solar home systems will have no land requirements and negligible disturbance effects.

Scope of Resettlement and Land Acquisition

2. The 11 kilovolt (kV) distribution line alignments will be within roadways from the existing grid to villages and settlements and along roads and pathways within villages and settlements. Consequently no resettlement will be required in the Project. Compensation for losses is not expected. However in the highly unlikely situation where distribution poles have to be located on land that is not a dedicated roadway (to get to a village or settlement), compensation may be required. The clearance of vegetation and disturbance to soils from electricity installations do not require compensation. Habitation near 11 kV and Low Voltage (LV) power lines does not pose a health hazard.

Policy Framework

3. The policy framework has been built principally on the Constitution of Fiji, the Crown Acquisition of Lands Act, the Fijian Affairs Act and the Electricity Act concerning the possibility of any resettlement and land acquisition and compensation.

4. The DOE will follow these implementation regulations on land acquisition as applicable.

Resettlement Principles and Objectives

5. The following are the key principles and objectives adopted for electricity projects and will be applied to this Project:

- (i) Involuntary displacement will be avoided by exploring all viable alternative project designs and locations.
- (ii) Any land acquisition required will be planned and implemented to cause the least possible social, cultural and economic disruption.
- (iii) Any affected people will be compensated as per the compensation principles below.
- (iv) DOE will see that institutional arrangements are in place to ensure effective and timely design, planning, consultation and implementation

of the short resettlement plan.

- (v) The cost of any compensation will be considered as an integral part of the sub-project cost and budgeted in overall project implementation plans.
- (vi) Any land acquisition program required will be planned and implemented with the consent and agreement of the affected people and will encourage their active participation.
- (vii) If agreement cannot be reached about compensation, grievance procedures as per the legislation will be followed.

Entitlement Matrix

6. The summary entitlement matrix below summarizes the types of losses and support that may be required.

	Type of Loss	Persons Entitled to Compensation		Entitlement	Implementation Issues
Grid	Land for electricity poles (unlikely)	Landowners		If land not given freely, cash compensation	Screening during engineering survey to determine if compensation is necessary
	Clearance of vegetation Removal of branches Trees cut and removed	No one No one No one	(under the current Electricity Act)	None None None	- - -
Solar	None	-		-	Used batteries collected and recycled.
Mini Hydro	Soil disturbance	No one		None	-
	Damage to immediate vegetation	No one		None	-
	If storage dam, soil disturbance & damage to immediate vegetation	No one		None	-

No compensation is required, except in the highly unlikely event that electricity poles need to be placed beyond areas covered in the Electricity Act. In all such cases, compensation values for land will be calculated by the Valuation Department, Ministry of Land. Crops will be valued in accordance with the crop schedule in the Crown Acquisition of Lands Act. No resettlement is required. No income restoration is required.

Institutional Framework

7. DOE has an established Rural Electrification Office that will monitor implementation. The office has a dedicated staff member for the RE Project. FEA also has a staff member responsible for the RE Project. DOE and FEA staff will be trained in environmental and social development under the implementation arrangements for the Project.

Preliminary Compensation Budget

8. If compensation is required, it will be provided from the sub-project budget. The Government will ensure that it meets any budget needed to meet the land acquisition plan objectives.

Monitoring and Evaluation

9. If required, DOE will monitor the preparation and implementation of an updated resettlement plan. The DOE will maintain a database of any land acquisition monitoring information.

SUMMARY POVERTY REDUCTION AND SOCIAL STRATEGY

Linkages to the Country Poverty Analysis

1. Social analysis conducted by TA 3961-FIJ showed clear links between the introduction of electricity and improvements in the quality of life for households in rural Fiji. The analysis showed that people who have recently been connected to a power supply indicated that electricity had made a significant positive difference to their lives. The analysis also linked the incidence of poverty to a lack of electricity in Fiji in several studies. Poverty is increasing and is related to, among other factors, the non-renewal of land leases resulting in more slum dwellings, increased petty crime, weakening of traditional family support systems, limited employment opportunities, inadequate capacity of the poor to take advantage of employment opportunities, weak governance and inadequate safety nets. As a result, increasing numbers of households are having difficulties in meeting basic needs. Breaking the cycle of poverty is a challenge for the Government.
2. The ADB 2003 report *Fiji Participatory Poverty Assessment* found a firm link between poverty ('hardship') and a lack of electricity in Fiji. Hardship in Fiji, found throughout the nation, was associated with a lack of or limited opportunities for income generation and limited access to basic services and infrastructure including electricity. This is more pronounced in rural areas than in urban areas.
3. The national Government developed a poverty reduction strategy in 2002¹², focusing on rebuilding confidence for stability and growth, for a peaceful and prosperous country. The goal for Government is to reduce poverty by 5% annually. Special affirmative action programs are outlined in the strategy to assist those who are among the poorest and most disadvantaged. The strategy also focuses on developing resources, particularly improving access to infrastructure and services, in rural areas where most of the population lives. The strategy also notes that poverty is significant, its prevalence is across all sections of the community, and it has increased in the last few years, particularly after the attempted coup of May 2000.
4. In 1998 the Government developed *The Women's Plan of Action 1999–2008* to address specific issues for women including poverty alleviation. The 1999 report titled *National Report on the Implementation of the Beijing Platform for Action* was prepared and provided an initial benchmark of the status of women in Fiji. Women's life expectancy is 71 years compared to 68 for men, female literacy is high at 95% but women's participation in the labour force is only 21% and is concentrated in lower skilled jobs. Female participation in public decision making, 12% in 1999 was targeted for 50% by 2003. ADB is supporting the Women's Plan of Action 1999–2008 through the implementation of technical assistance and continued promotion of mainstreaming gender issues in its Fiji Islands operations.
5. The 1997 *UNDP Fiji Poverty Report* provides details about the standard of housing in Fiji and specifically the percentages of households with unacceptable housing. It is of note that for the total population, about half of households do not have electricity. No electricity is also far more prevalent in rural areas than urban areas. While 18% of

¹² Strategic Development Plan 2003 – 2005

households in urban areas do not have electricity, 77.9% of rural villages and 64.2% of rural settlements do not have electricity.

Contribution of the sector/sub-sector to reduce poverty in Fiji

6. The poor in Fiji are burdened by lack of access to modern energy. Poor women are particularly affected as they have many roles where electricity could assist their daily lives. These include being responsible for household tasks including food preparation as well as helping children with homework, agriculture and business activities, and fulfilling village obligations. They spend a large proportion of scarce household cash income on alternative but less efficient sources of energy, are exposed to inadequate lighting and smoky cooking, have limited access to information and spend long hours in manual labour doing household chores. Children have limited time for studying due to poor light. Some medical supplies and animal vaccines cannot be stored. Fuel poverty particularly affects the poor because their cash income is scarce, their workload is heavy, and opportunity cost of time high. Inadequate and expensive sources of energy effectively reduce the poor's ability to diversify livelihood and income activities.

7. Access to modern energy will significantly reduce the vulnerability of poor households; reduce their expenditure on energy; improve their quality of life; provide increased access to information; and help reduce workload, especially for women.

8. Electricity is a key input to the development of agriculture and small-scale enterprises. Electricity supply 24 hours a day will reduce barriers to expand and enhance productivity. Increased rural commercial activity is a key to reducing poverty. Improved electricity supply will lift a significant constraint on economic growth and enable the poor to capture the benefits of economic growth.

Poverty Analysis Classification: Poverty Intervention

Poverty Profile

9. An urban survey completed by the Bureau of Statistics in August 2003 (which is the most recent data available) showed about 30% of Fiji's urban population was living below the poverty line. The rural survey results are not yet available from the Bureau of Statistics. The *Participatory Poverty Assessment 2003* indicated there are widening gaps in income distribution. The poverty incidence among the targeted beneficiaries is estimated on average around 25%. Higher percentages of poor households are in three of the 22 sub-project areas that are very inaccessible, isolated or have poor land.

Connecting the Poor

10. The O&M costs of stand-alone rural diesel power systems, a common means of rural electrification in Fiji in the past, generally exceed affordability and new construction of these is being discouraged by the DOE. Affordability constraints require that rural electrification for the poor be provided through connection to a national grid, a solar home system, or potentially an enclave mini-hydro system¹³.

¹³ Mini hydro systems are highly site-specific and require detailed resource measurement and design preparation. Nonlending technical assistance will be provided with the Project to permit a significant number of sites throughout Fiji to be investigated for potential development.

11. The economic analysis (Supplementary Appendix 7) shows that electricity from both grid extension subprojects and from solar home systems is affordable to poor households, in comparison with average poor-household expenditure on traditional rural fuels such as kerosene, benzine, and batteries. The public awareness/education program to take place as part of the Project implementation arrangements will assist poor households to understand the appropriate uses of electricity and ways to maximise its benefits.

Expected Impacts on the Poor

12. The social analysis indicates the most immediate effects of reliable rural electricity on the poor are (i) expenditure savings on household energy and (ii) expansion of consumption possibilities under a limited household budget. Electricity will benefit the lives of people in rural Fiji, particularly those of women and children, by household tasks taking less time, household chores being less onerous thus allowing women more time to concentrate on other tasks, such as helping children with homework, making more comfortable living conditions, or tending a shop or home handicraft enterprise. Having electricity will enable women to have 'an uplifted outlook on life'.

13. However, the extent of benefits from electrification will vary depending on the type of power generated (whether AC or DC, which affects the appliances that can be used), the hours of supply, the reliability of the service, and the nature and level of technical competence to maintain the system. Optimum benefits will arise from having electricity available for all electrical appliances, 24 hours a day.

14. Having electricity will reduce, not eliminate, the need to buy fuels and batteries at regular intervals. The cost and time needed to travel to a shop, which in some cases requires a lengthy vehicle ride and substantial fare, to purchase fuel or batteries is expensive in many areas and for some households onerous. Nevertheless, households with electricity report that the overall cost of electricity at current tariffs is lower than using other sources of energy such as fuels or batteries. Villagers that were connected to electricity three years ago indicated that their dreams had come true: they have the possibility of using electrical appliances and thus using energy in ways that previously weren't available.

15. Entrepreneurial activities are gradually emerging in some villages. They include carpentry and mechanical workshops for men and the possibility of starting a bakery or making and selling garments for women.

Affordability of Tariff Increases

16. The social analysis includes data on income levels and expenditure from several different data sources. From a DOE study of rural energy use¹⁴, conducted in 2003, the average household income was found to be F\$220 per month and average household expenditure around F\$174 per month. (These figures are consistent with the 1997 *UNDP Fiji Poverty Report*.) The consultant's qualitative survey provided some indicative information about the amount spent on energy sources for those without electricity and those that do have electricity. The monthly average spent by communities with no

¹⁴ *Establishment of Economic Framework and Incentive Policies for Renewable Energy Service Companies*, DOE, Nov 2003

electricity is generally higher than the monthly average spent by communities which have electricity from any source. For example, according to the DOE study, the average amount spent monthly on all sources of energy (fuels, including in some cases for a personal generator and batteries) in communities that do not have electricity was F\$55, the range being F\$8 – F\$154. The average amount spent monthly on electricity and other energy sources in communities that did have electricity from FEA grid was approximately F\$35, for solar was approximately F\$33 and for mini-hydro was F\$8. This is despite the fact that households with electricity are likely to use a number of electrical appliances that cannot be used without electricity.

17. Even when households have electricity they usually also spend money on other sources of energy. Reasons for this include the unreliability of electricity provided with the resulting need for backup energy and when the electricity supply is not powerful enough to provide all services required, such as with solar, which generally only provides enough electricity for limited use of lights and a radio.

18. The DOE study also indicated that rural household's level of expenditure on fuels for lighting only was F\$13-F\$19 per month. The study suggested that households could afford to pay a minimum of F\$15 per month for a RESCO tariff. The study found that household expenditure on energy fuels was greatest among those with their own petrol- or diesel-powered generators.

19. Using the same survey data as the rural energy study, another DOE study conducted in 2003 on the commercial viability of RESCOs¹⁵ indicated that 38% of households spent at least F\$20 in fuels for lights and dry cell batteries for radios. This study suggests that at least 4,500 households throughout Fiji could benefit from a solar home system similar to those installed by DOE in Vanua Levu, and afford to pay a monthly fee of F\$20.

Participation Process

20. For stand-alone electrification systems, lack of adequate maintenance and repair capacity has been a major constraining issue in rural villages and settlements. Training by DOE is planned concerning maintenance, electrical operation, and project management issues for households and RESCOs providing energy services. Also, a degree of misunderstanding among villagers concerning the choice of electrification systems available is evident, particularly in respect of solar home systems which are limited in the range and power of appliances that can be used. The awareness programs to be carried out by DOE under the implementation arrangements of the Project will assist this issue.

21. For consumers, public awareness programs carried out by FEA under the implementation arrangements for grid extension subprojects will focus on safe use of electricity, avoidance of waste, connection policy, tariffs, interpretation of billing statements, and disconnection policy.

¹⁵ *Financial Feasibility and Commercial Viability of Rural Sector Renewable Energy Service Companies in Fiji*, DOE, August 2003