REVIEW OF THE FIJI GOVERNMENT 1993 RURAL ELECTRIFICATION POLICY

– a UN/ESCAP Project for the Fiji Department of Energy –

Anare Matakiviti[1]
& Tam Pham[2]

December 2003 *SOPAC Technical Report 368*

[1] Energy Advisor, South Pacific Applied Geoscience Commission (SOPAC)
[2] Consultant, Wellington, New Zealand

UN/ESCAP

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REVIEW OF THE 1993 RURAL ELECTRIFICATION POLICY

REVIEW REPORT – FINAL

Prepared by:

Anare Matakiviti
Energy Advisor (SOPAC) – Suva, Fiji

&

Tan Pham
Consultant, Wellington, New Zealand

Document No. W1755-01 Rev 3

December 2003

Cataloguing in Publication data:

Matakiviti, A., Pham, T. 2003. Review of the 1993 Rural Electrification Policy. Review report – final.
(SOPAC Technical Report 368)

Note: A project for the Fiji Department of Energy

49 p.; 3 app.
ISSN: 1605-4377

1. electrical policy 2. Fiji

I. South Pacific Applied Geoscience Commission (SOPAC)
II. Author(s)
III. Series

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LIST OF ACRONYMS

CATD	Centre for Appropriate Technology & Development (Nadave, Fiji)
CPI	Consumer Price Index
DOE	Department of Energy (Fiji)
ESCAP	(UN) Economic and Social Commission for Asia and the Pacific
FDOE	see DOE
FEA	Fiji Electricity Authority
LV	Low Voltage (Reticulation)
O&M&R&R	Operations & Maintenance & Repairs & Replacement
OPRET	Office of the Promotion of Renewable Energy Technologies
PWD	Public Works Department
RE	Rural Electrification
REP	Rural Electrification Policy
RESCO	Renewable Energy Service Company
REU	Rural Electrification Unit

1.0 EXECUTIVE SUMMARY

This report, reviewing the 1993 Rural Electrification Policy (REP) has been prepared by Anare Matakiviti, an Energy Advisor of Suva, Fiji and Tan Pham, a consultant of Wellington, New Zealand for the Fijian Department of Energy (FDOE) with funding provided by the UN Economic and Social Commission for Asia and the Pacific (ESCAP). It has been prepared after extensive consultation, which started nearly 20 years ago. This is the first review of the 1993 REP.

The list of the key stakeholders involved in the Fijian Rural Electrification Programme electrification schemes consulted by the authors is given in Appendix I. The Terms of Reference are attached in Appendix II. The list of villages with installed rural electrification schemes is given as Appendix III.

The overall response of the key stakeholders is that the Rural Electrification Programme has been instrumental in the development of rural villages in Fiji and should be continued. However, improvements could be made to various aspects of the programme. Details of these improvements and our recommendations are discussed in the report. Our review has indicated that it would cost up to $35 million to complete the 499 schemes on the DOE's application-for-RE-scheme list. However, this figure would have to be increased to $41 million to include the upgrading of the pre-1993 schemes and to $43 million to include the maintenance of the schemes built since 1999 which are still within the 3-year grace period.

One major concern is the ongoing maintenance and capital replacement costs. Our review has shown that the annual savings by the villages, as proposed in the 1993 Rural Electrification Policy, are far from adequate for the 454 schemes already built. Before long, the same villages would turn to the government to ask for financial support to upgrade these schemes. This was not the original intent of the policy. Should this take place, which is highly likely, the government would have to consider forking out another $7.3 million to upgrade these schemes, on top of the $ 43million mentioned above.

In short, unless the ongoing maintenance and capital replacement fund is collected and saved, the Government will face a continuing bleed on its budget to support RE schemes in the years to come.

2.0 INTRODUCTION

The Fiji Government through the Department of Energy in the Ministry of Works and Energy has decided to review its 1993 Rural Electrification Policy (REP). The review is the first ever since the REP was promulgated in 1993 through a Cabinet decision. With a funding grant provided by the UN Economic and Social Commission for Asia and the Pacific (ESCAP), the review essentially looked at both the implementation mechanism and the institutional issues related to the policy and comes up with a revised REP policy with recommendations for improvements.

It is estimated that about 49%[1] of rural households have access to electricity. This leaves 51% still without electricity.

Taking 0.2 kWh/day (lighting only) as the entry level for electricity consumption for the average household, the potential demand for the electricity service in the rural areas is about 3 GWh per annum[2]. However if we increase the level of consumption to 2 kWh/day per household (which is a typical consumption for a Fijian rural household with TV, VCR Radio and a fridge of 60 kWh per month the potential demand for electricity in rural areas increases to 30 GWh/year. The above highlights the huge investments that need to be made in order to provide electricity to all the people in rural areas and this amount ranges from about $40 million to $140 million[3]. The above scenario demonstrates the great challenge facing government in its endeavour to provide electricity to the rural people. It follows that a rural electrification policy framework needs to look beyond the 1993 REP if it needs to expedite the provision of electricity to rural households. It is in the light of this challenge that the 1993 REP framework has been reviewed.

3.0 A BRIEF OVERVIEW OF THE FIJIAN ELECTRICITY SECTOR

In Fiji, the electricity sector is generally owned and operated by the Government. Except for small private owners especially in the tourism industry (island resorts) and the Vatukoula Emperor Gold Mine, Fiji Sugar Corporation and Tropikwoods, the provision of electricity both for urban and rural consumers has been undertaken by three Government institutions, the Department of Energy (DOE) through its Rural Electrification Unit (REU), Public Works Department (PWD) and the Fiji Electricity Authority (FEA).

[1] Population and housing census of 1996
[2] Source: Vega Luis 1999 – paper on RESCO
[3] Based on $5000 per kWh/day system, Vega, Bryant and Kumaran – Renewable Energy Service Companies for Rural Electrification in Fiji, 2001

The FEA, while operating also in Vanua Levu and Ovalau, is concentrates its supply services on Viti Levu where the bulk of its supply is provided by the Monasavu Hydro Electric Scheme[4]. FEA also operates a number of diesel-based generating power stations to supplement the Monasavu hydro scheme. In Vanua Levu and Ovalau, FEA focuses its operation on the main centers such as Labasa, Savusavu and Levuka and the means of supply are by diesel generators.

DOE, on the other hand, is responsible for the provision of electricity in areas that do not have access to FEA supply[5]. These are mainly the outer islands and remote villages and settlements in Viti Levu and Vanua Levu. These villages and settlements are provided with electricity through diesel schemes, small hydro schemes and solar home systems. In most cases these electricity schemes are operated and maintained by the villages/settlements themselves. Government, through DOE, assists these villages/settlements with their electricity schemes by subsidizing 90% of the capital cost.

PWD's involvement in the electricity sector is limited to the power supply systems of Government Stations. These Government Stations are basically Government administrative centres located in the rural areas. There are five such Government centers in Fiji namely, Nabouwalu in Bua, Waiyevo in Taveuni, Vunisea in Kadavu, Tubou in Lakeba and Malahaha in Rotuma. All the power supply systems in these Government stations are diesel-based except for Nabouwalu which has a hybrid power system that consists of a combination of diesel, wind and solar.

A good description of the electricity sector in Fiji can be found in Reference 1 (Vega, Bryant & Kumaran, 2001).

4.0 RURAL ELECTRIFICATION POLICY FRAMEWORK 1993

The provision of electricity to the rural areas has always been high priority on successive governments' development programmes. Prior to 1993 the government rural electrification programmes had always been the responsibility of PWD. Villages and settlements requiring electricity had little choice but to have a diesel scheme. The then government endorsed a Rural Electrification Policy in 1993, which aimed at streamlining the provision of electricity services into the rural areas. The choices available to rural people are much broader as they are now provided with five options to choose from. The electrification options available under the 1993 policy framework included:

[4] According to the FEA 1999 Annual Report, 81% of Fiji's electricity needs were supplied by the Monasavu Hydro scheme.

(a) diesel scheme;
(b) distributed solar scheme;
(c) focal solar scheme;
(d) hydro scheme;
(e) connection to the FEA grid; and
(f) connection to a Government power supply system.

Together with the endorsement of the 1993 policy framework, was the decision to shift the responsibility of planning and implementation of the Government rural electrification programme from PWD to DOE. In assuming this new role DOE was mandated to establish a Rural Electrification Unit (REU) for the purpose of implementing the 1993 Rural Electrification Policy. This Unit, is yet to have staff in position. DOE, since 1994, has been implementing the policy framework by seconding one of its senior staff to implement and manage the rural electrification programme. It should be pointed out that the REU, under budgeted and without the necessary staff, has accomplished much over the 10-year period as illustrated in Figure 1.

The list of applicants (Reference 4) shows the total number of 953 applicants since 1993. The earliest was dated 11 November 1993 and the latest was dated as 21 December 2002. It is not clear if this list is up to date. Of the 953 applicants, 561 schemes have been installed or are scheduled for installation, leaving 392 applicants to be considered for assistance and implementation by DOE.

Table 1 shows the breakdown of the types of schemes elected by the applicants:

Table 1. Schemes as Elected by Applicants 1993-2002.

Schemes	**No. Applied for 1993-2002**
Diesel	192 (20%)
FEA	682 (72%)
Solar	40 (4%)
Hydro	27 (3%)
Unspecified[6]	12 (1%)
Total	953

[5] By definition, DOE through the 1993 Rural Electrification Policy can provide assistance to any rural community as long as it is outside the gazetted boundary of a township.
[6] Refers to applicants that do not specify the type of scheme requested for.

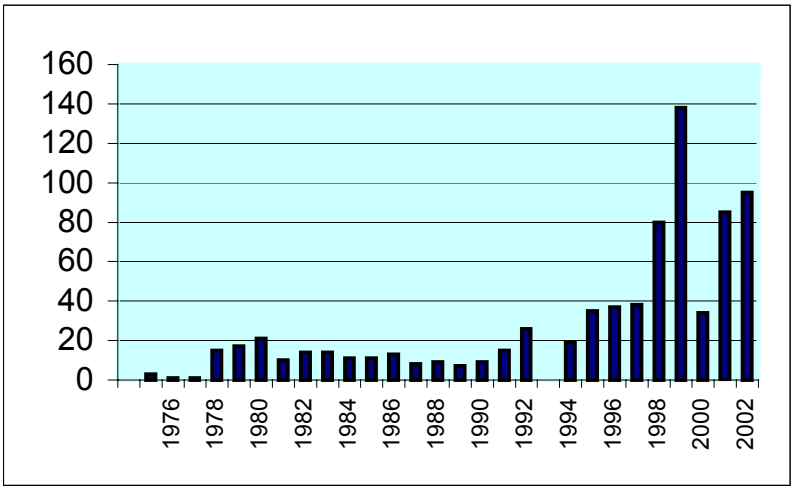
It was interesting to note that the largest percentage of preference for rural electrification (RE) schemes was for FEA grid connection. This fact may reflect the desire of the applicants for a continuous 24-hour supply of electricity and their preference for not having to operate and maintain the electrical network. In practice, there are more diesel schemes installed as shown in Table 2 (data from Reference 2).

Table 2. Number of Rural Electrification Schemes Installed 1975-2002.

	From 1975 to 1992	From 1994 to 2002	From 1994 to 2000
Total number of schemes	**205**[7]	**562**	**381**
Diesel	205	282 (50%)	197 (52%)
FEA	0	260 (46%)	164(43%)
Solar	0	13 (2%)	13 (3%)
Hydro	0	5 (1%)	5 (1%)
Hybrid (Govt. stations)	0	2	2 (1%)
Total No. of Consumers	7 745	25 000	17 000
Total kVA	2 965	?	?
kVA per Consumer	0.38	?	?
Average Number of Consumers per Scheme	38	45	45

Reference 5 shows 454 schemes (instead of 562 in Table 2) have been installed out of which 219 are diesel schemes and 213 are FEA schemes (instead of 282 and 197 respectively in Table 2).

The number of RE schemes installed on an annual basis is shown in Figure 1 (data taken from Reference 2).



[7] One DOE list shows 203, the other 205. 205 includes Visoto and Lau/Feavai villages. Ref 6 shows 165 schemes completed between 1974 and 1992 (164 diesel schemes and 1 hydro scheme) and not 205.

The figure shows a significant increase of rural electrification schemes since the 1993 REP came into effect. On average, the number of schemes per annum increased 4-fold from 11 schemes per year from 1975-1992 to 48 schemes from 1993-2002.

In terms of cost, Table 3 shows the estimated cost as provided by PWD and FEA from materials supplied by FDOE (Reference 3) as follows:

Table 3. Cost of Rural Electrification Schemes.

		1999	2000	2001	2002	2003	Total
Diesel	Total Project Cost	$5m	$3.36m	$4.69m	$5.65m	-	$18.7m
	Number of Schemes	112	62	92	109		
	Average Cost per Scheme	$44 643	$54 194	$53 152	$51 835		
	Assume 40 Consumers per Scheme. No of Consumers	4480	2480	3680	4360		
	Average Cost per Consumer	$1116	$1355	$1,329	$1296		
	Total Cost				$2.72m	$1.4m	$4.12m
FEA	Number of Schemes				27	15	
	Average Cost per Scheme				$100 849	$93 294	
	No. of Consumers				601	591	
	Average Cost per Consumer				$4531	$2368	
Aid-Funded 1998-2000 (Solar schemes include local costs)	Total Cost	$1.08m	$176 516		$207 751		$1.46m
	Total number of schemes	170	63		83		1929
Aid Funded Hydro Schemes	Total Costs (include foreign and local)	528 000					528 000
	Total Number of Schemes	3					3

Within the above setting, the findings and recommendations of the review are presented next. Text from the TOR is included (in italics) to provide context to our comments.

5.0 FINDINGS AND RECOMMENDATIONS

5.1 *Review the 1993 Rural Electrification Policy (REP) and make recommendations, in particular the:*

- *the overall objective of providing 24 hours electricity to the rural areas and its effectiveness, recommending ways to improve the possibility of achieving the overall objective but being mindful of the economic and financial capabilities of both Government and the rural people,*

In our view, *"providing electricity to the rural areas for 24 hours"* is a means to an end and should not be stated as a goal or objective. Stating this may reflect what the local people want but what they want may not be affordable or necessary from the national perspective.

We believe that the goal of rural electrification should be stated in terms of social and economic developments of rural Fiji. A possible statement for such a goal could be: *the goal of rural electrification in Fiji is to provide electricity to rural communities to assist their development both socially and economically*. This goal should be implemented with a strong emphasis on:

- self-sufficiency;
- affordability;
- sustainability;
- energy conservation/efficiency;
- renewable alternatives; and
- and environmental sustainability.

As further explained below, we do not believe that *"providing electricity to the rural areas for 24 hours"* is an effective goal and should not be stated in the revised policy.

We note that that the principles of the 1993 REP are:

- consistency;
- choice;
- sustainability;
- user pays;
- minimise cost to consumer;
- accountability;
- maximising coverage; and
- transition policy.

As far as we can ascertain, these principles have been generally followed but we note the following:

Consistency: in principle, we agree that all applicants should be treated equitably in so far as their application will be given the same consideration, offered the same choice of electricity supply and having the same rules applied. In practice, this principle can give rise to confusion, for example:

i) Unless the applicants pay the deposit, they will not get to the list of schemes to be considered for implementation.
ii) Once they get to the list, it will be first-come-first-serve, so there is no "equitable treatment".
iii) Table 1 shows that most applicants, while preferring FEA connections, ended up with diesel schemes (see Table 2).

Choice: the 1993 REP states that rural consumers will choose the form of electricity. For a number of reasons given below, we believe that this principle and consistency principles be removed from the revised policy:

(i) As explained above, in reality, the rural consumers do not have as much choice as the policy implies.
(ii) The rural consumers may not be able to make an informed choice given their limited technical and financial understanding of the wider picture of the energy sector.
(iii) With the emphasis on renewable energy by the DOE, rural consumers should be encouraged to use renewable energy.
(iv) Aid donors may not always be prepared to build the schemes that the rural consumers want.

It would be better to replace these two principles with suitable wording that expresses the policy's intention of giving all applicants equal consideration. The wording would also say that while applicants will be given an opportunity to express their choice of the form of electricity supply, they may not get what they choose. This wording could be built into the rural electrification scheme application form and not necessarily in the policy.

Sustainability: we agree with this principle but not with the expression that "*electricity will be permanent"* in the 1993 REP for two simple reasons that:

(i) who will be responsible if it is not; and
(ii) what if it becomes uneconomic to support the scheme?

Reference 6 shows that all of the existing schemes (309 diesel schemes, Table 2) will require financial support from the government to keep them from mechanical failure and thus

"*impermanent*". Sustainability should be expressed in the form of financial and environmental sustainability for the life of the scheme and not in "*permanent*" terms.

User pays: we agree with this principle. It should be emphasised and be made clear to the rural consumers that they would have to be paying for the O&M&R&R (operations, maintenance, repairs and future capital replacement) costs of the scheme. The government will pay 90% of the initial capital cost but will not subsidise the recurrent O&M&R&R cost. This is a very important point and should be emphasised in the policy. This could be done by including suitable wordings in the application form so that when the applicants sign the form, they will have to agree to this requirement.

Minimise cost to consumer: the description in the 1993 REP that "*assistance will be given in the provision of maintenance and repair facilities to encourage consumers to care for their electricity system"* can create the wrong impression that the government will help to maintain the scheme indefinitely. Reference 6 has certainly confirmed the situation where most rural consumers have not been able to collect enough funds for the maintenance. Reference 6 also pointed out that the government has not made adequate budgetary provisions budgets to meet its commitments under the pre-1993 policy and, within the 3-year grace period, under the 1993 REP.

We recommend that this principle be modified in the revised policy. We should mention that the schemes that are selected under the revised policy should be the most economic, based on life-cycle costing, so by implication, these will offer minimum cost to the consumers

Accountability: we agree with this principle. This will be further discussed under the section on the proposed structure of the DOE

Maximising coverage: we agree with this principle.

The DOE used the $ 3,500 per consumer for FEA schemes as the maximum support level. Additional costs would have to be paid for by the consumers themselves. Because of this ceiling, there are cases when the consumers would have to pay more than the 10% contribution. The $3,500 ceiling provides an effective means of ensuring funds are available for other schemes. However, at this stage, we have not been able to establish the rationale for $3,500.

Transition Policy: this may have made sense in 1993 to separate the schemes installed pre-1993 but should be discontinued in the revised policy. It has caused confusion in terms of government involvement (Reference 6) and the inclusion of this principle in the revised policy would create a 3rd

tier of transition i.e. from schemes implemented in 1993 to those yet to be implemented under the revised 2003 REP.

As to whether the 1993 REP was effective, it is difficult to make a full assessment because:

(i) there were no key performance indicators in the 1993 REP to be used to measure the scheme's effectiveness;

(ii) the REU structure, as proposed in the 1993 REP, never eventuated. However, it could be argued that resources that were supposed to be provided to the REU had been provided by the PWD;

(iii) the full annual budget of $6 m (1993 dollars) supposedly for allocation to the DOE to implement the 1993 REP never eventuated. In fact, only $18.2 m over 8 years, or $2.27 m per annum (Reference 5) was allocated. This worked out to be an allocation of $ 40 000 per scheme; and

(iv) The maintenance budget for the 3-year grace period for the schemes built under the 1993 REP also has never been allocated (Reference 6).

Under these severe constraints, the DOE via a defacto REU still managed to successfully implement about half of the 1000 schemes original planned for, under the 1993 REP. This, combined with the positive comments made by the stakeholders during our survey, demonstrated to us that the policy was well implemented within the limited resources made available.

However, the long-term objective of the 1993 REP of providing 24-hour continuous electricity supply has only been met by less than 50% of the schemes. As shown on Table 2, just about all diesel schemes, while able to provide 24-hour supply, have rarely been operated on a 24-hour continuous basis. The low monthly collection of fees does not allow the local communities to pay for the diesel required.

We believe that for the REP's goal to be effective, the REP should be implemented in conjunction with other government agencies such as the Ministry of Fijian Affairs, Ministry of Regional Development, etc, to incorporate other rural programmes including capacity building and institutional strengthening of local rural communities. REP should not be implemented in isolation. From our consultation, the key stakeholders in these Ministries stated strongly that RE, or for that matter, other infrastructure projects, should not be implemented until the local leadership has been trained and the capacity of the local community strengthened.

We support this position.

We note that many of the rural programmes are for Fijian villages and do not necessarily cover other settlements and other communities. Similarly, these rural electrification programmes do not cover all communities. To correct for this, we recommend that the DOE set in place a training programme that is applicable to all communities. This can be done under the Power Division by the PR (or Information) Officer (see Figure 2).

5.2 options of Electrification offered under the policy i.e. review the various options of electrification in view of the technological and institutional (RESCO for solar schemes) changes over the years,

The 1993 REP provides 6 options:

- centralised diesel;
- distributed solar lighting for each household/school/hall etc;
- focal point solar lighting at community focal points such as a community halls;
- FEA grid connection;
- connection from a centralised generating plant; and
- centralised hydro.

Materials supplied by DOE (References 2, 4) have shown that all of these options have been selected (see Tables 1 and 2). We note that, of the forty (40) solar schemes shown on Table 1, eleven (11) are focal point solar lighting schemes.

There are also various combinations of schemes.

For example, the DOE lists show a breakdown of the 250 FEA schemes (Table 2) into 59 FEA, 38 FEA/W, 7 FEA/HW, 78 FEA (GE/HW), 16 (GE) and 55 HW where HW = house wiring, W = wiring, GE = grid extension. FEA/W schemes are for wiring works only. The houses may be close to an existing line or the villages had paid for their own extension. The true FEA grid connection schemes are only 153 (59+78+16) or 50% of those listed.

Similarly, the Nabouwalu scheme funded by the government of Japan is a wind – solar – diesel hybrid.

At this stage, we believe that the current options are still applicable but the revised policy could add:

- wind;
- wind-solar hybrid;

- wind-diesel hybrid; and
- solar-diesel hybrid.

We note that many of the diesel RE schemes are for lighting only and run say 4 to 5 hours a day (mostly at night and early morning). In cases, where power is required during the day, such as schools, it may not be economic to run the diesel generator. In these cases, it is possible to provide batteries to be charged during the hours when the diesel generator is operating. The batteries would then be used during the day when required. The same principle can be used with solar or wind schemes. We could include another option to be called diesel-battery hybrid for this example.

There are other technologies such as wave/tidal power, geothermal, co-generation and biomass. We have decided not to include these in the revised policy because either the technology is relatively new and sophisticated for rural Fiji (wave/tidal power) or require a high level of skills, costs and labour input for operation and maintenance (geothermal, co-generation, biomass) that would be difficult to obtain. The report by Kingston Morrison on steam co-generation plants in Fiji (Reference 10) in 1999 painted a very poor picture of the sustainability of steam co-generation plants for similar reasons.

a) For reasons explained in the discussion of the **Choice** principle, we are not sure if it is a good idea to offer rural consumers choice. The 1993 REP states that "*the village/settlement may now make a choice of the type of electricity scheme they wish to have – The village/settlement will own its scheme"*. This is essentially saying to the village/settlement that "here are the options of the RE schemes that you can have, make a selection and the government will give it to you". In practice, the government do not always give to the rural consumers what they choose and the rural consumers, from our consultation, still believe that the schemes are owned by the government and the government should come and fix them up when they break down.

For long-term sustainability and self-sufficiency, it would be better to ask the rural consumers for what and why they need electricity – lighting? for schools? for freezers to keep fish? etc. and what they are prepared to contribute towards meeting those needs (financial contribution, labour input, ongoing fee collection, maintenance etc). It is crucial that government work with communities from the outset to decide which is the most suitable choice (diesel, FEA, hydro, solar, etc).

The government must clearly emphasise from the beginning that its contribution is an investment and that government expects communities to fulfil their side of the obligations in return. This would put a different emphasis on the RE options and how they are presented in the revised policy. Put

simply, the REP policy focus should be “Government Invests in Electricity” not “Government Provides Electricity” as is the case at present.

5.3 the current Government subsidy level being mindful of the Government’s economic projections for the next 10-20 years and taking into account the income levels of the rural people and the Consumer Price Index (CPI) during the same period,

Prior to 1993 REP, rural electrification schemes in Fiji were based on a 2/3 contribution from the government and 1/3 (or 33%) from the local community. Under this arrangement the government owned the schemes and maintained them (Reference 6). (We note that this 2/3 to 1/3 subsidy ratio is common to most community projects in Fiji). Under the 1993 REP, the 33% contribution from the local communities is reduced to 10%. The difference is that the government would maintain the schemes only for the first 3 years, after that the ownership of schemes would be transferred to the local communities who would be responsible for the operations, maintenance and replacement. This arrangement does not apply to FEA grid schemes or government station connections.

In practice, we have found that neither the 33% nor 10% subsidy level has worked. Just about all of the schemes built before 1993 now need funding from the government for upgrade or replacement. A number of them simply cease to function as the equipment reaches the end of its useful life and the local communities have not been able to save or raise enough funds to replace them[8]. Other schemes built after 1993 require a lot of maintenance to keep them going. The bulk of these maintenance costs are expected to be paid for by the government. There are a number of reasons for this.

(i) Inadequate levies were set to cover maintenance cost. $100 per annum (Reference 6) (increased to $440 in 1993 REP) is barely adequate. Maintenance cost is normally between 1.5 and 3 % of the initial capital cost. At $70 000 per scheme, this works out to be between $1050 and $2100 per annum.

(ii) Levies were set incorrectly in the 1993 REP and proved to be inadequate (refer 5.8 *sustaining of schemes*). For diesel schemes, we have found that money is collected by the local villages just enough to pay for the fuel without any savings for maintenance and replacement.

(iii) There is no budget for maintenance of schemes in the 3-year grace period (Reference 6). This was confirmed during our discussion with the National Planning.

[8] It should be noted that before 1993, the schemes were essentially owned by the government and the local communities have expected the government to carry out the repairs and keep them operational.

In our discussion with the key stakeholders, most thought 10% should be maintained but they make a number of interesting observations.

(i) The contribution from the villages/settlements is treated as a separate fund from the budget that is used to build the scheme. Interest accrued on this fund helps to reduce the government contribution assuming that the cost of the scheme stays the same.

For example, a scheme may cost $ 50,000. The contribution from the village concerned would be $ 5,000. This is deposited in an account that will then say after 2 years at 3% interest would amount to $ 5,304. Assuming construction takes 3 months. After 21 months, the government provides $ 50,000 for the scheme and the scheme is built at exactly $ 50,000. Effectively, the government gains $ 304 interest.

(ii) There is a perception that the records of the village/settlement contributions such as who paid what and when and how long they have to wait, are well kept. There was no suggestion of funding misappropriation.

Using Table 1 as a guide and assuming that there are 392 applicants who have paid the 10% contribution then there is a large sum of money that has been contributed of between $1 and $3m over the years.

So before we address the issue of whether 10% contribution is adequate, we need to look at why the REP requires a contribution from the local communities? There are basically two reasons:

(i) To help ease the financial burden on the government.
(ii) To ensure that the local communities take the scheme seriously and are committed to it.

However, there is a third reason by implication that the reduction of 23% (from 33% pre-1993 to 10% post 1993) is the same as the maintenance and replacement cost during the life of the scheme beyond the 3-year grace period.

We recommend that the new policy maintains the 10% contribution plus 5% as a deposit for future capital replacement. This is to ensure that the local communities are committed to the schemes and feel responsible for the scheme's O&M&R&R. We do not see any need to increase the 10%. As will be illustrated later, the main financial contribution to the scheme sustainability would come from the monthly fees.

In cases where the communities are unable to afford the contribution, it may be argued that the revised policy should include a "lifeline" subsidy. We do not agree with this position for the simple reason that it would be very difficult to administer (how would DOE determine which applicants are in the "lifeline subsidy" category?). Furthermore, such "lifeline subsidy" would give rise to complaints, political interference and is likely to consume a lot of resources from the DOE unproductively.

It should be pointed out that the 5% deposit only applies to stand-alone schemes or grid-extension schemes, since the tariff will cover O&M&R&R costs, there is no need for the 5% contribution but the 10% still applies.

5.4 Construction and costing of schemes (projects) of all options, offered in the existing REP. On a technical level, to re-look at the design templates used currently by the Department for the various scheme/options (particularly for solar and diesel schemes) and identify areas where efficiency gains can be accrued. Also to establish and ensure the scheme compatibility in terms of LV reticulation for both diesel and grid connected schemes (which is to be in accordance with the relevant FEA and AS/NZ 3000/2000 standards),

The scope of this review has not allowed for a detailed costing of 10 different RE schemes mentioned earlier (from diesel to solar-wind hybrid) nor to carry out a detailed review of the design templates used and the diesel/grid scheme compatibility. However, using the estimates from materials provided by the DOE, the following sums give some ideas of the order of magnitude involved. However, we would like to note that the costing for the hydro scheme may be grossly understated. One of the consultants to this project was involved with the planning of one of the hydro schemes listed as constructed under the 1993 policy framework. The particular hydro scheme costs more like F$800 000.00 to build.

Table 4. Estimated Cost of RE Schemes to be Built Excluding Maintenance Budget.

	Total No.	**Estimated cost per scheme. Assumed 40 consumers per scheme (from Table 3)**	**Total Project Cost**
Total number of schemes on the applicant list	953		
No. of schemes already completed since 1993	454		
Schemes yet to be built	499		
Assuming 50% of these are diesel (based on statistics from Table 2)	249	$ 50 000	$ 1 245 0000
Assuming 40% are FEA	200	$ 90 000	$ 18 000 000
10% are solar, hydro etc (based on $ 2500 per consumer)	50	$ 100 000	$ 5 000 000
		TOTAL	**$ 35 450 000**

Existing schemes will also need funding for upgrading and maintenance. The cost of upgrading 165 pre-1993 schemes (Reference 6), at $35 000 per project would be $5 775 000. $35 000 or 70% of the new diesel scheme at $50 000 each is not an unreasonable estimate. As all pre-1993 schemes would now be between 10 and 30 years old where most of the engines and generators have reached the end of their useful life but not the cable or household wiring hence the cost would not be the same as a new scheme.

Note that these budget numbers:

- have not included the maintenance cost covering the 3-year grace period under the 1993 REP. For those schemes built since 1999 which are numbered in Reference 2 at 352 (Reference 6 numbers 380 schemes). At between $1500 to $2000 per scheme per annum, this would cost up to:

  $ 704 000 in 2003

  $ 428 000 in 2004

  $ 360 000 in 2005

  $ 190 000 in 2006

- have assumed that the local communities would collect enough fees to maintain and replace aging equipment.

If the second assumption is wrong, as has been the case until now, then the government would have to look at continuing the programme with similar order of funding in the next 20 years or more.

In summary, the estimates are:

To build 499 schemes	$35 million
To upgrade 165 pre-1993 schemes	$6 million
To maintain schemes since 1999	$1.7 million
TOTAL	$42.7 million say $43 million

So we would be looking at a total capital requirement of **$ 43m** to complete the RE schemes on the applicant list and upgrade the pre-1993 schemes. The 1993 REP had proposed $ 6m per annum for the RE projects and for this level of finding it would take another 7 years to complete the RE programme.

Again, note that if the second assumption mentioned above is wrong (as proven), then the government would have to look at continuing the programme with an additional $7.3 m (209 schemes from 1994 to 1999 (= 561 less 352) at $35 000 upgrade per scheme) on top of the $40 million to a total of $50 million.

The maximum scope of equipment allowed in the current policy is adequate. All options provide the basic lighting facilities needed for the household. The addition of a General Purpose Outlet (GPO) for diesel, hydro and FEA schemes provides the opportunity for more affluent households to optimise on the use of available electricity. Similarly, for a solar scheme, a DC power outlet allows for the use of a radio – an item that is common amongst rural households. We do however recommend that to assist with the collection of fees charged by the village RE Committee a prepayment meter, where appropriate, be included in the scope of equipment. Although this is going to increase the capital cost, we feel this will be a worthwhile investment as the collection of fees is one of the most problematic areas highlighted from our community surveys.

We note that energy pre-payment meters such as the Cash-power 2000 (at about $200 per meter plus computer and software) are expensive. The system is also very sophisticated and should not be used unless there is sufficient number of consumers (over say 200) to warrant its use. We also note that the use of prepayment meters is in line with the current policy adopted by FEA for its rural consumers and will facilitate the transition from being an intermittent scheme to a 24-hour continuous scheme. The day pre-payment meters are appropriate for solar schemes as is the current practice adopted by DOE.

5.5 Operation of schemes in terms of procedures followed or not by village operators to operate their schemes as per the acceptable standards and their familiarity/knowledge with their system particularly the renewable energy systems,

The operators of the schemes we visited have not filled in the logbooks as required. The main reason for this appears to be because the operators do not see any value in filling in the logbook and equally there has been no consistent monitoring whether the operators are carrying out the correct procedure for operation of the scheme. To encourage the operator to follow proper operational procedure, we recommend that all stand-alone RE schemes (i.e. those are not grid connected, such as FEA schemes) should be licensed. The licensing of a rural electrification scheme conforms to the current Electricity Act. The licensing would give the DOE the authority to carry out annual inspection thus ensuring safety, financial and the local communities carry out maintenance practices. Without such requirement, there is no direct mechanism for the DOE to carry out its duty effectively. While the licensing process may add additional cost to the DOE, this

can be minimised by the DOE appointing a local registered electrician to carry out the inspection on its behalf.

5.6 Maintenance of schemes in terms of the additional training requirements needed by the recipients to properly maintain their schemes. This would involve reviewing of current training programme sponsored by DOE at CATD to determine if it meets its desired output of allowing operators to successfully carry out basic maintenance to their schemes or whether any additional barriers exists that hamper villages to undertake maintenance of their schemes should also be identified and the remedies proposed. Questions like - are the projects maintained properly according to requirements and are the operators capable of carrying out basic maintenance should be addressed here.

The community should be responsible for the maintenance of the scheme as they are the asset (scheme) owner. There are two levels of maintenance; the low-level maintenance which basically covers routine maintenance (oil and filter change) can be done by the village operator after undergoing training, and the major maintenance work that requires high-level skills. The community will need to contract out.

We found out in our community consultation that training is sporadic and inconsistent. In some cases training was not provided until one year after commissioning. We recommend that training involving low-level technical skills such as oil and filter change, cleaning of solar panels, checking battery connections, etc together with the operation procedures of the system be provided by the contractor that designs and builds it prior to commissioning. This training is to be supplemented by the more formal training usually organised by DOE for village operators. The village should contract out major overhaul or replacement of equipment that requires high-level technical skills and occurs infrequently.

We feel the level of skills covered in the current DOE-sponsored training programme for diesel scheme operators are adequate. We do not expect operators to be trained as mechanics or electricians; however, we would like to point out that it is imperative for operators to understand the basic operation and maintenance procedures including maintaining proper records.

One major problem that is faced by the communities is the loss of trained personnel. Most tend to be young males who would move to Suva or other bigger centres in search for jobs etc. Not getting paid for their job as the electricity operator in the village does not help. It is important that the DOE and contractor select the people carefully and if in doubt, train more people than required.

Preference should be given to older, mature people with some technical skills. Where possible, encourage the communities to pay them.

We note that very little training is provided to hydro operators. This is probably due to the nature of the technology. Hydro technology requires special training and an option that can be considered is the assistance of FEA to provide training. The training can be in the form of short-term attachments in its small hydro scheme in Savusavu. Another option is for DOE to sponsor (or seek sponsorship for) village operators to attend the "TCDC Training Course on Small Hydro Power" at the Hangzhou Regional Center for SHP, Hangzhou, China.

An important component of the training that we feel is lacking, is on the management of the schemes. A rural electrification scheme being a development project requiring technical skills will require a well-coordinated management system in place such as recording fuel consumption, kWh generated or battery age and maintenance history etc. Most villages unfortunately have their development projects fail due to the lack of management skills.

5.7 grace period for maintaining and servicing of schemes, in terms of its applicability and relevancy, e.g. evaluation of adequateness of current grace period timeframe, the adequacy of the existing levied amount to the villages under grace period, and its addressing of the transition arrangements as proposed in 1993 policy,

We feel that there should be no grace period given. The grace period appears to perpetuate the "dependency syndrome" and that government should continue looking after the maintenance of the scheme. The current 3-year grace period is not working, as most communities have not been able to pay for the maintenance cost after 3 years. The $100 per year contribution by the villagers for 2 trip maintenance trips of pre-1993 schemes is too small. According to the PWD, a 5-day trip to the villages would cost at least $500 per person to cover the wages and allowance let alone materials and transport costs. We discuss this in more detail later. For now, we recommend that the scheme becomes the property of the community from the day it is commissioned and the grace period be abolished and replaced by the maintenance timetable required by the manufacturers of the schemes involved. For example, for a diesel scheme, a major overhaul will not be needed until the engine has operated for 4000 hours. If the scheme operates at four hours a day the engine will not require overhaul until it has operated for at least three years. In other words there should be little maintenance required that needs DOE involvement in the first three years. Having the asset belonging to the Government and maintained by them in the grace period would encourage dependency from the village

Similarly, for solar schemes, the batteries may need regular check-ups to be done by a local community member but after 2 to 4 years; the batteries may need to be replaced. At that point, there should be enough funds saved by the village concerned to purchase and replace.

However, to ensure that the local communities can "walk before they run", funds should be set aside for DOE (or its Contractor) to visit the communities say at 1, 3, 6, 9 and 12 months after commissioning. After that, the DOE (or its contractor) would make an annual or bi-annual visit. The cost of the first year visits (5 visits) should be built into the project cost whereby the applicants would contribute 10%. We would call this as the "support during the defect liability period" and not a grace period.

5.8 Sustaining of schemes – evaluation in terms of it meeting or failing its intended outcome and the appropriate remedying mechanism. The evaluation would involve studying of the existing formula used to determine the sustaining cost and making required adjustments where necessary to ensure intended outcome is met. Given the current arrangement (under the 1993 REP), are the communities able to sustain the running of schemes without financial assistance from the Government should be considered here. Issues in respect to the replacement of schemes and the training in terms of capacity building for the management of schemes at village levels should also be considered. On a broader perspective, consider the need or other means of mobilizing NGOs and other Government Departments to further effect village level electrification to another level – that is for socio-economic development as well,

The 1993 REP requires the local community to establish a sustaining fund with a commercial bank account. The idea is that the community would regularly collect funds and pay into this account to meet future sustaining expenditure. From our community survey we found out that many villages/settlements do not have a rural electrification sustaining account.

The 1993 REP define sustaining expenditure as the sum of replacement and maintenance costs. Operation costs in terms of operator wages etc. are assumed to be negligible.

The methodology used is acceptable but not quite correct mainly because of the assumptions used. Let's review the example where the total monthly contribution payment for a solar scheme is calculated. This example shows a total cost for a solar scheme at $ 1,420 (1993 dollars) and calculates a monthly contribution of $6.35 or $ 76 per annum. This means that it would take 18.6 years to pay back the initial investment. This is too long for a solar scheme. In fact, if the household concerned has faithfully saved $ 6.35 per month over the last 10 years and earning

0.25% per month compounding, they would have only saved $887.4 (2003 dollars). This is far from enough to replace his solar equipment that would cost him up to $2500. (A typical solar system would cost about A$1700 ex Australia, adding tax, transport, profit margin for importer etc would take this up to about $2500).

There are a number of assumptions that need to be changed:

(i) The life of a solar panel should be shorter than 20 years. It would be better to have a conservative assumption given the difficult marine environment and the likely lack of maintenance in actual application. A 10-year life should be assumed.

(ii) The use of future value being the actual cost at the time the scheme is installed in the calculation in the 1993 REP is incorrect.

The formula used in 1993 REP is:

Monthly payment = Future value*i/((1+i)*(1+i)^n –1)

This formula is incorrect for use to calculate the monthly payments (or an annuity). The correct formula is:

Monthly payments = Present value*i*(1+i)^n/((1+i)^n-1)

Since Future value = Present value*(1+i)^n

The above formula can be rewritten as:

Monthly payments = Future value*i/((1+i)^n-1)

The mistake in the 1993 REP is the inclusion of (1+i) at the denominator and applying present value instead of future value in the equation for the calculations.

(iii) To ensure that inflation would not erode the purchasing power, it is important that a suitable saving bank account be opened that earns interest above inflation rate. Given the uncertainties around the assumptions, we recommend a 10% margin be added to the calculation of the monthly contribution.

For the same example and adopting the above changes but with a shorter battery life of 4 years and an annual interest rate of 4% :–

the yearly contribution = $188.77

monthly contribution = $ 15.73

add 10% to produce = $ 17.30 per month and not $ 6.35 as estimated in the 1993 REP.

Ten years after 1993, if $17.3 were collected monthly, the householder would have saved $2548 which should be enough for a new panel costing about $2500.

(The calculation can be done simply in EXEL as follows: for a solar panel of $1000 (1993 dollars), 10 years and annual interest rate of 3%, use formula in EXEL, PMT (3%,10 yrs, 1000) = $ 117.2 per year and so on). $2548 comes from EXEL, FV (0.25%,120, $17.3).

Similarly, the example used for the diesel scheme in the 1993 REP that shows a monthly contribution of $51.36 for replacement and $158.69 for upholding is incorrect. A monthly payment of $51.36 for 10 years from 1993 at 3% interest would only amount to $7065 in 2003 dollars. This is far from enough given that the estimated upgrade cost is $35 000 per scheme and the cost of a new diesel scheme is about $50 000 or a new small genset costs about $22 000. The reasons for this discrepancy are the same as those given to the solar scheme.

If we apply the correct procedure as outlined above and use a shorter life (which is more realistic) of 20 yrs for the powerhouse, 15 yrs for the genset and 30 yrs for the underground cabling, then at 4% interest, the monthly contribution for the replacement would be $191.28. If the village concerned has been able to collect this amount per month for the last 10 years, it would have saved over $ 26,000 in 2003. Similarly, the monthly upholding cost would be $179.19 giving a total of $370.46 per month for sustaining cost. For a village of 40 households, this works out to be $ 10 per month including the recommended 10% or **$ 2.35 per week** per household.

It is interesting to note that these calculations have **not included fuel costs**. In our consultation, a number of villages simply collect the money at about $ 2 per week per household for diesel whereas this should be set aside for sustaining expenditure. Fuel cost is a lot higher; the following example would illustrate this:

Household consumption	200 Wh per day (2 x 20 W lights for 5 hrs)
Consumption per week 7days	1400 Wh
Small genset fuel efficiency	0.45 litre per kWh
Expected fuel consumption per household per week	0.63 litre
Cost of diesel per litre	$1.5 (outer islands)
Fuel cost per household per week	$0.94

In other words, an average household would need to contribute **$3.3 per week** to meet the sustainability of a diesel scheme.

In ensuring that the scheme is sustainable there are two main issues to take into account. The first, is as recommended in the current policy, is the establishment of a sustaining account. We believe that this is a good idea however; from our community survey we observe that many villages do not have a sustaining account established. To ensure that the village/settlement has a pool of funds for sustaining their rural electrification scheme, we recommend that the account be established prior to the construction of the scheme.

We further suggest that an amount equal to half of the 10% of the village/settlement capital contribution be used for this purpose and DOE should assist in establishing a fixed-term account in a commercial bank. The recommended term is ten years being about the conservative lifetime of the engine. DOE's signature will also be an authority for the account. We note that the outcome of the current Financial Management Reform will decide how the account should be operated.

The second point is training and this is covered in our recommendation at 5.6. We also need to highlight here the general principle and direction, taken by the Ministries of Regional Development and Fijian Affairs. These ministries want to provide leadership training and capacity strengthening of the village recipients of a scheme prior to any infrastructure implementation. Rural Electrification should be implemented using the same approach.

In the examples above, the initial contribution would be as follows:

Solar schemes (1993 dollars)	
Initial capital cost per household	$1420
No. of households per village/settlement	40
Total capital investment	$56 800
10% contribution to capital (go to government)	$5600
5% contribution to sustaining account owned by village	$2800
After 10 years at 4% interest per year, this amounts to	$4204
Percentage of this saving in terms of new replacement scheme at $ 3000 per household	3.5%

Diesel schemes (1993 dollars)	
Total capital investment	$30 000
10% contribution to capital (go to government)	$3000
5% contribution to sustaining account owned by village	$1500
After 10 years at 4% interest per year, this amounts to	$2204
Percentage of this saving in terms of new replacement scheme at $ 50 000	4.4%

The example illustrates that the bulk of the savings used for sustainability would come from regular monthly collections. However, the initial 5% contribution would ensure that a sustaining account be opened. This, if anything, is a significant step toward making the local communities committed to savings for sustainability.

In short, we do not believe that the schemes under the 1993 REP would be financially sustainable unless more funds are collected and additional budgetary allocations be made available to carry out timely maintenance and upgrade.

5.9 Extensions or upgrading of existing schemes – determine if current terms and conditions for extensions or upgrading of schemes are appropriate and also evaluate and develop mechanisms to amalgamate the pre 1993 REP operational schemes into the 1993 REP framework in the best appropriate manner,

a) From community consultations it was found that many people were confused with regard to the upgrading, extension and or the maintenance of schemes. We believe the existence of the 1973 RE Policy as allowed under the existing RE Policy as the main reason for this confusion. To avoid such confusion, we recommend that a survey of the all the schemes should be carried out to find the latest status covering technical (what make, size, number of consumers, conditions etc.), financial (are there any funds from the communities, if so how much and where's it kept) and institutional (who is looking after the scheme, how many operators, level of technical skills etc.) aspects. The current database that we have obtained from the DOE does not have these details.

   Once the survey of the schemes has been carried out, we recommended that the terms and conditions of the 2003-revised policy be applied. For example, if some schemes need new generators, the local communities would have to pay the 10% contribution and so on. While we recognise that applying the revised policy to a whole lot of existing schemes could generate practical difficulties, it is important that it is applied consistently without any exceptions. Exceptions, which may offer a short-term solution, could generate a whole lot of long-term difficulties.

b) Without such a survey, it is difficult to formulate a sensible programme. Since 1974 and 1993, many things have changed. The population may have increased or decreased, the demand for electricity may have changed. What once was a stand- alone solar may now be better replaced by a grid connection scheme etc. In any case, the selection criteria as outlined in this report should apply.

5.10 Changing of schemes to a continuous supply – examine if current terms and conditions (of the existing 1993 REP) are appropriate and if any outstanding issues exists that need to be resolved when a scheme opts for a continuous supply,

With regard to schemes changing to continuous supply, we recommend that the current terms and conditions generally be retained so long as the scheme is 10 years or older. Effectively, the continuous supply scheme is treated as a new scheme with the same selection criteria and 10% plus 5% contribution proposed in this report. If the local communities own the existing assets, they will dispose of them and keep the money themselves.

As for the FEA schemes, we believe that FEA should contribute to the cost of the scheme the equivalent cost of the same scheme that it would have built itself given the tariff that it has to operate under.

5.11 Review the modalities in terms of the terms and conditions applied to the various electricity options under the policy and recommend changes where appropriate,

The options provided under the current policy framework are generally adequate. As recommended at 5.4, the inclusion of pre-payment meters, where appropriate, in the scope of equipment will enhance the village's ability to sustain their rural electrification scheme. The installation of prepayment meters will also facilitate the use of a pre-determined tariff that reflects the true cost of electricity. It should be noted that prepayment meters are expensive and require a lot of management. They may not be suitable for small communities.

We recommend that the applications for rural electrification schemes be made in more details to secure the commitments from the villagers (such as signatures of all users to agree to make the financial contribution required etc). We note that the RESCO model does not require the 10% initial contribution, as this will be included in the monthly fees. We do not support this position for reasons stated earlier. In our opinion, upfront payments reflect the commitment of the local communities; without which situations where some consumers would sign up but do not intend to stay in the village or pay the monthly fees cannot be monitored and kept in check.

5.12 Develop criteria for determining the appropriate government/recipient contribution mix for large-scale donor-funded projects;

With regard to large-scale donor-funded rural electrification projects we recommend that consumers pay 10% of the most economic equivalent scheme that would otherwise be built if donor funds were not available. Some donors, for their own reasons, may wish to provide a grant to build, say, a hydro scheme at $300 000 capital cost whereas the most economic option could be a diesel scheme at an initial capital cost of $8000. Note that the life-cycle costs (discussed below) would be different. Should the diesel scheme turn out to be the most cost-effective, it would not be fair to expect the local villagers to contribute 10% or $30 000 for the hydro scheme whereas they should only contribute $800. It is important that the donor be informed of the economic costing. In a wider context, Fijian resources should be developed in the most economic manner. Having a $300 000 hydro scheme where a $8000 diesel scheme would meet the needs would seem a waste of resources. The donor may be better off spreading that $300 000 to other more economic projects.

5.13 Develop criteria to ensure that only the most cost-effective Rural Electrification (RE) projects are implemented;

The current criteria of choosing the scheme with the lowest initial capital cost per household of $3500 per household, while simple and easy to apply, is incorrect. This is because it does not take into account the upholding and replacement costs (or O&M&R&R costs). For example, solar schemes or hydro schemes may have very high initial capital cost but low O&M costs as compared with diesel schemes. This criterion also does not take into account the cost of electricity produced in cent per kWh.

In the revised policy, we propose that the criteria of choosing the scheme with the lowest life- cycle cost per kWh be chosen where life-cycle cost is the present value of all costs associated with the scheme concerned. The examples below illustrate this criterion:

A) Solar scheme – using values used earlier which are taken from the 1993 REP

Assume 40 households

Initial capital cost in year 0, $56 800

Every 4 years, batteries need to be replaced at a cost in real terms of $3600

Every 10 years, the whole solar panels etc. need to be replaced at a cost in real terms of $53 200

The cash flows in real terms for the next 20 years are:

Year 0	$56 800
Year 1	0
Year 2	0
Year 3	0
Year 4	$3600
Year 5	0
Year 6	0
Year 7	0
Year 8	$3600
Year 9	0
Year 10	$53 200
Year 11	0
Year 12	$3600
Year 13	0
Year 14	0
Year 15	0
Year 16	$3600
Year 17	0
Year 18	0
Year 19	0
Year 20	$56 800

Note that the above dollar values are in real terms i.e. there is no inflation and the cost of battery replacement in year 16 is the same as in year 4. The effect of inflation is cancelled out when we choose the appropriate real discount rate that is the margin between, say, bank interest rate and the inflation rate. For this example, we use 3%.

Over the 20 years, the Present value of the costs from years 1 to 20 would be $109 447 (EXEL formula NPV (discount rate, cost at year 1 to cost at year 20)).

Present value of future cost	$109 447
Initial capital cost	$56 800
Total life-cycle cost	$166 247
Life-cycle cost per household	$4 156

Under this scheme, each household will be provided with two 11-W and one 7-W lights. The total Wh per household per day would be 145 Wh or 53 kWh per annum. Assume the consumption is unchanged for the next 20 years. The present value of consumption for each household would be:

Present value of consumption 787 kWh (EXEL PV(discount rate, 20 yrs, annual consumption)

Life-cycle cost per kWh-solar $ 5.28 (= 4156/2157)

B) Diesel scheme – using values used earlier which are taken from the 1993 REP

Assume 40 households

Initial capital cost in year 0 $30 000

The cash flows in real terms for the next 20 years are:

Year 0	$ 56 800
Year 1	$550 overhaul at $ 750 every 200 hrs or 1.37 years
Year 2	$ 550
Year 3	$2000 top overhaul at $ 2000 every 400 hrs or 3 yrs
Year 4	$ 550
Year 5	$1050 powerhouse cost at $ 500 every 5 yrs
Year 6	$ 2000
Year 7	$4000 major overhaul every 10 000 hrs or 7 yrs
Year 8	$ 550
Year 9	$ 2000
Year 10	$ 1050
Year 11	$ 550
Year 12	$ 2000
Year 13	$ 550
Year 14	$ 4000
Year 15	$15 500 new genset at yr 15
Year 16	$ 550
Year 17	$ 550
Year 18	$ 2000
Year 19	$ 550
Year 20	$9000 (new powerhouse)

Over the 20 years, the present value of the costs from years 1 to 20 would be $33 867 (EXEL formula NPV (discount rate, cost at year 1 to cost at year 20)).

Annual diesel cost is based on 200Wh per household per day that works out to be $ 1966 per year for 40 households (refer calculations above). Present value of fuel costs over the next 20 years can be calculated using the same formula.

Present value of future sustaining cost	$33 867
Present value of fuel cost	$29 243
Initial capital cost	$30 000
Total life-cycle cost	$93 111
Life-cycle cost per household	$2 328

Assuming the consumption per household at 200Wh per day or 73 kWh per annum. The present value of consumption per household would be:

Present value of consumption	1086 kWh (EXEL PV (discount rate, 20 yrs, annual consumption)
Life-cycle cost per kWh - diesel	**$ 2.14 (= 2328/1086)**

The diesel scheme should be chosen over the solar scheme.

Life-cycle costing is only one criterion, other criteria should also be used to select the scheme. These are tied back to the policy goals and principles as discussed earlier. Each scheme should be evaluated by asking:

a) Does this scheme promote self-sufficiency? Would it be sustainable? For example some of the applicants on the DOE list only involve 1 or less than 10 households. Would they be able to keep the scheme going by themselves?

b) Is this scheme affordable? One way of evaluating this affordability is to check how much the local people have been paying for energy needs such as kerosene lamps or petrol generators. If the scheme is likely to cost the consumers more in terms of the monthly contribution than they are not likely to use it.

c) Is this scheme the most energy efficient? For example on the island of Naigani, the nearby resort has already had its own diesel generator. It would be more efficient to have the village connected to this rather than providing its own scheme.

d) Could a renewable alternative scheme such as wind or solar be installed instead? If in the application form, the applicants state that they would only need electricity for lighting than solar may be a better option than diesel.

e) Is the scheme environmentally friendly? A hydro scheme that would require a significant disruption to the environment may not be the best choice.

f) Lastly, there is an important question of social development. A less economic scheme could be installed if there are strong social reasons (health care, schooling etc.) for doing so.

5.14 For non cost-effective RE projects, develop guidelines to determine additional consumer contributions necessary for obtaining cost-effectiveness;

The above examples are used to illustrate the use of specific criteria to select one scheme over another. The examples only show that the diesel scheme is more cost-effective than the solar scheme but they do not answer whether the diesel scheme is cost-effective or not simply because there is no benchmark for it to be compared with.

So when we talk about non cost-effective RE projects (or schemes), they have to be measured against some standards. These standards have to be based on economic benefits that the schemes will generate so that the investment from the government would produce an economic return. For example, prior to the electrification, the local communities have been using kerosene lamps, batteries and small-scale generators. This would have an economic cost of $X. With electrification, there would be an initial capital cost of $Y and ongoing costs of $Z. $Y and $Z may be larger than $X but the electrification would produce economic benefits such as having longer lighting hours for handicraft, increase in fish catch due to the use of freezers etc. The most economic RE projects would ensure that there would be at least 10% economic return on the original investment.

To assess the economic benefits such as additional household income from fishing (due to the introduction of electric freezers) or increase in handicraft production (longer working hours due to better lighting) would be quite involved as it varies from village to village and scheme to scheme. This work was beyond the scope of this review.

5.15 Evaluate past implementation of the REP including the DOE RE programme, focusing on implementation modalities, responsibilities and authorities. The existing REP should also be evaluated in its effect on setting baselines for future RE development and its consistency in terms of meeting Fiji's National Development goals;

To date 562 villages and settlements have received assistance under the 1993 policy framework (Table 2). About 50% of these schemes are diesel schemes, 46% are connections to the FEA 24-hour continuous supply, 2% are solar schemes and less than 1% are hydro schemes.

DOE has a waiting list of about 500 communities requesting assistance for a rural electrification scheme. Given the budget allocated for this year's rural electrification programme, the target of assisting 100[9] communities per year may not be realised[10]. According to the Ministry of Finance and National Planning, the budget is for capital projects, i.e. new schemes. There is no budgetary provision for supporting the schemes that are still within the grace period[11] and all those schemes that were built under the original policy framework but have yet to be integrated into the current policy framework. It is noted that DOE over the years (since the implementation of the current policy framework) have had difficulty convincing the Ministry of Finance, despite the assistance being an inherent component of the policy, to allocate funds for the purpose. In its 2003 budget submission to the Ministry of Finance and National Planning, DOE stated that to meet the policy commitment of maintaining rural electrification schemes during the grace period, it would need F$668 000.00. In addition to this amount, DOE would need F$5.75 million to bring those schemes built under the original policy into the framework of the current policy.

For the policy framework to be successful it needs the full support of Government. However, Government commitments appear to be lacking as can be seen from the above. There is no staff for the REU despite DOE efforts to establish the REU and the budgetary allocation is insufficient to support the implementation of the policy. (For more information on the implementation of the REP 1993, please refer to Section 4: Rural Electrification Policy Framework 1993, in this report).

We note that the majority of the diesel schemes were implemented by the PWD and almost without exception, all FEA extension schemes were built by FEA. We do not believe that this is a cost-effective means of implementation or a good way of ensuring a good skills base is maintained for Fiji. A contestable method is preferred with at least 3 contractors including FEA and PWD. It would

[9] The Strategic Development Plan 2003 –2005 (Ministry of Finance and National Planning) targets 100 communities per annum.
[10] The average cost per scheme is F70,000.00 (PWD figure).
[11] A three-year grace period is given to diesel, solar and hydro schemes in which the Government pays for the maintenance and any repair work undertaken.

ensure funds are effectively employed by DOE and would provide experience to private contractors.

We note that current procedures within FEA have construction conducted on an approximately 70/30 basis in favour of contractors and each job contested.

5.16 Establish budget guidelines for successful implementation of the RE programme and the electrification of the country as a whole;

To meet the targeted number of 100 communities receiving electricity in one year, a budget of at least $7 million should be allocated for rural electrification annually. The amount is based on an average cost of $70,000.00 per scheme (a more detailed costing is shown on Table 4). We note however that under the RESCO framework being proposed by DOE, achieving the target of electrifying 100 communities in one year may not be a daunting task. On that note, we recommend that DOE should carefully look at the different types of technologies available, the resources available, the different implementation approaches (business approach, partnerships, RESCO, etc) and the investment resources available (private financing, donor funds, Kyoto Protocol and its mechanisms, etc) for development programmes.

With regards the implementation of the RE Policy, we note that the Rural Electrification Unit (REU), despite Cabinet decision to have the Unit set up at DOE to implement the 1993 RE Policy, has until today not being established. We further note that DOE over the last ten years has managed quite satisfactorily to implement the RE Policy, but at the expense of one and half of its staff. A senior staff member (at Principal level) has been seconded to implement the policy and he is assisted by another staff who shares his time between the DOE and REU work.

5.17 Review the role of the Rural Electrification Unit (REU) including staffing structure and responsibilities;

As discussed earlier, the REU as recommended by the 1993 REP has never materialised. No staff were appointed and the bulk of the implementation was done by PWD. The Electrical Section of the PWD, who has been implementing the RE schemes, pointed out that they would prefer to be either part of the DOE or the REU should be part of the PWD. As it is now, they believe that the process is very inefficient and not service-orientated. For example, the villagers would contact the PWD and be told to contact the DOE as the PWD has no control over the budget for RE schemes. The DOE would then told the villagers to contact the PWD because the DOE has no control over

the physical works of the RE schemes. In some villages, it would take hours for the villager to walk to the nearest public telephone to make such phone calls.

At this stage, we do not believe that it would be cost-effective to absorb the Electrical Section of the PWD into the DOE nor to create a new REU in the PWD. Apart from the cost, the merger of these two entities would not provide the accountability and transparency that are essential for the success of the RE programme.

We believe that the REU should be with the DOE as the “Programme Manager” and “Policy Maker” and leave the Electrical Section with the PWD as one of the implementation contractors. The PWD would then have to tender for the works thus ensuring contestability resulting in the cost-effectiveness of the scheme implementation

The RE models are shown on Table 5. Based on our proposed model, we suggest that the REU be structured as given in Figure 2.

One thing that has become clear to us is that we cannot review the REU in isolation within the DOE. We recommend that the rural electrification programme be integrated as part of the core programme area of DOE. That is to say the DOE would need to be restructured, not only because the RE budget is so much larger than the budget for other DOE activities ($3 to $ 6m as compared with $1m per annum but also the expertise required for the REU activities is transferable to other activities in the DOE. We must emphasise that to enable DOE to undertake the programme more effectively it will need to boost its staff compliment and skill level. In light of this we have recommended a corporate structure based on its current work programmes. As we see it, there are four main programme areas: Administration and Finance; Policy, Planning, Research and Information; Power; and Energy Conservation and Efficiency. Rural Electrification should be part of the Power programme area.

The rationale for our proposed structure is as follows:

Administration and Finance or Corporate Support

This function currently exists in DOE and headed by two different officers reporting directly to the Director of Energy and RE. There could be a case to combine the two headed by an Admin and Finance Officer. Given the large number of RE schemes and the financial transactions which DOE would be involved in, we recommend that at least one additional clerk be appointed to handle the scheme registration and keep track of various deposits and village accounts

Policy, Planning, Research and Information

Currently the DOE is responsible for all energy-related matters in Fiji. Currently, various tasks shown on Figure 2 are handled by the Scientific Officers. We believe that this important function should be recognised and a division be created to be headed by a Manager (or a Principal Scientific Officer). We recommend that the library should be in this division and not under the Administration Officer as is the case at present. Licensing of RE schemes should also fall under this division. This is to provide a "Chinese wall" with the Power Division and ensuring an element of accountability

Power

We believe that a separate division to he headed by a Manager (or a Principal Scientific Officer) be created to cover all issues related to power. This division would be responsible for the RE schemes as well as policies applicable to FEA and other generators in Fiji with respect to economic utilisation of resources for power generation.

The skills level commensurate with the functions envisaged in the power sector programme include the following:

(a) Engineer/contracts/projects/RESCO (Three). The maximum number to undertake the engineering functions is three. They will be responsible for planning, surveying, designing, supervision, inspection, enforcing standards and implementing the RESCO concept in rural electrification.

(b) Economist/Pricing/Costing (one). Pricing is an important element of any RE programme. For DOE to be able to work out the appropriate pricing structure to evaluate RE options, dealing with FEA tariffs and other private generators they will need an economist. This economist could also provide advisory services internally to the other divisions. It should be pointed out that tariff setting is not DOE's responsibility. It is currently done by the Commerce Commission.

(c) Policy Analyst (one). The appropriateness of a policy has a great influence on its effectiveness. The policy analyst will be responsible for formulating and reviewing the policies related to RE, RESCO, FEA and independent power producers. If resources are limited, this Policy Analyst could double up as the Economist described above.

(d) Public Relation Officer/training/community consultation (one). This position adds to the corporate image of DOE and the person would be responsible for training and community consultations related with RE schemes. These are two areas, which DOE need to strengthen to dispel any confusion that may arise as a result of changes made to the policy.

We note that the DOE currently employs a number of Energy Analysts and Senior Energy Analysts plus Senior Technical Assistance. Some of these people could be redeployed under the Power Division.

Energy Conservation and Efficiency

This is a very important division. Effective practices in energy conservation and efficiency would save Fiji a significant amount of money and resources that could be used elsewhere for its economic development. We suggest that this division be headed by a Manager who will be focused mainly on policy making, monitoring, public education and utilise the skills/knowledge from other divisions

We should point out that given the large amount of money involved in RE schemes and the importance of this investment by the Government of Fiji, that should the DOE be given the responsibility to manage the RE schemes, then it should be given the resources to do so. We believe that the current structure and resources in the DOE should be reorganised and strengthened for the tasks required.

On a wider perspective, we believe that the proposed structure would enable DOE to carry out its duties effectively. In our view, DOE duties should be to investigate, consult, formulate, recommend and implement energy policies for the Government to ensure a successful development of a peaceful and prosperous Fiji as per the Governments Strategic Development Plan 2003-2005.

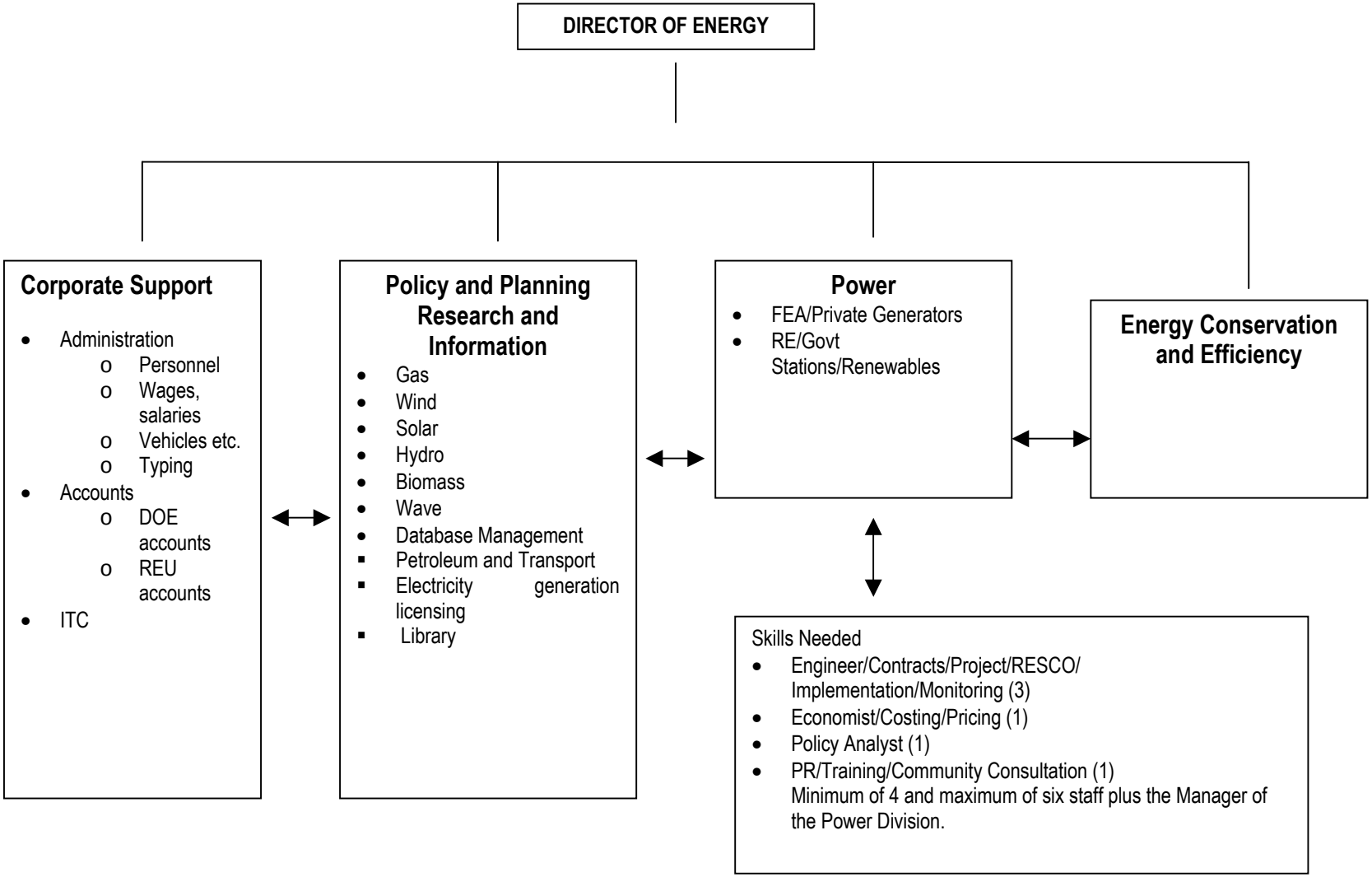


Figure 2.Recommended Corporate Structure.

5.18 Develop guidelines & provisions for involvement of RESCOs in the provision of RE services (the OPRET unit of DOE would need to be consulted on this).

In developing an appropriate model for rural electrification we took into account DOE's current project on the promotion of renewable energy service companies under the Office for the Promotion of Renewable Energy Technologies (OPRET) programme. The OPRET programme is also taken as a future programme area for DOE. To assist in explaining the proposed model we look at seven major components of electrification and they include:

(a) Planning;

(b) Design and Construction;

(c) Operation, Maintenance and Replacement;

(d) Collection of Revenues;

(e) Ongoing evaluation and Monitoring;

(f) Inspection and Licensing; and

(g) Asset Ownership.

In the table below we show, using the above seven components, how rural electrification is being implemented currently, the RESCO model, and our proposed model.

Table 5. Rural Electrification Models.

	Planning	**Design & Construction**	**O&M&R&R**	**Collection of Revenues/Fees**	**Ongoing Evaluation and Monitoring**	**Inspection and Licensing**	**Asset Ownership**
Current Position	DOE in conjunction with FEA and PWD	PWD- Diesel FEA – Line Ext. DOE – PV	PWD – Diesel FEA-Grid DOE and RESCO – PV	Village – Diesel FEA-Grid PV – Village Council, Post Office	DOE FEA – Grid DOE,	Under the Electricity Act FEA is responsible. Currently being undertaken by PWD for diesel schemes and DOE for PV	Diesel Scheme – Govt for the first three years and the village after that. Grid Extension – FEA after commissioning. PV – Same with diesel for non-RESCO schemes. RESCO Scheme – Govt.
RESCO Model	DOE	Managed by DOE and contracted to RESCOs for PV.	RESCO	DOE through Post Office but prepayment cards required.	DOE	DOE	Same as current position.
Proposed Model	DOE in conjunction with FEA.	Managed by DOE and contracted out to the market. FEA, PWD and RESCO will have to tender for the work. Only pre-qualified and licensed contractors are allowed to work on rural electrification programme.	Low-level skills by village operator trained by the design/built contractor. High-level skills e.g. longer term overall or replacements be carried out by the contractor that designed and built the scheme or by RESCO's where appropriate..	Install prepayment meters where appropriate. Money to be collected by the village or pay at the Post Office. Money to be kept in a Trust Account and managed by the village council and or DOE. Private contractor should not keep money unless a performance bond is provided.	DOE – All schemes must have a license to generate and sell electricity. The electricity regulatory role currently with FEA should be taken away and given to DOE.	DOE	Grid Extension to be owned by FEA. Value to be determined by the equivalent investment that FEA would have made for a given tariff Diesel scheme to be owned by the village after commissioning. The village, unless funded by the RESCO, should own PV schemes, after commissioning.

REFERENCES

1. Vega, Bryant and Kumaran, (2001) Renewable Energy Service Companies for Rural Electrification in Fiji. Unpublished paper.
2. Rural Electrification Projects installed to date *(implemented under the 1974 and 1993 Rural Electrification Policy Frameworks*). Supplied by DOE on 3 March 03.
3. This reference is taken from the following materials supplied by DOE on March 03:
   - Surveyed Villages Requested for Diesel Projects – Rural Electrification – Data on Survey of New Diesel Schemes (estimates by PWD including labour and materials for installation).
   - Rural Electrification – FEA Surveyed Schemes.
   - Annex 3 – Summary of Projects funded under the $10.0 million Grant – Cabinet Memorandum –Rural Electrification (For Discussion) – Memorandum by the Minister for Energy – 7 May 2002.
4. List of Applications (DOE's RE_DATA) supplied by DOE on March 03.
5. Cabinet Memorandum – Rural Electrification (For Discussion) – Memorandum by the Minister for Energy – 7 May 2002.
6. Cabinet Memorandum – Maintenance and Replacement of Electrification. Infrastructure (For Discussion) – Memorandum by the Minister for Works and Energy – September 2002.
7. Rural Electrification Policy – 1993.
8. Review draft of A Framework for Sustainable Electricity Development in Fiji by Peter Johnston and Eric Esler, October 1999.
9. Fiji Government National Strategic Development Plan 2003 – 2005, Ministry of Finance and National Planning publication 2003.
10. Kingston Morrison (1999) – Department of Energy – Assessment of Potential Sites for Steam Cogeneration Plants in Fiji.

APPENDIX I

List of Key Stakeholders Consulted

	Organisation	Personnel	Position
1	Fiji Electricity Authority	Rokoseru Nabalarua	Chief Officer Marketing and Business
2	Ministry of Finance and National Planning	Sailosi Kepa	Economic Planning Officer
		Cama	Economic Planning Officer
3	Ministry of Regional Development	Savenaca Kaunisela	Deputy Permanent Secretary
4	Ministry of Fijian Affairs	Mataiasi Lomaloma	Deputy Permanent Secretary
5	Public Works Department (Electrical Section)	Joseph Montu	Principal Electrical Engineer
		Waisake Savu	Supervisor Higher Grade
		Metui	Supervisor
6	Ministry Works and Energy	Devendran Kumaran	Deputy Permanent Secretary
7	Depart of Energy	Navendra Prasad	Director
		Peceli Nakavulevu	Principal Energy Analyst
		Makereta Sauturaga	Program Manager, OPRET
8	Fiji Employers Association	Charles Barclay	Board Member
9	Prime Minister's Office	Sakiusa Tuisolia	Deputy Secretary
10	Clay Engineering Ltd	Bruce Clay	Managing Director

APPENDIX II

Advisory Services to Fiji on Review of the 1993 Rural Electrification Policy

TERMS OF REFERENCE

With the general guidance and supervision of the Chief of Environment and Sustainable Development Division, ESCAP, and in close collaboration with staff from the Department of Energy (DOE), Fiji, a team of two advisers, a Local Energy Adviser and an International Energy Advisor, will evaluate the current Fiji Rural Electrification Policy (REP) and advise on further steps the DOE take.

Tasks

The two advisers will, using the existing REP as the base, perform the following tasks:

- Review the 1993 Rural Electrification Policy (REP) and make recommendations for improvements.
- Develop criteria for determining the appropriate government /recipient contribution mix for large scale donor funded projects.
- Develop criteria to ensure that only the most cost-effective Rural Electrification (RE) projects are implemented.
- For non cost-effective RE projects, develop guidelines to determine additional consumer contributions necessary for obtaining cost-effectiveness.
- Evaluate past implementation of the REP including the DOE RE programme, focusing on implementation modalities, responsibilities and authorities. The existing REP should also be evaluated in its effect on setting baselines for future RE development and its consistency in terms of meeting Fiji's National Development goals.
- Hold discussions with all stakeholders including villages to obtain their views on the REP and the RE programme and resolve, to the extent practical, outstanding policy issues. Some rural surveys may need to be undertaken to give fair representation from the rural village/settlement sector.
- Establish budget guidelines for successful implementation of the RE programme and the electrification of the country as a whole.
- Review the role of the Rural Electrification Unit (REU) including staffing structure and responsibilities.
- Develop guidelines & provisions for involvement of RESCOs in the provision of RE services (the OPRET unit of DOE would need to be consulted on this).

Outputs

- A detailed REP review report with recommendations on future effective implementation of the REP according to the above-mentioned tasks. Four copies of the report are to be provided to ESCAP. The reports shall be of bounded type and have the appropriate title shown on the title page.
- A draft revised REP incorporating changes as agreed in consultation with DOE and ESCAP. Five copies (inclusive of an electronic copy stored in a CD) of the revised

REP are to be provided to ESCAP. The reports shall be of bounded type (except the electronic copy) and have the appropriate title shown on the title page.

Sharing of work between the two advisers:

In order to achieve the above outputs, the advisers will perform activities and produce outputs as follows:

Local Energy Adviser (LEA)

Activity	Output
Village visits	Report on village consultation
Evaluate past performance of REP implementation	Report on performance of REP
Review implementation institutional structure	Report on implementation institutional structure

International Energy Adviser (IEA)

Activity	Output
Stakeholder consultation (including Governments, NGOs, private sector)	Report on stakeholder consultation
Report writing for REP review with recommendations	A detailed review report with recommendations on future effective implementation of the REP (incorporating the reports prepared by LEA)

LEA and IEA in partnership

Activity	Output
Report writing for revised REP	A revised REP

The activities require continuous discussions between the two consultants. Even though the consultants each will take the leading role in activities as indicated above, they are expected to consult with each other on a continuous basis.

Qualifications

Local Energy Adviser

- Detailed knowledge of Fiji's government structure, energy policies in general, and the 1993 Rural Electrification Policy in particular.
- At least ten years experience in rural electrification policy development in developing countries (working experience in Fiji preferred).
- Experience in information gathering and stakeholder consultation.

International Energy Adviser

- Experience in information gathering and stakeholder consultation.
- Knowledge of strategic energy planning, including financial aspects.
- Extensive experience and in-depth knowledge on energy policy analysis and development, including experience in renewable energy sector.

Duration

The consultancy work is expected to include a total of 61 (40 by LEA; 21 by IEA) working days, including 1 week's travel to Fiji by IEA for stakeholder consultation, and domestic travel for village consultation by LEA.

Remuneration and in kind contributions

A fee of US$ 13,725 to be shared by LEA (US$ 9,000) and IEA (US$ 4,725) in accordance with the workload distribution.

DOE will provide:

- 1) Copies of all relevant reports and materials to the consultants; and
- 2) Staff time and office support as required.

APPENDIX III

List of Rural Electrification Schemes/Villages Surveyed

No.	Schemes	Location	Type of Scheme	Commissioned
1	Naqali	Central Division	Diesel	1994
2	Waitolu	Central Division	Diesel	1995
3	Muana	Northern Division	Hydro	1999
4	Naqaravutu	Northern Division	Hydro	1999
5	Wailevu	Northern Division	Hydro	1999
6	Natewa	Northern Division	Diesel	1992
7	Naroi	Eastern Division	Solar	1999
8	Keteira	Eastern Division	Diesel	1999
9	Vunulu	Eastern Division	Diesel	1983
10	Kabariki	Eastern Division	Diesel	1998
11	Levuka	Eastern Division	Diesel	1997
12	Rokovuaka	Western Division	Diesel	1978
13	Nalalawa	Western Division	Diesel	1994