Establishment of Economic Framework and Incentive Policies for Renewable Energy Service Companies

Final Report

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(UNEDITED)

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Table of Contents

1 Summary of Findings and Recommendations

The findings and recommendations in this report respond to the main themes and issues arising under the Terms of Reference (TOR) for the Economic Issues Consultant (EIC). The summary of recommendations appearing immediately below relate to the cost of energy, patterns of household expenditure, affordability, subsidy considerations and the RESCO selection process, financial incentives for RESCOs.

On consideration of the recommendations to follow there are two caveats. The first concerns the method prescribed to the EIC to calculate the cost of energy. Here the TOR provides that the Cost of Electricity (COE) is to be calculated on the basis of (Capital Costs + Operations, Maintenance, Repair and Replacement (OMR&R)–Subsidies). This method is therefore deficient as it does not provide for the environmental costs of alternative energy options and therefore, renders any comparison between fossil-fuel and renewable energy alternatives somewhat artificial and limited to pure financial measures.

The second concerns the COE data. Here information obtained remains patchy due to gaps in the data supplied to the EIC such as capital establishment costs for generation systems or OMR&R. Hence where appropriate, the COE is reported as the "recurrent generation COE and the relevant recommendations read in this light. All amounts are calculated in Fijian Dollars.

1. The first recommendation falls outside the TOR for the EIC but must be stated given the limitations of the findings in this report. Obvious capacity deficiencies within the DoE must be addressed prior to any further progress being made towards implementation of the RESCO program. These deficiencies relate to the number of personnel, scope of duties and requisite level of training. Data recording and management systems with respect to the DoEs rural electrification program must be improved. Certain DoE personnel assisting the DoE have worked tirelessly to get the results to this point but much more is needed if the DoE is able to manage a serious rural electrification program. Therefore, the key

recommendation here is that steps must be taken to conduct an internal resource and capability audit and appropriate resources devoted to remedying these deficiencies.[1]

2. The average cost to generate electricity by the PWD at their four sites is estimated between 0.51 - 0.83$/kWh, calculated on the basis of recurrent costs (fuel, direct labour, maintenance and repair) only. No reliable data for capital establishment, technical and non-technical transmission and distribution losses were available. Data on household billing could not be obtained. Hence the COE here is defined as generation costs.
3. Generators supplying rural houses with electricity under the DoE's diesel electrification scheme results in an average COE of 1.83$/kWh. This figure is comprised of 0.43$/kWh of fuel and 1.39$/kWh capital costs. Data for OMR&R were not available and therefore not included in these figures.
4. Data obtained from the DoE reveal a COE for their SHS at Namara, Navoi and Vunivau of 6.16$/kWh, 6.70$/kWh and 5.90$/kWh respectively.
5. Subsidies provided by government to defray the COE do not in any way reflect true costs or indeed, levels of affordability and therefore, have very little bearing on reality. Hence, government subsidies have been treated superficially throughout this report.
6. Data could not be obtained from the DoE mini/micro hydro sites.
7. Based on present level of expenditure on fuels for lighting only, rural householders spend between $13.00 and $19.00 per month.
8. Based on these data, householders can be reasonably expected to pay a minimum of $15 per month for a RESCO tariff.
9. The proportion of people presently paying below this amount is estimated at 26% or 1,851 households of the 7038 houses that have applied to the DoE for electrification.
10. While a subsidy for investment in energy generation equipment and infrastructure will probably be needed any consideration for a consumer subsidy (a recurring one that offsets the operating and maintenance costs

[1] See also Funding Report where similar capacity constraints are addressed.

of energy delivery) appears contrary to the commercial underpinning of the RESCO concept and is therefore not recommended.

11. In the event that a consumer subsidy is contemplated, the burden on government for an across the board subsidy amounts to $1.6 million per annum.
12. In the event that a consumer subsidy is applied to those households presently spending less than $15.00 per month on lighting fuels, then the burden of subsidy on government is $132,660 per annum.
13. Whilst a consumer subsidy is not recommended there might be grounds to contemplate an area-based subsidy that cushions cost differentials in servicing difficult areas.
14. If this were the case, it is recommended that any such recurring financial support be administered by government agencies with interests in rural areas such as Department of Fijian Affairs or Department of Rural Development and therefore, remain outside of the DoE program of activities.
15. The willingness of consumers to pay for SHS can be expected to depend on whether SHS are able to improve upon present levels of lighting service (quality and duration) and remain within the affordable limits noted above.
16. The recommendation here is that willingness to pay will also be enhanced by promoting and marketing SHS as a modern, safe and clean alternative to present methods of lighting.
17. The RESCO Selection Criteria evaluates potential RESCO candidates on three related lines, Legal and Financial standing, Products and Services; Business Management/ Entrepreneurial Skills, Technical Skills/ Service Capabilities.
18. The RESCO selection process must be conducted in an open and transparent manner by a RESCO Selection Panel an on a footing consistent with relevant legislative and regulatory provisions. The Panel must include individuals with business and commercial experiences in order to assess the business and financial aspects of applicant's proposals. The DoE is well placed to undertake the technical evaluation of RESCO proposals.

19. Comments have been made concerning a range of payment systems including pre-payment metering.
20. There are both advantages and disadvantages attached to pre-payment systems. The decision to build pre-payment systems into a rural electrification program depends upon socio-economic and technical/equipment-type considerations.
21. Here the payment is for a RESCO service and not according to metered consumer usage and therefore at odds with a pre-payment system and hence the benefits are lower.
22. The recommendation here is that in-keeping with commercial principles, RESCOs must be left to determine their own payment system.
23. A range of risk factor have been identified and similarly a number of financial and non-financial incentives to attract private sector investment into the RESCO program have emerged in the course of inquiries. The recommendation here is to promote the legislative framework under which RESCOs will operate and the inherent risk-reducing mechanisms contained therein.
24. It is also recommended that departments other than the DoE, such as Rural Development, are better placed to contemplate the nature and extent of any subsidies designed to boost consumer affordability.
25. It is also recommended that in relation to non-financial incentives appropriate agencies such as health and education are in a better position than the DoE to increase understanding of SHS under a package of promotional measures.

2 Introduction

This report is prepared by the Economic Issues Consultant (EIC) and represents one of several reporting outputs under a UNDP/GEF funded project to promote the sustainability of Renewable Energy Service Companies (RESCOs) in Fiji. The project centres on the creation of a number of public-private partnerships between the Department of Energy (DoE) and private enterprises. The RESCOs will be selected by the DoE according to merit criteria and will be allocated a region within rural Fiji to install and maintain SHS on a fee-for-service basis. The RESCOs will lease the SHS system calculated at 10% of the capital value from the DoE. The *Rural Electrification Act*[2] the RESCO Charter and subordinate operational programs devised by the DoE provide the legislative, regulatory and operational frameworks under which the RESCOs will conduct their affairs.

The outputs of relevance here are concerned with the *"Establishment of Economic Framework and Incentive Policies for Renewable Energy Service Companies."* This report comments on the cost to government to generate electricity in rural Fiji and patterns of expenditure on energy fuels in rural households without electricity. Estimated levels of affordability for RESCO services and related factors which condition demand or create the willingness to pay for RESCO services are derived from these inquiries. The results help to determine a reasonable (affordability-based) tariff for RESCO services.

The main theme running through the recommendations promotes the need for RESCOs to operate in a commercial manner allowing a combination of market mechanisms and competition between RESCOs to set market prices and overall standards of customer service. Apart from an up-front capital subsidy available to RESCOs, it is considered undesirable that RESCOs receive subsidy support to support or defray recurrent costs as this would merely create distortions in the market and create other complexities, detailed later, for government. Nonetheless, it is accepted that cost-structures between RESCOs will vary according to the

[2].Currently in the drafting stage.

degree of difficulty in servicing certain areas in remote parts of Fiji and island communities and hence, some financial support available through other agencies such as the Department of Regional Development and Department of Fijian Affairs might be required to offset some of the RESCO costs to consumers.

Arguing for a commercial thrust does not however, imply that there exists a strong and robust electricity market in rural Fiji and or strong latent and hence untapped demand for electricity services. Rather, on present indications there is little or no evidence that RESCO operations will be commercially sustainable nor are their any implicit assumption that this situation might develop over time. On the contrary, there are clear signs that market conditions are in fact less than ideal for private sector operations and therefore serious thought must be given to how a commercially-orientated RESCO program might derive profits from a fragile rural electricity market.

Here, the weaknesses present in the Fijian rural market do not necessarily stem from a lack of consumer affordability as there appears, on present estimates, capacity across a great many numbers of household to afford the recommended RESCO tariff of $15 and $17 per month. Rather, the main issue of concern that has potential to erode the commercial basis upon which the RESCO program depends is consumer willingness to pay for a RESCO service. This simply turns on consumer perceptions of what represents value-for-money and whether SHS are able to meet minimum threshold expectations.

In the event that consumers find SHS lacking in any manner or form, the DoE and other relevant agencies with portfolio interests in rural Fiji may need to contemplate various consumer support schemes that might involve demand-side subsidies. Overlaying these considerations is the long history and systemic application of subsidies in Fiji and hence, a resultant expectation amongst consumers of a continuing subsidy regime. Hence, despite the strong recommended emphasis on commerciality in all RESCO undertakings, comments are made in respect of consumer subsidies and the impact of these subsidies on government budget.

Recommendations are made for the RESCO selection process in keeping with the relevant sections of the *Rural Electrification Act* and Business Planning Framework developed under this project. Finally, recommendations for an electricity payment system and a private sector incentive policy designed to attract private enterprise into the RESCO program are developed.

3 Terms of Reference

This element of the UNDP/GEF project responds to the following broad Terms of Reference (ToR):[3]

1. Establish the cost – pricing/tariff policies for rural electrification and the level of government subsidy that will enable consumers to meet the delivered cost of electricity services; The COE is to be calculated on the basis of (Capital Costs + Operations, Maintenance, Repair and Replacement (OMR&R) – Subsidies);
2. Provide recommendations on community payment systems, village selection criteria for installation, RESCO selection criteria and a framework for the RESCO selection processes;
3. Develop an appreciation of end-user levels of affordability and factors bearing on household willingness to pay;
4. Development of market-based incentives to attract private sector interests the further the development of SHS in rural Fiji; and
5. Recommendations to be widely communicated to policy makers and key stakeholders through seminars and workshop.

4 Methodology

The methodology was designed in response to each of the ToR and in close consultation with the Project Manager (PM). Initial planning meetings held at the DoE in November 2001 involved all team members. This meeting helped to define, expand or narrow the various elements of the individual consultant's ToR while providing an overview of the inputs required by co-consultants as well as affording a snapshot of their initial views on how they might approach their individual tasks. The question of management and coordination was settled at this initial meeting on the basis that all outputs would be communicated through the PM for distribution for comment by others.

The particular methodology for the present ToR favoured a strong participatory approach. The result is aimed at capturing as near-as-possible the views of a broad group of potential stakeholders in RESCO activities. The thematic areas are:

1. Cost of Energy (COE) framework
2. Social Survey Framework
3. Investor Forum

4.1 Cost of Electricity (COE) Framework

The first principal task in this project is to fully account for the costs to provide electricity to communities not connected to the Fiji Electricity Authority (FEA) grid. The intended scope of sites included mini-micro hydro installations at Nasogo, Bukuya, Koro, Vatukarasa, solar lighting at Vunivau, Naroi and Navakavou, stand-alone diesel generators undertaken in the past by the DoE and diesel power stations operated by the Public Works Department (PWD) at Kadavu (Vunisea), Lakeba (Tubou), Rotuma (Ahau), Taveuni (Waiyevo) and solar-diesel hybrid installation at Nabawalou.

For this purpose the EIC developed a generalized framework to help capture relevant data of the cost features of the PWDs generation stations. This framework is depicted in Table 1.

[3] Details of the ToR are presented in the Appendices.

Table 1 Cost Framework for Estimation of Cost of Electricity		
Cost Item	Unit	
Capital Parameters		
Date of installation	Month/Year	
Installation and commissioning costs	$	
Capital upgrade cost	$	
Depreciation schedule	$	
Network Parameters		
Historical cost of transmission lines	$	
Historical cost of distribution lines	$	
Cost of Connections - house/commercial/government building	$/premise	
Date of installation	Month/year	
Depreciation schedule	$/annum	
O/M/R/R	$/annum	
Operating Parameters		
Direct wages/salaries	$	
O/M/R/R	$	
Fuel and oil	$	
Administrative and Building Overhead Parameters		
Indirect wages and Salaries	$/annum	
Powerhouse building and infrastructure costs	$/annum	
General administrative overheads including tariff collection	$/annum	
Efficiency Parameters		
Installed capacity	KW	
Delivered power	KWh	
Duration of electricity service	Hours/day	
Times of electricity service	Times/day	
Demand Parameters		
Number domestic connections	Total	
Number commercial connections	Total	
Number of public/government buildings	Total	
Income/Tariff Parameters		
Income received from domestic connections	$/month	
Income received from commercial connections	$/month	
Income received from public/government connections	$/month	
Other income from generating assets	$/month	

The framework is designed to capture the various cost structures according to the following parameters:

4. Capital;
5. Operating;
6. Building/Administrative Overhead;
7. Efficiency; and,
8. Demand/Income.

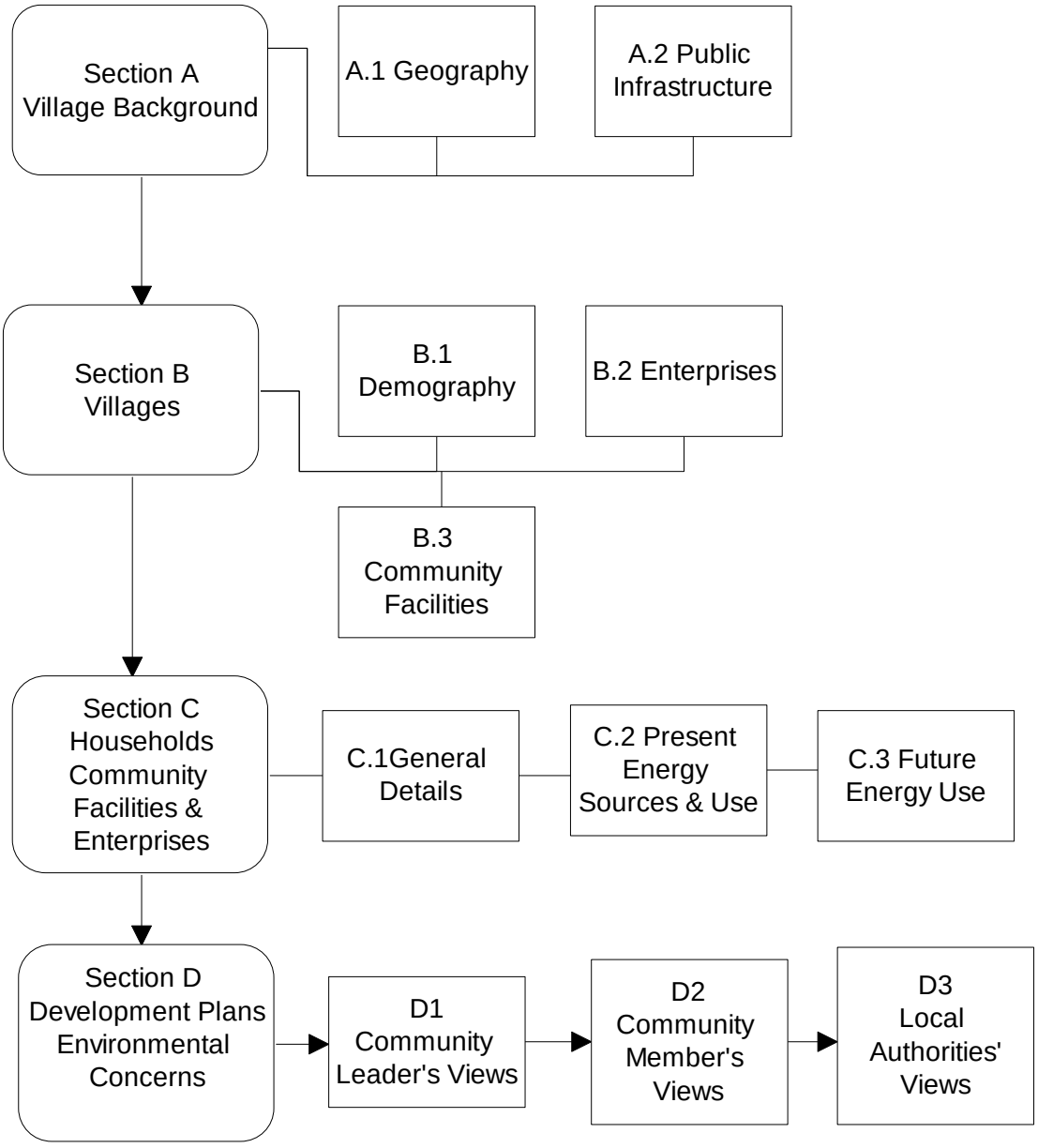
As can be seen in Table 1 both costs and efficiency measures in providing electricity to domestic, commercial and government customers at each of the sites[4] are of interest. Estimates of gross income (through tariff collections) are also captured as well as indications of system performance. In keeping with the ToR the full COE is calculated on the basis of (Capital Costs + Operations, Maintenance, Repair and Replacement (OMR&R) – Ssubsidies);

4.2 Social Survey Framework[5]

The second principal task in this project is to determine present levels and patterns of expenditure on energy in rural households. Given the inherent limitations of SHS, the results presented here concentrate on assessing that part of the household energy budget spent on basic lighting and entertainment. The aim here, is to derive levels of consumer affordability for SHS services and at the same time consider the factors that circumscribe consumer willingness to pay a RESCO for such services. Ultimately, these considerations will shed light on the range of tolerance for a monthly SHS tariff.

For this purpose, the EIC developed a comprehensive social survey questionnaire in consultation with relevant DoE Staff. The questionnaire, available elsewhere, covers a wide range of issues related to the target market. It should be noted that while the essence of the task here is to come to some understanding as to what might represent a reasonable tariff band based on existing patterns of expenditure on lighting and entertainment, the enlarged questionnaire was considered necessary by the DoE as part of their ongoing efforts to develop a comprehensive database on rural electrification customers. The areas covered by the questionnaire is depicted in Chart 1 below.

[4] Income data based on DoE tariff collection was not available at the time of writing and therefore, it was not possible to calculate the return on generating assets.
[5] The following sections should be read in conjunction with the questionnaires in the Appendices.



The questionnaire was administered by the DoE between May – November 2002 with final results available to the EIC in January 2003. Further data qualifications requested by the EIC shortly after receiving the original survey results were became available in June 2003. The DoE has 7,039 applications for rural electrification scattered across 209 villages. The social survey reached 433 households across 45 villages/settlements that appeared to have a low probability of qualifying for Fiji Electricity Authority (FEA) line extensions. These villages/settlements are scattered throughput Fiji and therefore, the survey undertaken by the DoE was a painstaking and arduous task.

A snapshot of the survey framework relating in respect to energy usage is depicted in Table 2.[6] It should be noted that this is only the framework, the questionnaire itself goes into explicit detail.

Table 2 – Household Survey Questionnaire Framework[7]	
Present levels of energy use	Number and type of energy implements/equipment in each household
	Type and amount of fuel used in each household
	Costs of fuels used in each household
	Equipment for which fuel is used (separate lighting from other uses)
	Time and hours of use
	Estimation of present load = (number households x energy used). Where electricity used = (Number of appliances x total wattage x hours of use)
Future levels of energy use	Number and type of appliances wanted by the household if they had (more) electricity (to estimate peak load growth)
	Number of people migrating or traveling to and from the village (to estimate total load growth)
	Growth of existing and starting of new commercial activities (example fish processing) or prospects to start new businesses (example tourism)
Estimation of Tariff Affordability	Tariff Affordability = (Total household expenditure on lighting fuels per month)
Willingness to Pay	Comments in relation to satisfaction with existing methods of lighting, knowledge of SHS, expectations from SHS.

Sections A and B of the questionnaire attempt to capture information on the physical location of the village, village demographics and insights into local economic resources and existing and potential commercial enterprise. These sections attempt to 'characterise' the village in terms of its basic assets and therefore, of planning and logistical value to the DoE for their rural electrification program.

Section C relates to specific aspects of energy use in the home, types of fuel used, energy applications and expenditure on these fuels. This section examines how people in communities use energy, their choice of fuel and the relative costs associated with their purchases in an overall household budgetary setting.

[6] The questionnaire used can be seen in the Appendices. See also the report prepared by DoE - Participatory Workshop in five villages: October 1996 (Kadavu, Viti Levu, Vanua Levu).
[7]The DoE is developing a social data base as part of their ongoing monitoring activities in rural villages. The questionnaire therefore sought information beyond the present scope of the ToR for this assignment

In order to obtain a cross section of views on the patterns of energy use at each of the villages surveyed, it was important that the views of the community as a whole were represented in the survey results. As a matter of field protocol, village leaders were first consulted followed by interviews with village council members as happened to be the case. The views of the local school principal and teachers along with local health and community workers were also sought. Consumers were then interviewed in their homes where DoE field staff had the opportunity to also inform consumers of the RESCO program and obtain their views on their expected levels of service from a SHS.

4.3 Investor Forum

Financial capital will be needed in order for the RESCO program to maintain an existence beyond the present UNDP/GEF activities. The possibilities for further government appropriations for the DoE to continue the RESCO project is slight leaving a combination of private and donor funding the only possible options. At the same time, the RESCOs themselves may require financial capital, the nature and level of which will depend upon their individual business circumstances. Hence, the RESCO Investor Forum represented a way to obtain the views of government, industry, donor agencies and the finance sector on the RESCO program as a potential commercial investment.[8] To this end, individuals were invited from the public and private sectors, including the finance sector, NGO's international donor agencies and local industry associations.[9]

The Forum objectives were to:

- Identify barriers (risks) to investing in the RESCO program.
- Identify the factors that would promote investment in RESCOs.

[8] This activity was undertaken very late in the project by the EIC following the departure of the original financial consultant. Given that no records of interviews with the private sector had been left behind by the departing consultant, it was considered that convening the forum was the most expeditious if not the only means (within the time available) for bridging information gaps.
[9] See Appendices.

Representatives were briefed on the:

- DoE's Rural Electrification Unit's activities.
- Nambawalou hybrid renewable energy installation.
- Proposed principles and operations of RESCOs.

Questions and responses were recorded and plans were made to conduct follow-up interviews with key individuals. It was also agreed that participants interested in keeping abreast of the progress of the RESCO program would receive periodical updates from the DoE.

5 Limitations of the Report

A major limitation of the results presented here turns on the accuracy and reliability of data made available by the PWD and the DoE in relation to the relevant costs of their operations. Similar considerations are raised in relation to the results to emerge from the social survey. The effectiveness of the Investor Forum to fully capture an appreciation of the perceived barriers that exist among potential private and financial sector investors in the RESCO program is not as comprehensive as originally desired by the EIC. The concerns giving rise to the limitations in this report are expanded further below.

COE data

The Cost Framework for Estimation of Cost of Electricity (at 4.1 above) provided to DoE and PWD proved difficult to fulfill. Data were obtained by the EIC from PWD staff at Walu Bay for each of their power stations in November 2002. Further log book extractions around January 2003 by a co-consultant however, produced information which varied considerably with that originally obtained. Extensive inquiries to obtain data for each of the mini-hydro sites produced no results while information obtained from DoE on their solar lighting sites permitted only a superficial analysis. Problems in accessing information that the EIC could

acknowledge as being acceptable resulted in a delay of approximately 18 months.[10]

Therefore, it is emphasised that the analysis of the COE remains superficial and until such time as information of greater substance is made available the results reported here can only provide a partial response to the relevant TOR. It must be stressed that the foregoing is not to be construed as a fault of either PWD or DoE staff but rather an overall deficiency in record-keeping and staff access to information.

Social Survey Data

With respect to the social survey data, there were several internal inconsistencies between data sets and while it is acknowledged that problems of this kind can usually be traced to questioning and recording techniques and are common to rural surveys, the substantial point to be made here is that the EIC provided a detailed training program for interviewers that addressed these potential problems.

The training program delved into each question and explained its underlying reasoning, methods of triangulating answers and ways of testing the accuracy or otherwise reasonableness of responses. However, budget constraints did not allow this training program to go ahead although relevant DoE survey staff commented that their task would have been made much easier with the benefit of such training. Again, the EIC emphasizes that the foregoing is not to be construed as a deficiency in the people carrying out the survey. Indeed, there efforts were remarkable under the circumstances. Rather, an overall lack of consideration for interviewer training in the original ToR for the project.

Social Survey Database

[10] Key departmental documents such as the "1990-1999 Achievements of The Past Decade" and Fiji's Electricity Sector Reform (Past Developments and Future Direction" Department of Energy Government of Republic of Fiji, shed little light on the matter. Moreover, inquiries in August 2003 revealed that these documents had no been substantially updated.

A problem closely related to that just mentioned stems from the social survey database. The EIC designed the social survey questionnaire keeping in mind that a database was in the process of development. For initial purposes, Microsoft Access was selected as an appropriate platform. Unfortunately limited capacity within the DoE prevented the full realization of this facility to effectively manipulate the detailed information gathered through the survey. Under the circumstances, the EIC had to resort to manual transformations of the data before sense could be made of the findings. A fully working database at the time of analysis would have helped identify and provide an early resolution to the nuances in the social data.

RESCO Investor Forum

The final point is that the original Financial Issues Consultant hired under the relevant TOR departed the project without completing his assignment and did not leave behind any records of his activities including extensive interviews with industry representatives. Hence, within the time frame allowed, the RESCO Investor Forum was considered the only mechanism to obtain information on potential sources of investment from industry. While the Forum did produce valuable results participants did not represent a true cross section of industry, larger firms operating in Fiji were not present nor was there the required level of participation by the financial sector. Moreover, follow-up interviews with people representing those sectors not present at the Forum were constrained by time and budget limitations.

6 Project Outputs

The core outputs below capture the essential ToR for the EIC.[11]

- Output 1 – COE;
- Output 2 - Affordability and Willingness to Pay;
- Output 3 - Tariffs and Subsidies;
- Output 4 - RESCO Selection Criteria and Selection Process;
- Output 5 - Electricity Payment Systems; and
- Output 6 – Private Sector Financial Incentive Policy.

Additional outputs 7 & 8 were generated as a consequence of the process of inquiry linked to the core outputs and can be seen in the Appendicies.[12]

6.1 Output 1 – COE

The key task here is to estimate the present COE provided by government to rural communities in Fiji. The COE is calculated on the basis of (capital costs + Operations, Maintenance, Repair and Replacement (OMR&R) – subsidies). Due to difficulties experienced in obtaining accurate and relevant data from the PWD and DoE several points need to be made.

In relation to the PWD sites, no data were made available for capital establishment costs nor OMR&R, technical and non-technical losses. Hence the COE reported here is in effect the "recurrent COE of generation." Billing information was also unable to be obtained. The DoE recently undertook a survey of 55 generator sites of which 11 provided valuable data with regards to recurrent fuel costs and capital establishment costs. However, no costs were gathered for OMR&R. Data received from the DoE for three SHS sites provide cost of establishment costs and recurrent costs are inferred from the data provided. The DoE were unable to provide actual cost data for their micro hydro schemes.

[11] Output 5 Social Survey Questionnaire can be seen in the Appendices.
[12] Reference can be made to the second report by the Financial Issues Consultant on the funding data base.

6.1.1 FEA Grid Connected

The Government has set the FEA national tariff at 0.205 $/kWh[13]. Actual costs however, are much higher for power provision to rural areas. The rate is in effect subsidised by Viti Levu urban customers. FEA audited costs for 2001, for service available through the national grid system are depicted in Table 3.

Table 3 FEA Reported End User Costs ($)	
Viti Levu Urban	0.19 $/kWh
Viti Levu Rural	0.51 $/kWh
Vanua Levu Urban	0.40 $/kWh
Vanua Levu Rural	1.22 $/kWh
Ovalau Urban	0.38 $/kWh
Ovalau Rural	1.88 $/kWh

6.1.2 PWD Stations[14]

The PWD operates a grid scheme using diesel generators (gensets) at four of the five government stations, Kadavu (Vunisea), Lakeba (Tubou), Rotuma (Ahau) and Taveuni (Waiyevo). These gensets supply electricity to government offices, community hospitals, public institutions, stores, icehouses, and nearby villages. Electricity is supplied through mini-grids of a few kilometres in length. Since January 1998, the fifth government station in Vanua Levu (Nabouwalu) uses a hybrid power system to generate electricity using solar and wind renewable resources as well as diesel generators. The recurrent generation COE for these sites is depicted in Table 4.[15]

[13] Fijian Dollars ($)

[14] The costs shown are solely the cost of generating electricity and are probably at least 25% lower than the real delivered cost of energy and may be as much as 50% lower as based on rural diesel experience in other countries where complete records are kept. These data could not be reconciled with information provided initially be the PWD, see Memorandum, Chief Engineer Mechanical Electrical File No. EM31/16D/08, 13 February 2001.

[15] Rotuma is not included because records are not kept at one location and some expenditures (e.g., fuel) are not incurred by PWD.

Table 4 Breakdown of Recurrent Generation COE PWD Power Stations (2002)[16]				
Costs	**Lakeba**	**Vunisea**	**Taveuni**	**Nabouwalu**
Annual Production kWh/day	486	671	626	593 (diesel genset only)
Fuel Efficiency kWh/l	2.5	2.6	2.4	2.73
Hours/Day	12	18	24	24
Diesel $/kWh	0.506	0.477	0.380	0.347
Oil $/kWh	0.011	0.016	0.007	0.004
Supplies $/kWh	0.126	0.053	0.019	0.124
Transport $/kWh	0.009	0.016	0.010	0.031
Labour $/kWh	0.182	0.161	0.094	0.167
Total Cost $/kWh	**0.834**	**0.723**	**0.510**	**0.673**
Tariff $/kWh	0.205	0.205	0.205	0.205
Subsidised $/kWh	0.629	0.518	0.305	0.468

The recurrent generation COE at these stations is quoted in the Rural Electrification Policy of 1993 as ranging from about 0.80 $/kWh to 1.50 $/kWh without providing background information. However, users of the government stations electrification schemes are also only charged the national tariff of 0.205 $/kWh. Therefore, electricity consumption at the government stations is subsidised but the extent of the subsidy has never been officially documented.

PWD operates the government station schemes under a yearly budget. The fees collected from consumers are forwarded to the central government (Ministry of Works) and not correlated to the PWD cost-of-electricity production.[17] Towards the end of the budget cycle, with the possibility of service curtailment looming, the local residents and provincial officials manage to reach their central government representatives and somehow additional fuel funds are made available.

Unfortunately, maintenance, repairs and replacements are typically postponed. There are documented cases where replacement parts that represented less than 1% of the original capital investment, were postponed for 6 to 12 months. Thus, the current institutional framework does not provide incentives to charge true

[16] These are lower limits COE estimates. Capital costs are not available and yearly expenditures were estimated by reviewing all purchase orders and trying to identify those belonging to different stations. Hence, some costs might not have been identified. Costs do not include losses (Production – Consumption = Losses) estimated and based on comparisons of production and meter readings at Nabouwalu (1995) and prior to installation of hybrid system, losses there were estimated at 10%.

[17] There is some disagreement as to the accuracy of this as one commentator understood that though collected by the PWD it goes directly to the central treasury where it in no way relates to PWD budgets.

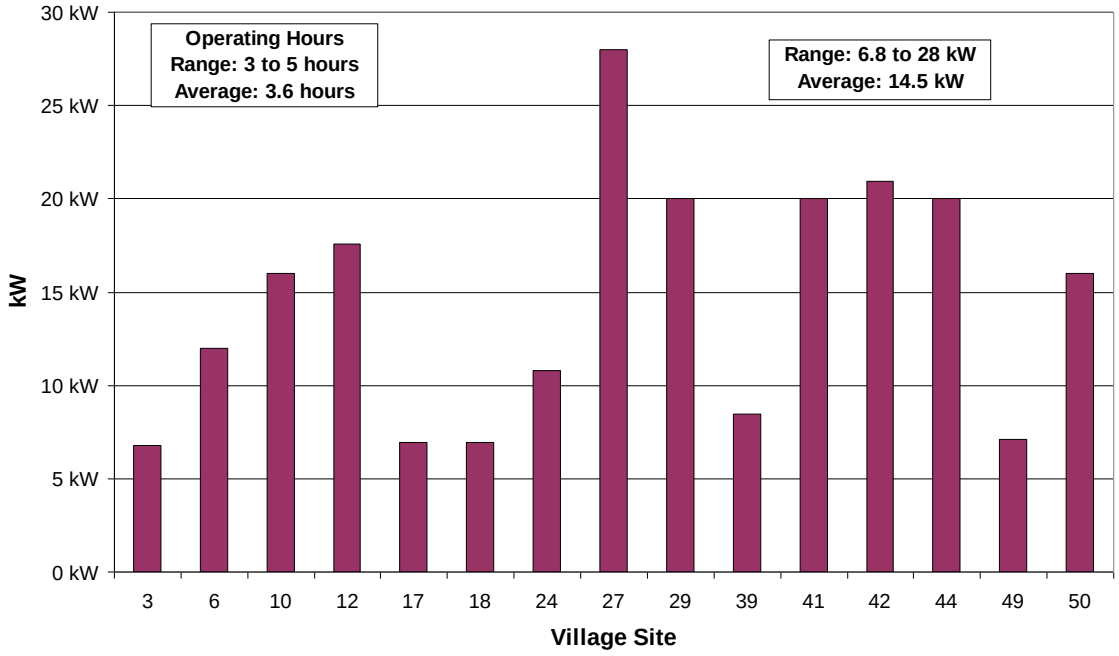
costs, to endeavour to optimise the operation of the equipment or to provide reliable service.

6.1.3 Diesel Systems

In February 2002 the DoE conducted a survey of 55 diesel generation sites which they had previously installed beginning in 1994 under the 1993 Rural Electrification Policy. Of the 55 sites surveyed only 11 sites provided sufficient information to assess the recurrent costs of energy and capital cost component.

Chart 2 reveals that across the total survey, the generators range on size from 6.8 kW to 38 kW and with most around 14.5kW. With an average household occupancy of 4.6 person, the generators operate from between 3 hours to 5 hours per day averaging 3.6 hours per day.

Chart 2 Village Diesel Schemes: Installed Capacity



The chart reveals that the service provided by these systems range from 92 – 933 Wh/day averaging 500 Wh/day.

Chart 3 Village Diesel Schemes: Daily Energy Produced (Wh) per Household

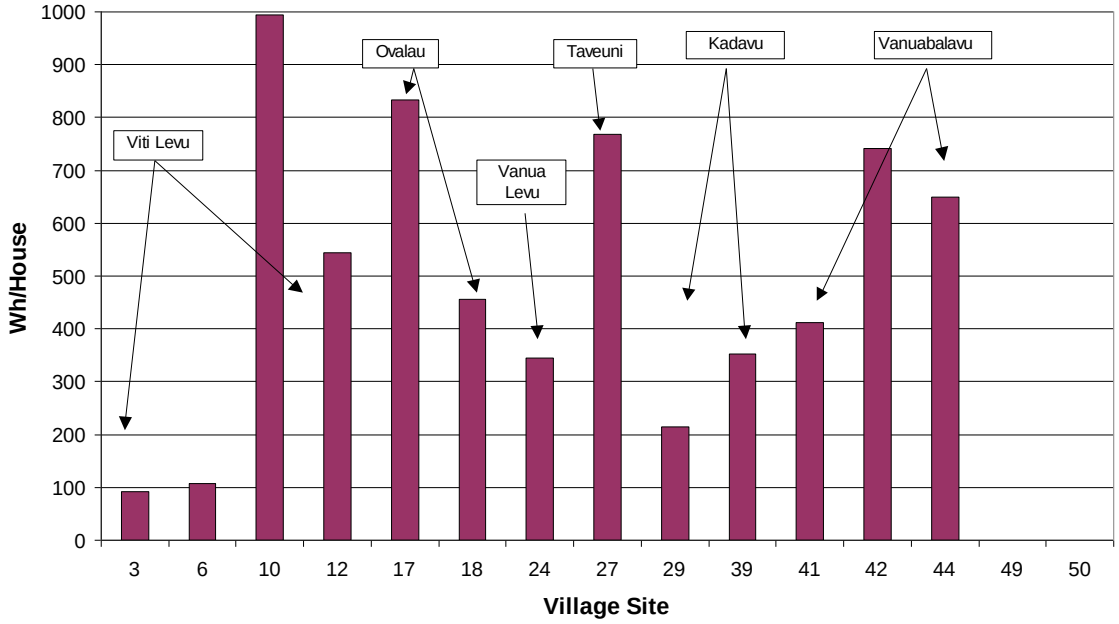


Chart 4 depicts the recurrent fuel costs, capital costs and their combined COE expressed in kWh for the 11 sites. Costs have been annualized at 8% per annum over 9 years producing and annuity factor of 6.246888.

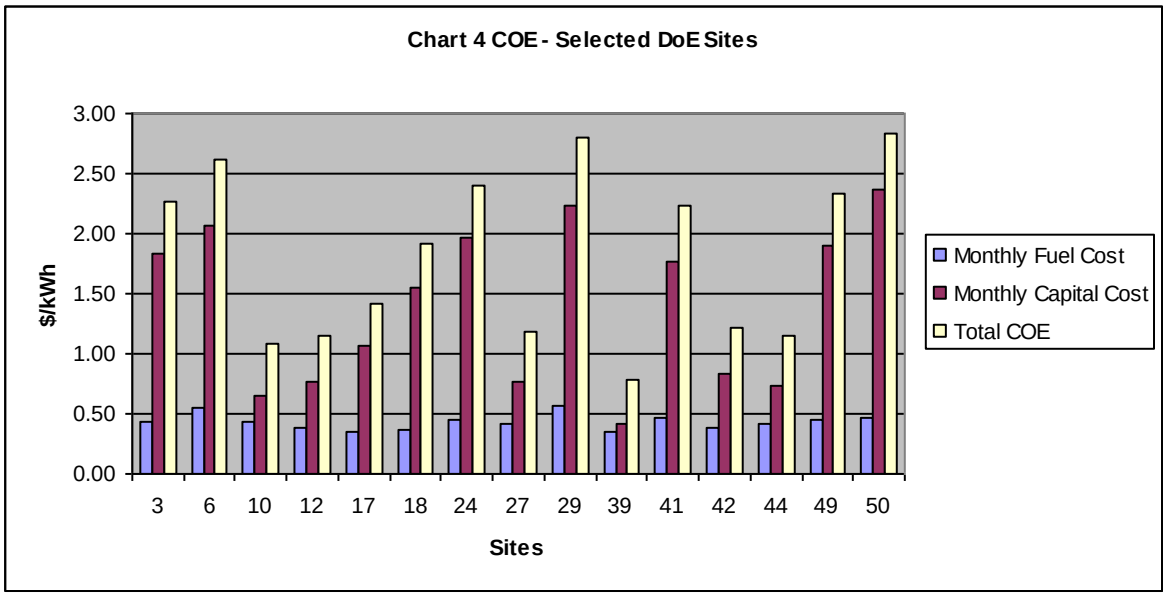


Table 5 represents the tabularized version of Chart 6 where it is easier to see that the average COE is equal to 1.83 $/kWh within a range of 0.78$/kWh to 2.84$/kWh.

Table 5 Monthly COE – Selected DoE Sites			
Village	**$Fuel/kWh**	**$Capital/kWh**	**COE kWh**
Namosi Village	0.44	1.83	2.26
Nausori Highlands	0.55	2.07	2.62
Waitolu	0.43	0.65	1.08
Naqali	0.38	0.77	1.15
Nasaumatua	0.35	1.07	1.42
Vuniivisavu	0.37	1.56	1.92
Naividamu	0.45	1.96	2.41
Qila Settlement	0.42	0.76	1.18
Natumua	0.57	2.23	2.80
Nasau	0.35	0.42	0.78
Daliconi	0.46	1.77	2.23
Levukana	0.39	0.83	1.22
Mavana Mualevu	0.41	0.73	1.15
Drano	0.45	1.89	2.34
Vunaniu	0.47	2.37	2.84
Maximum	**0.57**	**2.37**	**2.84**
Minimum	**0.35**	**0.42**	**0.78**
Average	**0.43**	**1.39**	**1.83**

6.1.4 DoE Solar PV Sites

Data obtained from the DoE for the Namara, Naroi, Vunivau sites were insufficient to draw meaningful conclusions. However, based on the data that were available annualized costs for each of the sites have been calculated on the basis of an annuity factor of 8.514 derived, in turn, from an assumptions of a 10% interest rate over a 20 year life of the system and battery replacement every 5 years at a cost of $681 which produces an annuity factor of 3.791. On this basis the monthly costs are produced in Table 6. Cost per kWh assumes 6kWh/month.

Table 6 Annualized Costs of Producing Electricity DOE SHS			
	Namara	**Naroi**	**Vinivau**
Initial capital cost per system	$2,438	$ 2,650	$ 1,187
Monthly annualized cost per house (capital)[18]	$23.00	$26.00	$11.60
Monthly annualized cost (battery replacement)	$14.00	$14.00	$14.00
Total annualized monthly cost per house	$37.00	$40.00	$35.60
$/kWh/month	**$6.16**	**$6.70**	**$5.90**
Monthly tariff per house	**$2.00**	**$7.50**	**$14.00**
Current subsidy	**$35.00**	**$32.50**	**$21.60**

Due to the variations in the data, meaningful comparisons cannot be drawn between PWD sites and DoE generation sites or SHS.

6.1.5 COE – Mini/Micro Hydro Sites

The data obtained for the mini/micro hydro sites at Nasoqo, Bukuya, Kadavu, Koro, Vatukarasa were insufficient to draw meaningful conclusions. [19]

[18] Does not include a contingency for any other replacement costs.
[19] Also, Navakawau co-generation steam plant is no longer operational. Also note that not all these sites are operated by the DoE as many have been turned over the local community.

Summary of Findings and Recommendations

1. The average cost to generate electricity by the PWD at their four sites is estimated between 0.51 - 0.83$/kWh, calculated on the basis of recurrent costs (fuel, direct labour, maintenance and repair) only. No reliable data for capital establishment, technical and non-technical transmission and distribution losses were available. Data on household billing could not be obtained. Hence the COE here is defined as generation costs.
2. Generators supplying rural houses with electricity under the DoE's diesel electrification scheme results in an average COE of 1.83$/kWh. This figure is comprised of 0.43$/kWh of fuel and 1.39$/kWh capital costs. Data for OMR&R were not available and therefore not included in these figures.
3. Data obtained from the DoE reveals a COE for their SHS at Namara, Navoi and Vunivau of 8.60$/kWh, 7.40$/kWh and 4.90$/kWh respectively.
4. Subsidies provided by government to defray the COE do not in any way reflect true costs or levels of affordability and therefore, have very little bearing on reality. Hence, government subsidies have been treated superficially throughout this report.
5. Data could not be obtained from the DoE mini/micro hydro sites.

6.2 Social Survey Results

Having made the point earlier that problems were encountered in the results to emerge from the social survey, the data did yield valuable information on patterns of expenditure on energy in households and therefore has proved useful in addressing the relevant TOR for this project. For purposes here, consumer affordability has been assessed on the basis of current levels of household expenditure on energy relevant **only** to that part of the household energy budget spent on lighting and for powering small consumer appliances such as radios.

The reason for adopting this approach acknowledges that SHS represent a direct substitute only for basic lighting, entertainment needs and power requirements for small appliances. Therefore expenditure on other energy sources such as wood and/or gas and the component for kerosene used for cooking and dry cell batteries for portable lighting needs are only included below in the lead-up to the final analysis.

6.2.1 General Findings

At the time of writing[20] the social survey had reached 432 homes in 45 un-electrified villages/settlements[21] on Vitu Levu and Vanua Levu and the outer islands of Lau Group, Yasawa Group and Rotuma Group. This accounts for 6% of the 7039 houses in 209 villages/settlements who have applied to the DoE capital subsidy under the 1993 for either grid connection or diesel policy (Table 7).

Table 7 Applications to DoE May 2003

Island	Households	Villages
Viti Levu	2236	61
Vanua Levu	2725	87
Kadavu	399	17
Lau Group	557	13
Lomaiviti Group	569	22

[20] August 2003.

[21] The data for another 100 or so homes surveyed on the outer islands were not available for analysis at the time of writing.

Yasawa Group	553	9
Total	7039	209

Within the survey group, the total population is estimated at 10,000 people with males accounting for 51% and females 49%. Household occupancy averages 3.5 persons per house but varies from between two persons (14%) and 11 persons in a few (7%) of cases. By far the largest number of people (over 85%) are self-subsistence farmers, fisher-folk and market sellers while the balance is composed of a mix of wages earners working for NGO's, government departments, hotels, and shops assistants. Average income is reported as $220 per month (Table 8) with average household expenditure of around $174.00 per month.

Table 8 Estimated Annual Household Income	
(%) Household	Annual Income ($)
14	Less than $1,500
37	$1,500 - $3,000
18	$3,000 - $5,000
31	Greater than $5,000
100	Average $2,640

The relationship between household income and expenditure is produced in Chart 5.

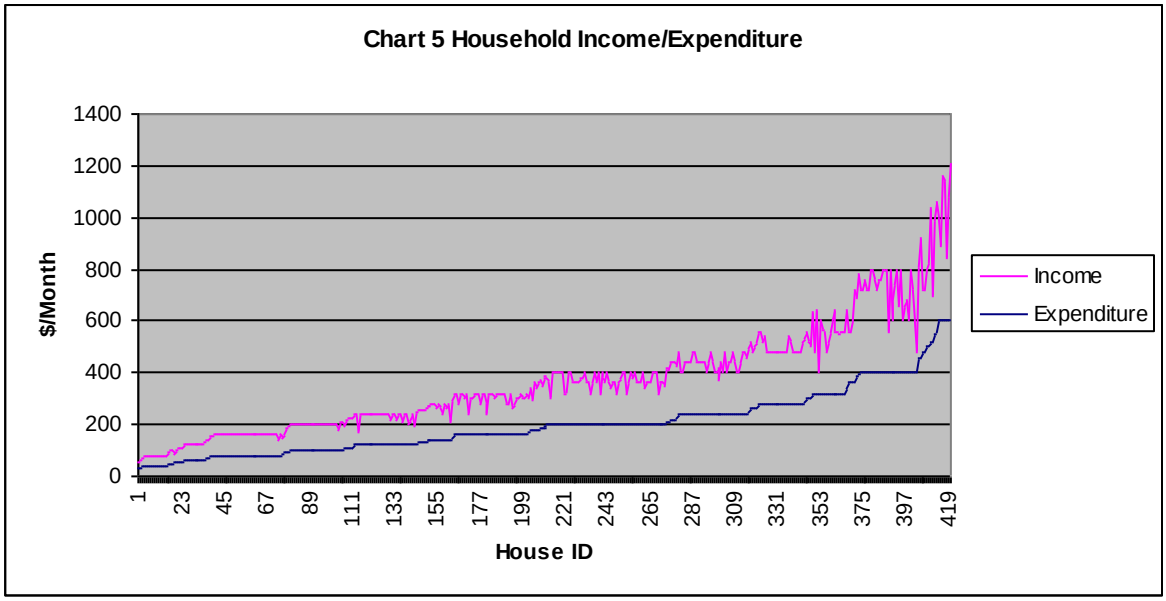


Chart 5 reveals a close relationship between household income and expenditure with estimates of household expenditure (median) comprising of food (36%), general household goods (18%), schooling (18%), medicine (13%) and other (15%) which presumably includes energy. Other data indicates some level of savings across the surveyed households however, in reality savings are negligible and in keeping with subsistence communities and/or where the opportunities to purchase goods beyond daily necessities are limited.

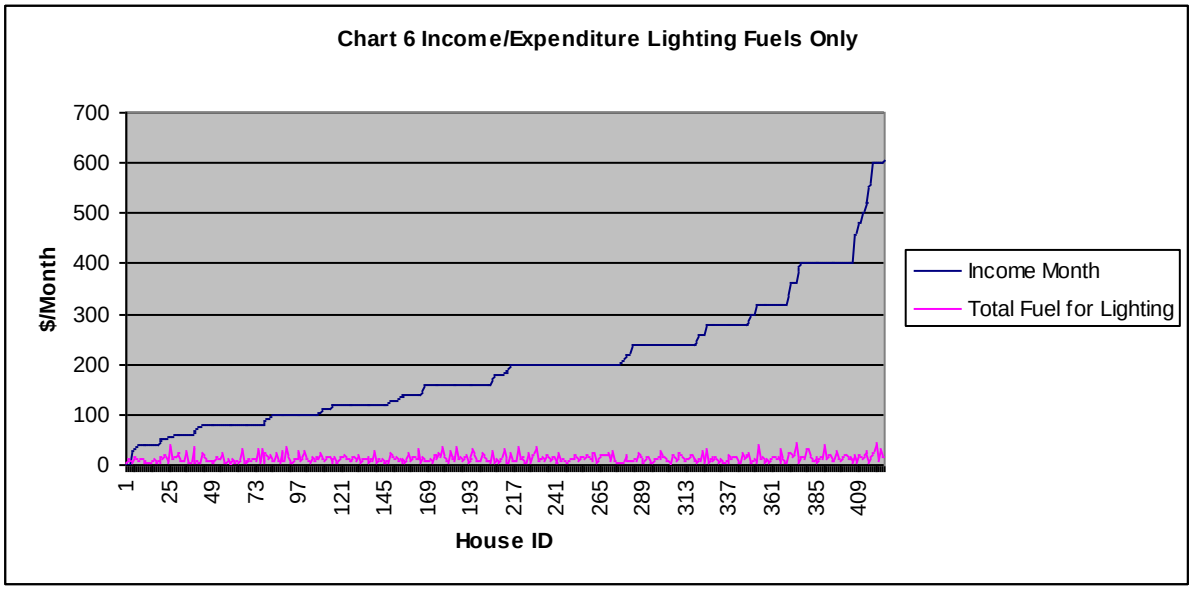
Crops planted are the main source of household consumption while any surpluses are sold for cash hence, the majority (85%) of households surveyed plant to eat but at their same time there is spare capacity to increase the quantity and/or harvest more under crop and therefore, scope exists to expand cash income. This is often the case when the need arises. For example, farmers reported that when there were family or customary events planned or church tithes due they were able to expand income by simply harvesting more product such as cassava or dalo (taro). The same respondents state that meeting a monthly electricity tariff should on the face of it, pose no problems as long as there was real value-for-money.

Householder levels of satisfaction with present energy sources were considered, revealing that around 58% were satisfied with present ways of lighting and cooking and 38% dissatisfied, the remainder provided no comment. While on balance people are happy with their present lighting and cooking circumstances householders were open to the thought of an alternative least-cost (within the present household energy budget) ways of lighting.

The total household budget contains a component for energy and more particularly in the context here, the monthly average expenditure on household lighting and entertainment is important to distinguish. The relationship between income and expenditure on these items is depicted in Chart 6.

It seems clear that as income increases, expenditure on lighting remain practically constant. The reason being that homes only need so many lights and entertainment is limited to small radios. Hence, the implication here is to avoid considering using income as a means of determining affordability for SHS

services that merely substitute existing lighting for that already being used in homes.



6.2.2 Affordability

Consumer expenditure on energy fuels is estimated in Table 9.

Table 9 Estimated Average Total Monthly Household Expenditure on Energy

Energy Source	$/Month	Proportion of Households (%)	Predominant Application
Unleaded petrol	16.00	Few - Unable to extract[22]	Petrol generators/vehicles
LPG	12.40	33%	Cooking
Kerosene Primus lantern	 6.57 7.70	 15% 100%	 Cooking Lighting
White Benzine	9.23	59%	Lighting
Pre-Mix	18.70	Few Unable to extract[23]	outboard motors
Candles	2.50	Unable to extract	Lighting
Dry Cell batteries	9.00	79%	Portable Lighting/ Entertainment

As to be expected, household expenditure on energy fuels is much greater for those with home-scale petrol generators than those without such facilities. However, of the 433 homes surveyed there were 62 homes or less that 2% of the survey with generators. These generators service another 165 homes with most connected by standard electrical extension leads. These households commonly possess televisions, stereo and video recorders, electric fans and tube lighting.

[22] Data not extracted at time of writing due to problems with accessing the social data base.

Some houses have electric fry pans, rice cookers, standard lamps and in some, albeit very few instances, freezers are being used.

Householders report that they use their generators an average of 3.5 hours per day with associated daily costs of $2.30. At face value this would translate into round figures to $60.00 per month. In reality people use their generators mainly on a Friday night and over the weekend for social gatherings and on this basis fuel costs are estimated to be around $16 per month. Table 10 provides a breakdown according to expenditure bracket and appliance.

Table 10 Household Expenditure on Energy

Expenditure $/month	**Appliances/applications**	**Notes**
<20	Two lanterns, flashlight, radio, two burner stove	Low income household – small house one – two bedrooms – basic lighting needs three – four occupants
20 – 40	Two – three lanterns, radio, flashlight, single or two-burner stove	Same as above
40 – 45	Two – three lanterns, radio, torch, stove, brush-cutter, chain saw	Medium size house – three to four bedrooms/rooms six occupants
>45	Tube lighting, TV/Video, radio, outboard motor (coastal villages), brush-cutter, chain saw, refrigeration	90% own diesel genset – often power extension cords connecting neighboring houses

Table 10 shows that those families spending $20.00 or less on energy devote a considerable proportion of their energy budget to lighting, radios and flashlights.[24] The data here suggests that the minimum that consumers might be expected to pay for lighting is less than $20.00 per month although there is still a small component of expenditure on cooking.

The majority of people (98% of households) do not have access to petrol generators and therefore possess modest convenience items namely, LPG cook stoves (32% of households) and kerosene lanterns (all households) and /white benzene lanterns (50% of households). Over the houses surveyed, expenditure on energy varies from as low as $3.80 per month to as high as $29 per month. The average expenditure on kerosene, used by all households is around $9.00 per

[23] See fn 18.
[24] Meaningful comparisons cannot be made with houses running their own gensets.

month and between $2.00 and $4.00 per month is spent on white benzene and dry cell batteries add around another $7.00 per month. Taken together this indicates that the average monthly expenditure on home lighting and entertainment is around $18.60 varying between $13.00 and $19.00 depending upon the use of dry cell batteries. Table 11 depicts average expenditure of around $19.00 per month on lighting fuels and dry cell batteries only.

Table 11 Monthly Expenditure ($) on Kerosene and Benzine for Lights and Dry Cell Batteries	
Average Expenditure	$18.60
Standard Deviation	$11.30
Maximum	$69.60
Minimum	$4.80
Modal Occurrence	$16.60
37% of Expenditures > $20	>$20

Hence, based on household level of expenditure, it reasonable to expect a tariff in the range of $13.00 and $19.00 per month. Setting a tariff at $15 per month would effectively capture 75% or all households in those surveyed, (see Table 12 below) that are in fatc paying this figure or more per month for lighting and home entertainment services..

Summary of Findings and Recommendations

1. Based on present level of expenditure on fuels for lighting only, rural householders spend between $13.00 and $19.00 per month.
2. Based on these data, householders can be reasonably expected to pay a minimum of $15 per month for a RESCO tariff.

6.2.3 Consumer Willingness to Pay

The analysis and discussion above was concerned with the patterns of consumer expenditure on energy broadly and lighting specifically. From this, a reasonable level of affordability of $15 per month has been derived. Being able to afford the RESCO service however, is not enough to conclude that purchase and commitment will ensue. Willingness to pay represents the other half of the equation and is driven largely by the incentives required to switch from present methods of lighting to SHS.

Given that SHS are able to meet basic household lighting and small appliance needs, assessing the circumstances surrounding willingness to pay must be related to issues of service equivalency able to be provided by SHS. For example, the data reveals that consumers use lights for an average of 5 hours per night[25] hence, consumers will expect the same duration of service from SHS. Should this not be possible, due to system limitations or factors that might degrade system performance, consumers will when there is no alternative immediately revert to their old ways of lighting when SHS fail.

In the event, consumers will be faced with additional energy costs as they are forced to resort to kerosene lanterns and flashlights. In view of household budget constraints there is limited scope to increase expenditure which simply means that consumers will not pay their monthly tariff or pay less according to the perceived (diminished) value of the SHS. Consumers will decide on the degree of departure of service level provided by the SHS from their expectations, based on either what they have been told or from what they have heard or seen, and their actual experiences with the system when in operation.

As pointed out above, factors bearing on this decision to switch to a SHS will invariably include whether the consumer will gain or lose financially and whether the level and quality of lighting increases or decreases. It does not necessarily follow however, that demand for SHS will be attenuated if the SHS is provided at a higher cost than what consumers are currently paying for equivalent service. Added expenditure will invariably be justified on the basis of whether the consumer perceives increased value in the SHS electricity service over present methods of lighting.

In this respect, attention must focus on the non-financial gains to be made by the family. For example, SHS lighting does not produce fuel odours, people and especially children are safe from accidental burns, incandescent lighting poses little or no fire hazard, is conveniently available at a flick of a switch compared to

[25] This is in keeping with the findings from the DoE survey of diesel generator survey, see 6.1.3.

the burden of transporting fuel and the recurrent cost is not subject to volatile fuel prices.

Summary of Findings and Recommendations

1. The willingness of by consumers to pay for SHS will depend on whether SHS are able to provide a perceived improvement upon present levels of lighting service (quality and duration) and remain with affordable limits noted above.
2. The recommendation here is that willingness to pay will also be enhanced by promoting SHS as a safe and clean alternative to present methods of lighting.

6.3 Subsidies

The issue of subsides, whether applied at the consumer or producer (RESCO) level is a thorny issue. On the one hand, there are legitimate grounds for government to defray costs for public goods where market forces fail to operate effectively and in exceptional circumstances government can support low-income households who are unable to meet expenses for basic necessities. However, subsidies are resource depleting and as a solitary policy instrument, inherently undermine price signals. Further, there is reason to question whether electricity should be considered a "basic necessity" that should be subsidized at all for rural households.

The RESCO program here however, is designed to have operation and maintenance implemented along commercial lines and therefore, the issue of subsidies for recurring costs should not be entertained. The manner of implementation of the RESCO program does allow the use of capital subsidies however, and those can dramatically affect the end-cost to the consumer if so desired. The grounds for this argument emerge from the analysis on expenditure on lighting which shows that it is not immediately apparent that it is income dependant. Rather, the estimated level of affordability of $15.00 per month is derived from actual expenditure at present and householders are in a position to increase their income as the needs arises. Hence, it would seem unnecessary to contemplate a consumer subsidy.

There is also the perspective of the RESCO to consider. Invariably, RESCO candidates must approach their task in a commercial manner. Basing their business plan on a market that is propped-up by a government subsidy and therefore, profitability turns on government intervention and is problematic as it introduces a further element of risk. Risk here derives from the fact that besides anything else, subsidies in the main result from political decisions and can therefore, be removed according to the political party/agenda at the time. Hence, RESCOs would need to construct the business plan according to political will and factor potential changes. From a commercial perspective, this is unacceptable lending further support to a general disapproval of consumer subsidies.

Nonetheless, it must be recognised that different RESCOs will have different cost structures depending upon the characteristics of their service region. A combination of distance, terrain, presence or absence of transport routes an so on mean that some areas simply cost more to service. In this regard there is some rationale for an area-based subsidy that would bring down the costs of access and hence, service. It must emphasized that any subsidy that is applied in this regard should remain outside of the RESCO program.

There are grounds to argue that departments beyond the DoE that have an interest in rural areas such as department of Fijian Affairs would be in a better position to assess and administer their particular regional needs for recurrent subsidy support. Notwithstanding these comments, any recurrent subsidy burden should be borne by other agencies and not the DoE and should be made directly on the behalf of the consumer not provided to the RESCO to offset their costs. The RESCO should be required (and allowed) to operate on a purely commercial basis..

In the event that consumers are subsidized for recurring SHS monthly tariffs the impacts and difficulties in applying such must be considered. Table 12 offers a bold extrapolation from the data at hand to the 7,039 households which have to date, applied for SHS.

Table 12 Estimated Distribution of Fee Scale for SHS Services				
Monthly Tariff	**Household (%)s**	**Number**	**Cumulative Number**	**Cumulative %**
$5	7	472	472	7
$10	18	1267	1739	25
$15	19	1323	3062	44
$20	18	1274	4336	62
$25	13	915	5251	75
$30	10	704	5955	85
$35	6	422	6377	91
$40	4	260	6637	94
>$40	6	401	7038	100

These data show that if the tariff is set at $15.00 per month then 26% or 1,739 homes are to require subsidy support. If the tariff is raised to $20 per month, then the proportion of homes able to afford the monthly tariff reduces to 43% or 3,063 houses will be needing a subsidy. On the basis of these data, Table 13 shows the cumulative impact of subsidies depending upon the monthly tariff.

Table 13 Annual Subsidy at Varying Set Monthly Tariff ($)		
Monthly Tariff ($)	**Number of Houses Requiring Subsidy**	**Annual Impact of Subsidy ($)**
10	472	28,320
15	1267	132,660
20	1323	311,720
25	1274	576,540

If the tariff is set at $15.00 per month then the impact of the subsidy on government is $132,660 per annum for 1,739 homes. If the tariff is set at $20.00 per month then the annual subsidy required is $576,540 or an 85% increase over the previous. Given the recommended tariff of around $15.00 per month an annual subsidy of $132,660 is required. Whilst these figures seem insignificant, around $1.00, on a per household basis, the real impact is felt when the issue of how the subsidy is to be applied is considered. An across the board subsidy calculated on the house number above and to $20.00 tariff would create a burden on government to the sum of $1.6 million per annum

6.3.1.1 Application of Subsidies

Several scenarios have been presented with regards to the appropriate level of subsidy based on estimates of consumer affordability. There are however, concerns with the application of a subsidy in terms of to whom should it apply which on its face does raise issues and concerns. The main concern surrounds problems that are likely to be encountered if the subsidy is applied differentially across consumer households. That is when the subsidy applies only to low-expenditure houses, that is to say those in the present $5.00-<$15.00 per month. It is predictable that this will lead to disquiet among those receiving no subsidy support and will therefore, have a negative effect on consumer willingness to pay for those concerned. Hence, the main issue now is how to get around the problem.

The overt method is to provide a subsidy for all consumer households. This means that if the monthly tariff is set at $20.00, then working on the minimum monthly payment for electricity or around $5.00 (See Table 10), everyone then receives a $15 subsidy every month which on present figures translates to an subsidy impact on government of $1,266,840 per annum.

This result is neither acceptable nor desirable and therefore, mechanisms are needed in order to identify the needy households and apply the relevant subsidy without inspiring community unrest. However, following this line of arguments leads to an escalation of the problems and issues. For example, Table 14 provides five generic scenarios for applying subsidies based upon the economic and financial circumstances of individual households and it should be noted that the applicability of any of these generic scenarios depends upon local economic and policy circumstances.

Table 14 Application of Differential Subsidy	
Generic Subsidy Scenario	**Applicability**
1. Tax adjustments	Applicable where taxes are levied on individuals and households such as income tax or land tax respectively.
2. Discretionary local government taxes and charges	Applicable in the above cases but applied by local authorities in a discretionary manner, for example, refuse charges or community improvement/infrastructure programs.
3. Low-Income household support payments	Applicable where low-income households receive financial support for necessities where top-ups can be factored in for electricity charges.
4. Capital cost rebate	Applicable where consumer household purchases the system and a capital cost rebate is provided by government.
5. User-pay system	Applicable were electricity consumption can vary according to consumer household demands.

Examining the five scenarios presented in Table 13 against policy and program circumstances operating in rural Fiji, it seems that scenario five might be the only possibility. The problem though is that a monthly tariff for SHS is based on a level of services provided rather than consumption of electricity. It is necessarily a fixed monthly fee based on the size of the system installed, metering of energy usage is not practical nor appropriate. There are therefore, immediate difficulties in applying this scenario to the problem of supporting those consumers paying below the recommended monthly tariff of $15.00 per month. Even this option however, is not without its own problems of which many below will fall upon the DoE to manage:

1. Determination of "true" less affordable households;
2. Accounting for lighting expenditure escalations within this group of households over time and therefore identifying those rising above the subsidy category; and
3. Accounting for expenditure declines among other consumer households over time and therefore identifying falling into a subsidy category.

Further, in the event of a subsidy, another major problem to consider is the time frame over which the subsidy will operate. To say the least this is a complex issue where a spectrum of scenarios exist:

- national subsidy for an indefinite time frame, as appears to be the case with the national electricity tariff;
- defined subsidy period where the subsidy is extinguished after all SHS systems have been installed; or
- diminishing subsidy declining over time as a consequence of rising levels of affordability.

Once again, problems attach to each of these possible time-frame scenarios. The first and second scenarios lacks substance based on the above findings and arguments. The third scenario depends upon complex national policy issues relating to rural development agenda and relative performance outcomes. In this respect, the complexity lies in the fact that the gradual reduction of subsidies and relative increase in tariffs to reflect true costs are bound up in national development efforts and progresses made in this regard. Hence, while the RESCO program is incorporated within the national development agenda of Fiji greater efforts must focus on income policies as part of governments national livelihood improvement program. Where job creation is limited and hence, income growth constrained, it is very difficult to suggest a time frame for a subsidy as the whole issue turns of levels of affordability.

The problems and difficulties raised above render any arguments for a consumer subsidy seemingly groundless. On the other hand, the argument for not contemplating a consumer subsidy does, on balance, seem to have more merit. By way of summary these arguments are grounded on the following:

- RESCOs contemplate a commercial venture and would be reluctant to base their profitability on the fragility of a consumer subsidy;
- The level of subsidy required will exert a considerable impact on government budget;
- Survey data reveals that households have the capacity to vary income according to needs and therefore, there is no reasons to suspect that consumers will be unable to meet monthly tariff commitments
- Application of a consumer subsidy is logistically difficult

- The application of differential subsidies would lead to community unrest;
- Identifying needy households is difficult;
- adjusting subsidies over tome to reflect changes in individual household economic and financial circumstances is logistically complex and resource demanding.

There exists a possibility for a major subsidy for capital cost reductions that are passed on to the RESCO and thereby to the consumer, are transparent and are one time only, not requiring a recurring subsidy budget to provide an offset for operation and maintenance costs. On the basis of these arguments, it is recommended that recurrent consumer subsidies should not be contemplated within the RESCO concept but consideration given to area-based financial support by local development agencies on the basis of verified service cost differentials among RESCOs.

Summary of Findings and Recommendations

1. The proportion of people presently paying below this amount is estimated at 26% or 1,851 households of the 7038 houses that have applied to the DoE for electrification.
2. Any consideration for a consumer subsidy appears contrary to the commercial underpinning of RESCO activities and is therefore not recommended.
3. In the event that a consumer subsidy is contemplated, the burden on government for an across the board subsidy amounts to $1.6 million per annum.
4. In the event that a consumer subsidy is applied to those households presently spending less than $15.00 per month on lighting fuels, then the burden of subsidy on government is $132,660 per annum
5. Whilst a consumer subsidy is not recommended there might be grounds to contemplate an area-based subsidy that cushions cost differentials in servicing difficult areas.
6. If this were the case, it is recommended that any financial support be administered by government agencies with interests in rural areas such as Department of Fijian Affairs or Department of Rural Development and therefore, remain outside of the DoE program of activities,

6.4 Output 2 - RESCO Selection Criteria and Selection Process

This section deals with the process of selecting RESCOs and generally underscores the main principle that market mechanisms must be allowed to work and therefore, RESCOs must be selected according to cost-service and efficiency guidelines.

6.4.1 RESCO Selection Criteria

This section outlines several key criteria that should be used in selecting RESCOs from a pool of private sector candidates. The material below complements the requirements for RESCOs contained in the Business Planning Guidelines developed elsewhere under the GEF/UNDP project for RESCOs. RESCO candidates must be able to meet three generic competencies: financial base and stability, business management/ entrepreneurial skills, and technical/ service capability. An outline of what should be expected from a RESCO candidate is depicted in Table 15.

Table 15 RESCO Selection Criteria

Generic Criteria	Specific Criteria
Legal and Financial standing	• Legal status (eg, private/ public company, limited liability, partnership, trust etc) • Identify whether new-start, or existing firm with rural experience product diversifying, or existing firm no rural experience, product and market diversifying • Credit worthiness • Access to commercial finance/ borrowing capability • Balance sheet (existing firms)
Products and Services	• List of products and services to be considered • Type of installations expected to be made • Location of installations
Business Management/ Entrepreneurial Skills	• Personnel structure • Marketing and sales skills • Business history (direct or indirect experience in rural electrification, development, electricity industry) • Five years estimated profit and loss statements • Projected working capital requirements • Cash flow projections (10 years) • Business management skills (financial management and accounting systems); demonstration of fee collection procedures and banking/funds transfer processes. • Commercial sense in regards to fee collection, debt recovery, and customer service delivery

	• Risk assessment and response strategies
Technical Skills/ Service Capabilities	• System installation (against DoE standards) • System inspection • System maintenance and repairs • Technical trouble shooting • Technical training (staff and community) capacity • Quality control standards and monitoring system performance • Maintenance program • Inventory purchasing and stock control systems (assuming shared warehousing responsibilities with DoE)[26] • Logistical capability (order processing, product/ service delivery including time frames, warehousing/storage capabilities)

As stated above, these criteria must be applied with reference to the RESCO Business Planning Guidelines, the *Rural Electrification Act* and Regulatory Charter. Supporting the assessment process, are the operational policies, yet to be prepared by the DoE, which provide an overall guide as to what is expected from RESCOs in terms of performance measures, reporting, monitoring and evaluation. The DoE must attribute significant attention to data recording, storing, access and retrieval systems. Information is critical to the success of the RESCO program as the very nature of public-private partnerships calls for heightened public sector scrutiny.

6.4.2 RESCO Selection Processes

The DoE is to ensure that the RESCO selection process proceeds in an open and transparent manner. This is critical when the outcome is designed to bring private and public sector interests together in a commercial venture. Here, the emphasis in selecting RESCOs remains an objective assessment based on the above criteria and detailed scrutiny and verification of their business plan. It is recommended that the process be undertaken by a specially convened RESCO Selection Panel with members having extensive commercial background and experience. The work of the Panel can be guided by the seven-stage selection process depicted in Table 16.

[26] The RESCO-DoE partnership program operates on the basis that DoE will purchase, test and warehouse all SHS equipment and balance of systems components. However, logistical realities dictate that RESCOs will need to possess the capacity to store equipment and components.

Table 16 RESCO Selection Process		
Stage	**Process**	**Outcome**
1. Legislative Uniformity	Review legislation for broad terms and conditions/ performance issues.	Selection process conforms with relevant legislation
2. Charter Uniformity	Review RESCO Charter to inform broad terms and conditions/performance criteria	Selection process conforms with RESCO Charter
3. Selection Criteria Uniformity	Review selection criteria	Selection process agrees with selection criteria
4. Call for Applications	Advertise for Applications	
5. Identify Panel Members	Identify RESCO Selection Panel	Panel formed
6. Panel Preliminary Vetting of Applications	Assess conforming applications on basis of Business Plan	List of eligible candidates
7. Candidate Selection	Assess Business Plan	Short listed candidates
	Evaluate financial base and stability	
	Evaluate business management/ entrepreneurial skills	
	Evaluate Technical skills/ service capability	RESCO Selection
8. RESCO Briefing	Convey Legislative, Regulatory, Operational Performance guidelines	RESCO Performance Agreement
9. Licensing	License Negotiations	License Agreement

Stages 1-3 aim to ensure that the selection process commences and proceeds in conformity with the *Rural Electricity Act*, Regulation Charter and appropriate selection criteria. The importance of taking these steps lies in keeping with the legality of the selection process under principles of public law. Stages 4 & 5 are designed to attract potential RESCO candidates and suitable panel members. In stage 4 advertisements should aim to have a wide geographic reach in order to attract applicants from all over Fiji. In stage 5 potential panel members should represent the finance sector, industry and commerce preferably with interests and experience in rural markets.

Stages 6 & 7 represent the evaluation stages of RESCO applications. Stage 6 offers a preliminary step to exclude those applicants unable to meet the basic criteria and could largely be undertaken by DoE staff. Stage 7 requires are more critical evaluation of candidates business and technical standing and therefore, a task for the full RESCO Selection Panel. This process should culminate in a license agreement between individual RESCOs and the DoE.

The issue now becomes one of the composition of members on the RESCO Selection Panel. It must be recognised that the selection process will consider the technical/operational and commercial wherewithal of RESCO candidates where the latter is assed in terms of past performance, for existing businesses, and future performance for all candidates. The DoE has the requisite capacity to assess technical merit along guidelines established elsewhere under the present UNDP/GEF project but arguably lack the capacity to assess commercial merit.

An evaluation of the commercial elements of the RESCO applications demand considerably skill and experience more than a mere understanding of commercial principles. These skills are invariably not within government agencies but in industry. Hence, there is a critical need for commercial, managerial and possibly legal skills on the RESCO Selection Panel. It needs little mention that when selecting panel members an awareness of any existing or potential conflicts of interest must be assessed. It is recommended that the DoE advertise for expressions of interest from eligible individuals that represent industry and those individuals are selected on the basis of a reasonably remote chance of a conflict of interest emerging and according to relevant skills and experience.

Summary of Findings and Recommendations

1. The RESCO Selection Criteria evaluates potential RESCO candidates on three related lines, Legal and Financial standing, Products and Services; Business Management/ Entrepreneurial Skills, Technical Skills/ Service Capabilities.
2. The RESCO selection process must be conducted in an open and transparent manner by a RESCO Selection Panel an on a footing consistent with relevant legislative and regulatory provisions. The Panel must include individuals with business and commercial experiences in order to assess the business and financial aspects of applicant's proposals. The DoE is well placed to undertake the technical evaluation of RESCO proposals.

6.5 Output 3 - Electricity Payment Systems

A major departure in this project from traditional approaches to rural electrification involves the private sector (RESCO) as delivery agents. For their effort, the RESCOs must cover their operating and inventory costs plus derive a profit that will ensure their continued participation. In the RESCO project, remuneration derives from a fee-for-service charged to the consumer by the RESCO which therefore, represents their main source of income.

6.5.1 Commercial Considerations

At the outset its must be stressed that the method by which an individual RESCO adopts to collect tariff payments should be a matter for them to decide. This supports the commercial underpinning of the RESCO program and individual RESCO and the success or otherwise of RESCO operations determined on the basis of the commercial decisions they make. Nonetheless, of interest to the DoE, comments can be made as to what might be appropriate ways of tariff collection. As depicted in Table 17, there are several ways in which a fee-for-service can be collected.

Table 17 Methods of Payment, Collection and Funds Deposit[27]

Method of Payment	Method of Collection	Collection Agent	Method of Deposit
Direct to RESCO	Personal cheque Cash	RESCO	Cash deposit (RESCO Account)
Direct to central community fund	Cash Cheque	Community Agent/ Intermediary	Cheque or cash bank deposit (community account)
Direct to local banking facility	Periodic bank transfer Cash deposit	Consumer	Bank deposit (RESCO Account)
Direct to other payment facility (eg post office)	Cash deposit Cheque	Consumer	Cheque/ Cash deposit (Payment Facilities Account)

Again, emphasizing the fact that a determination of how to collect fees should be the responsibility of the individual RESCO local circumstances may inform an otherwise decision. The ability of consumers to make regular payments will in

[27] Please note that recent developments in the establishment of the NCSMED -See Funding Report- may ease the burden of tariff collection if done by means other than direct to RESCOs)

part be influenced by the frequency of household income, whether or not there are local facilities for tariff payments (local deposit taking institutions or informal collection centres such as the local shop, community administrator or post office) and the distance required by the consumer to travel to and from the payment facility.

As to be expected the main factors that lead to uniform payment histories include regular household income and/or remittances and local payment facilities. As mentioned previously willingness to pay will turn on levels of customer satisfaction which correspond with levels of RESCO service that is able to be provided.

As to be expected there will be a transaction cost in tariff payment and collection however, these costs can be minimised by limiting the number of steps in the transaction process. The less number of agents in the chain also exerts a considerable impact on reducing the number of tariff defaults; lowers the risk of misappropriation of proceeds and reduces the time between tariff payment and deposit. In sum, there are costs and benefits associated with each of the various methods depicted in Table 17. Experience is telling in that there is direct link between limiting the number of people in the transaction chain, reduced costs and heightened benefits most notably risk reduction.

6.5.2 Pre-Payment Systems

It has been requested by the PM in accordance with the TOR to provide an account of pre-payment systems however, it is acknowledged at the outset that the ways in which most pre-payment systems operate are not conducive to SHS. For example, pre-payment systems have relevance when in situations where consumers purchase electricity on an energy use basis. In the present case with RESCOs this is not so clear, consumers are purchasing a service for a fixed monthly fee and therefore, it is difficult to distinguish one consumer household from another based on consumer demand.

Having said this, pre-payment systems have been employed with a degree of success in many rural electrification projects, particularly in remote Australian Aboriginal communities. As part of a package of measures designed to improve project sustainability pre-payment systems coupled with smart metering using key pad (pin numbers) or swipe card facilities can be a sound option over conventional manual meter reading and periodic billing systems. The decision as to whether or not to use pre-payment systems in the first place is dependant upon a number of factors that are generally resolved in terms of effort/ financial outlay against, the likely level of payment default. In other words, is the financial cost of including pre-payment hardware and software in the program budget outweighed by community default on tariff payment? Or are there any other mechanisms to improve tariff payment and hence, ensure financial sustainability of the program?

In general terms, a pre-payment system is useful in low-income communities where irregular patterns of income are the norm and where there are discernible wealth differences between households. In the Australian experience, pre-payment systems were designed to protect households and the community administration falling into debt. Unfortunately, there is little or no information available that has comprehensively tracked and documented the effectiveness of pre-payment systems over the long term. There are however, some lessons to be learned from anecdotal evidence from Aboriginal communities in Australia where pre-payment systems have been introduced.

Service organisations in Australia report that a pre-payment system coupled with suitable metering devices can be effective if they are properly introduced into the community and that effective institutional arrangements to administer the user pay system are implemented. Consideration must be given to the metering device as well as the hardware (swipe cards) and software technologies (recharge and accounting systems) in respect to local resources, skills and in general operational capabilities. Introducing low-level appropriate systems and devices are recommended as opposed to complex devices that require skills outside of the community to service maintain or simply repair. Experience in Australia shows that when a pre-payment system fails, for whatever reason, it is difficult to make a fresh start.

In a general sense, Australian experience again indicates that flexible tariff setting mechanisms, open and transparent accounting procedures and a high degree of accountability in funds management and secure banking procedures improve sustainability. Despite best intentions problems have arisen giving cause to take special care with implementation protocols:

1. Technical problems not addressed in establishing the metering system making it hard to recover from a poor start;
2. Poor tariff collection where cards are provided to households on credit producing debt problems for system administrators;
3. Deliberate tampering to circumvent the metering system;
4. Illegal and often dangerous power sharing practices between groups of households;
5. Cards used as medium for exchange for goods and services and other even less desirable activities such as gambling or for purchasing alcohol or illicit drugs;
6. Propensity to establish a secondary market in the trade of cards compounding power and financial inequities in the community; and
7. Third party underwriting household electricity debt and either reselling to the household at a premium to maintain electricity service on-selling to another party.

There exists some debate amongst service managers in Australia as whether pin numbers or swipe cards are a preferred solution. Generally speaking, a pin number system is not readily transferable, minimises the incidence of theft and/or third party use for whatever reason. On the other hand, remembering pin numbers can prove difficult requiring a master record usually kept by the community administrator or service provider. Swipe cards are simpler to use but can be easily appropriated by a third party or readily used as a negotiating medium.

The decision as to which system to implement will ultimately be informed by the results of community consultations in conjunction with limitations and constraints placed by financial and technical factors. Hence, as to whether a pre-payment

system is required needs to be assessed in light of the RESCO concept developed here and the limitations of pre-payment systems and indeed, inappropriateness of such to standard monthly fee-based services rather than pay-as-you-go type metered systems. On balance, and in keeping with the overall commercial thrust of the RESCO program it is recommended that the RESCOs themselves determine on what basis they are to be paid by consumers.

Summary of Findings and Recommendations

1. Comments have been made concerning a range of payment systems including pre-payment metering. There are both advantages and disadvantages attached to such systems.
2. The decision to build pre-payment systems into a rural electrification program depends upon socio-economic and technical/equipment-type considerations.
3. Here the payment is for a RESCO service and not according to metered consumer usage and therefore at odds with a pre-payment system.
4. The recommendation here is that in-keeping with commercial principles, RESCOs must be left to determine their own payment system.

6.6 Output 4 - Financial Incentive Policy

This section considers the incentives necessary to attract private sector interests to the RESCO program. At the outset it must be emphasized that the element of risk remains the main barrier to private investments in RESCO activities. Having said this, the *Rural Electricity Act* provides for three key risk-reducing mechanisms. These are:

1. The main risk reduction element of the whole RESCO programme is the fact that capital investment is unnecessary for the equipment. The DOE will lease the equipment to the RESCO, and therefore, the RESCO will have very little requirement for up-front capital investment. Hence, if a RESCO wants to get out of the business, they will not capital loan obligations or expensive properties that have to be disposed of.
2. RESCOs are guaranteed their own operational region;
3. Further to the FEA expanding their grid services into a RESCO region the DoE undertakes to remove systems at their costs

Whilst these mechanisms address the risk factors directly associated with the RESCO program, others must be considered. In order to better understand the types of incentives required to boost the effectiveness of this program, an Investor Forum was held. The Minister of Energy the Hon. Savenaca Draunidalo opened the Forum before an audience of 26 people representing government, enterprise, industry associations and the financial sector along with trade commissions from Australia, New Zealand and Japan. The Head of Delegation for the European Commission was present.

The outcomes of the Forum emphasized that the main hurdle to overcome in attracting private investors into the RESCO program are the risks associated with any capital outlay and the stream of financial benefits anticipated from this outlay. It was recognised that rural electrification projects are inherently high risk given

factors associated with limited size and scale, low levels of consumer income. Other factors revolve around limited finance by mainstream lending institutions such as banks and credit societies who inherently place a high risk on lending for SHS projects. Table 18 reveals the outcomes of the Investor Forum on the question of risk. Only responses perceived by participants of having a high risk are presented.

Table 18a Investor Risk Assessment – Government Sector Response[28]	
Risk Level	**Response from Government Sector**
High Risk	• Governance elements. • Economic climate. • Political climate. • Demand risks. • Consumer affordability. • Rules of participation as a RESCO. • Government policy concerning regulatory framework and support for the program additional to their current support for rural electrification.
Information and Incentive Requests	• More detailed information on RESCO program. • 10-year lifecycle projections for return on investment. • Market information concerning market size and possible effects of technological development in future. • Opportunities for hybrid power schemes.
Table 18b Investor Risk Assessment – Private Sector Response	
Risk Element	**Incentives Required/ Response from Private Sector**
High Risk	• Cost of capital. • Government policy concerning regulatory framework and support for the program additional to their current support for rural electrification. • Liquidity risks. • Commercial mismatch with organization objectives. • Political climate. • Rules of participation for RESCO. • Vehicle concessions. • Provide for the carrying forward of losses into future financial years. • Possible social impact benefits and can these be used as a qualifying agent for tax rebates. • Freedom to remove systems on payment default
Information and Incentive Requests	• Target market description and customer requirements. • Market size in relation to demand and risks. • Equipment type and capacity and link to market needs. • Plant and equipment requirements. • Cost of capital. • Return on investment 5 to 10 year period. • Opportunities for hybrid system developments. • Feedback on current test sites. • Examples of social benefits to be derived. • Possible developments in future investment opportunities

[28] Please note that Tables 18a, 18b were evaluated and agreed by the Fiji Chamber of Commerce and Industries at their June 2003 Executive Meeting.

	unrelated to SHS.

Government support through tax rebates or depreciation incentives, coupled with a transparent regulatory framework, are of considerable importance for both government and private sectors when addressing issues of risk. From a government perspective the tax incentives and transparency of the regulatory framework would encourage private investment in the RESCO scheme thereby supporting their current policies for rural development. From a private enterprise perspective the tax concessions would indicate strong Government commitment to the scheme as well as removing government barriers to private return on investment in the initial stages when the probability of losses are high on EBIT sheets.

External investment variables such as the economic and political climate were also of high importance, particularly for the government sector. These variables bare heavily on how and to what extent the government will commit to the scheme which in turn affects the likelihood of private investment. Information on the RESCO program was considered of high importance for the government sector because they need information concerning the functional capacity and transparency of the scheme before making specific policy decisions.

Summary of Findings and Recommendations

1. A range of risk factor have been identified and similarly a number of financial and non-financial incentives to attract private sector investment into the RESCO program have emerged in the course of inquiries. The recommendation here is to promote the legislative framework under which RESCOs will operate and the inherent risk-reducing mechanisms contained therein.
2. It is also recommended that other departments such as Rural Development are better placed than the DoE to contemplate the nature, extent and application of financial incentives in relation to the RESCO program
3. It is also recommended that in relation to non-financial incentives appropriate agencies such as health and education are in a better position than the DoE to increase understanding of SHS under a package of promotional measures.