MONITORING & EVALUATION OF THE

RENEWABLE ENERGY FOR RURAL DEVELOPMENT PROJECT

SEPTEMBER 2004 – SEPTEMBER 2008

COMPLETION REPORT

Submitted to

Administrative Unit of the

RENEWABLE ENERGY FOR RURAL ECONOMIC DEVELOPMENT PROJECT

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DISCLAIMER

Obtaining data from the various stakeholders by mailing questionnaires / survey formats continues to be difficult as their response rate is very low. In addition, some stakeholders seem to find it difficult to provide the data required correctly. RERED Project AU has been helping the Consultants to obtain some of the required data. This report is based on the data that the Consultants have been able to gather within the resources available.

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LIST OF ABBREVIATIONS

AU	Administrative Unit of the RERED Project
BEIQ	Basic Environmental Information Questionnaire
BPR	Bi - Annual Progress Report
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CFLs.	Compact Fluorescent Lamps
CO_2	Carbon dioxide
COC-P	Certificate of Conformity-Project
DFCC	Development Finance Corporation of Ceylon
DS Division	Divisional Secretary's Division
DSM	Demand Side Management
EA	Environmental Assessment
EAD	Export Agriculture Department
ECF	Energy Conservation Fund
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
ESAMF	The Environmental and Social Assessment and Management Framework
ESCOs	Energy Service Companies
ESD	Energy Services Delivery
FECS	Federation of Electricity Consumer Societies
FGDs	Focus Group Discussions
FMR	Financial Monitoring Report of RERED Project issued by AU
GDR	Grant Disbursement Request
GEF	Global Environmental Facility
GOSL	Government of Sri Lanka
GWh	Giga Watt hours
HHs	Households
IBRD	International Bank for Reconstruction & Development – World Bank
IGC	Induction Generator Controller
IDA	International Development Association
IEE	Initial Environmental Examination
kg	kilogram
kW	kilowatt

kWh	kilowatt hours
LDR	Loan Disbursement Request
LEDs	Light Emitting Diodes
LOI	Letter of Intent
M&E	Monitoring and Evaluation
MFI	Micro Finance Institution
MW	megawatt
MWh	megawatt hours
MWp	mega watt peak (measurement of maximum power generated by a collection of electricity generating devices)
NEA	National Environmental (Amendment) Act No. 56 of 1988 of Sri Lanka.
PAD	Project Appraisal Document of the RERED Project
PC	Provincial Council
PCI	Participating Credit Institution
PODIE	People's Organization for Development Import and Export
PUCSL	Public Utility Commission of Sri Lanka
PV	Photovoltaic
QE	Quarter Ending
Qr	Quarter
QPR	Quarterly Progress Report
RA	Refinance Application
REAP	Rural Economic Advancement Project
REECS	Rural Energy & Environmental Consultation Services
REN	Rural Enterprise Network
RERED	Renewable Energy for Rural Economic Development
Rs. / SLR / LKR	Sri Lankan Rupees
SDAs	Special Dollar Accounts
SLSEA / SEA	Sri Lanka Sustainable Energy Authority (formerly ECF - Energy Conservation Fund)
SEEDS	Sarvodaya Economic Enterprises Development Services (Guarantee) Ltd.,
SHSs	Solar Home Systems
TV	Television
US $	United States of America Dollars
VECS	Village Electricity Consumer Society
VHWG	Village Hydro Working Group
Wp	Watt peak (measurement of maximum power that can be generated by an electricity generating device)

EXECUTIVE SUMMARY

Renewable Energy for Rural Economic Development (RERED) Project can be rated as quite successful in achieving its objectives and surpassing most of its targets and having very beneficial impacts (Table ES 1). It has supported the establishment of 41 grid-connected hydro sub-projects with an installed capacity of 92 megawatts (MW) supplying electricity to the national grid and 118 off-grid community-based hydro sub-projects with an installed capacity of 1,168.1 kW providing electricity to 4,487 households (HHs) More grid-connected and off-grid community-based hydro sub-projects would have been in operation by 30/06/2008, the original date for the Project to end, if it was possible to deal with the causes that delayed the completion of some of these sub-projects. One 1.0 MW grid-connected biomass sub-project that was established was not in operation as at 30/06/2008. One off-grid community-based biomass sub-project was established with technical support from RERED Project but this is not considered as a sub-project under RERED. 98,738 HHs have installed SHSs.

A very significant contribution of the Project has been the technical and financial support for new initiatives in the renewable energy sector which enabled private sector organisations to take the risks involved and this has encouraged them to establish a few biomass plants without Project support.[1] The Project has encouraged private sector investment in grid-connected and off-grid power generation, supplying SHSs, manufacture of machinery and equipment for off-grid community-based hydro sub-projects, renewable energy based technological innovations and energy efficiency. It has established the feasibility of making barter arrangements for low income families to obtain SHSs.

Considerable benefits have been gained at the national, community and HH level. The economic value of power generated by the grid-connected hydro sub-projects from March 2004 to September 2008 has been estimated at Rs. 31,143 million. The value of power generated by solar home systems (SHSs) for the same period has been estimated at Rs.647 million. The grid-connected power plants and SHSs have saved US$.164.59 million and US$. 465,457 respectively in foreign exchange over this period. It was not possible to estimate these values for off-grid community-based hydro sub-projects because of the variability in them.

Savings in carbon emissions have been an important benefit of the RERED Project. As a result of using less kerosene for lighting in HHs receiving electricity from SHSs and off-grid community-based hydro sub-projects 14,719 tonnes of carbon dioxide (CO_2) emissions have been saved during March 2004 to September 2008[2]. This has improved the air quality in the homes receiving electricity from these off-grid systems. The grid-connected hydro power plants constructed with Project support saved 1.18 million tonnes of CO_2 emissions during the same period by using hydro power to generate electricity.[3]have been as a result of not using fuel oil to generate the power generated by.

Although rural HHs electrified from off-grid systems exceeded the target, frequent breakdowns in the power supply and dim lighting have caused much disappointment to several HHs receiving electricity from off-grid community-based hydro sub-projects. One

1 Comment by H. K. Wickramasinghe, Deputy Director General, Sustainable Energy Authority, Sri Lanka, during interview by Consultant. Annex 5 gives details of these constructed by the private sector.

2 Annex 10 for details.

3 If fuel oil powered plants had been used to generate this amount of electricity, 1.18 million tonnes of CO_2 would have been released to the atmosphere on the basis of 0.8 kg of CO_2 per 1 kWh of electricity.

contributory reason might be that the installed capacity of nearly half of these sub-projects was less than what was planned while the number of HHs served remained the same. This could have contributed to the complaint of dim lighting due to the demand exceeding the installed capacity. Further it was the perception of some of the communities adversely affected by poor service that sub-standard machinery, deficiencies of Developers and weaknesses of Village Electricity Consumers' Society (VECSs) also contributed to the shortcomings in the power supply. Another reason for the low voltage experienced by the HHs is the long length of the electrical distribution network. The situation was better in HHs with SHSs but over use and lack of proper maintenance have caused poor quality of lighting in some HHs.

HHs receiving electricity from off-grid systems have been able to improve the quality of their life in several ways and described its impact as a "reawakening" of their lives.

Better lighting has benefited all the HHs. Reduction in the use of kerosene has eliminated smoke inhalation and accidents to a great extent and also reduced blackening of walls in their houses. This has encouraged them to improve their houses. Parents perceived better lighting as the main benefit because it enabled their children to study longer. It also made work more convenient for women. The use of electricity to watch television (TV) has saved the expenses on battery charging. It has also given them better access to information and entertainment and encouraged men to stay at home in the evenings instead of going out with friends to consume alcohol and gamble. This has improved family life. HHs receiving electricity from off-grid community-based hydro sub-projects were able to use electrical appliances also. Electric irons were the most commonly used appliance (over 68% of the HHs) other than TVs. Electric fans, refrigerators and rice cookers were far less common. VECSs discouraged the use of appliances because of their stress on the supply.

Economic benefit gained by HHs receiving off-grid electricity has been limited. They benefited mainly from saving of expenses on kerosene used for lighting and charging batteries used to watch TV or listen to radio/cassette players estimated at Rs.506 a month for HHs that installed SHSs and Rs.250 a month for HHs that received electricity from off-grid community-based hydro sub-projects. All the families receiving electricity have benefited financially from this. Available information indicates that only 736 enterprises benefited from receiving electricity from off-grid sources but as nearly all of them employed only family labour who worked longer hours after receiving electricity, they did not generate opportunities for paid employment. Some enterprises reported higher profits due to improved productivity and longer working hours. Focused Group Discussions (FGDs) revealed that electricity enabled people to work 2-3 hours longer a day but the lack of opportunity for gainful employment limited their ability to use it productively. If it had been possible to use it productively, it would have been worth Rs.2,500 a month for each HH and its cumulative value for all the HHs over the Project duration would have been Rs.141 million.

According to the licence granted to Developers to establish grid-connected power plants, they must sell the power they generate to CEB. Hence, the Developers cannot supply electricity to the local communities which caused some disappointment among them. Therefore, in order to overcome this and gain their support and goodwill for their sub-projects, the Developers have carried out improvements to the village infrastructure. This situation may change with the activation of the Public Utility Commission of Sri Lanka (PUCSL)[4].

[4] PUCSL is an independent body regulating the terms of transactions amongst the stakeholders such as the utility (CEB), the consumers, private power producers, etc.

The main contribution to employment income came from constructing grid-connected hydro sub-projects and installing/removing SHSs. The employment income generated by the 41 grid-connected hydro sub-projects in operation as at 30/06/2008 has been estimated at between Rs.44 – 61 million. Regular employment for maintenance provided by them generates Rs.1.1 – 1.5 million monthly for these communities. The installation of 98,738 SHSs has generated employment valued at Rs.222 million in direct and indirect employment. As about 10% of SHSs are removed mainly because of loan default, the value of employment generated by that has been estimated at Rs.14.8 million.

Economic activities started under Innovation Solicitation have not been very successful as there are several constraints to making them profitable in the remote villages where off-grid community-based hydro sub-projects are located. Also the promoters who helped to start them did not have the expertise or capacity to promote such micro-enterprises. While the project to introduce solar dryers for drying medicinal herbs has been quite successful, the one to introduce them for spice drying has been less so. The project to enable low income HHs to obtain SHSs on barter has also been successful. However, the Project did not have a strategy to replicate the successful innovations.

The Project has built up institutional links and social capital among stakeholders such as investors, banks and other financial institutions, suppliers of machinery and equipment, consultants, technical institutes, Government agencies and other stakeholders to develop renewable energy. This will enable the renewable energy sector to play a more important role in the future in meeting the country's energy needs. Weaknesses among some institutions such as the VECSs need to be remedied through developing social capital at village level.

A very important and far reaching benefit gained from the Project is the strengthening of critical capacities among stakeholders to harness renewable energy and improve energy efficiency. The strong foundation it has laid for the renewable energy sector has received the support of the Government through favourable policies and the establishment of the Sri Lanka Sustainable Energy Authority. It is expected that it will play a key role to build up technical and social capital after the end of the Project. This will enable them to carry forward the initiatives taken by Energy Services Delivery (ESD) and RERED Projects to develop the renewable energy sector and benefit rural people, the national economy and the environment.

This report includes Lessons Learnt and a list of Recommendations.

***Table ES 1*: SUMMARY OF PROJECT ACHIEVEMENTS**

Item	Target at Appraisal	Achievement	
		No.	%
Grid-Connected Power Generation:			
Installed capacity of grid-connected hydro sub-projects	85 MW	93 MW	109.4
Installed capacity of grid-connected biomass sub-projects			
No. of grid-connected hydro sub-projects commissioned	Target unspecified in PAD	41	------
No. of grid-connected wind sub-projects commissioned		------	------
No. of grid-connected biomass sub-projects commissioned		1 *	------
Off-Grid Power Generation - All Types			
Power Generation	Target unspecified in PAD	-------	-------
No. of households benefiting	100,000 HHs	103,225 HHs	103.2
No. of enterprises institutions benefiting	1,000	718 (64 hydro; 654 solar)	79.7
No. of institutions benefiting		79	
Off-Grid Power Generation - Hydro			
Installed capacity	Target unspecified in PAD	1,168 kW	-------
No. of off-grid community-based hydro sub-projects commissioned		118	-------
Off-Grid Power Generation - Solar:			
Installed capacity	Target unspecified in PAD	4.363 MWp	-------
No. of solar home systems installed		98,738	-------
Off-Grid Power Generation - Wind			
Installed capacity	Target unspecified in PAD	-------	-------
No. of off-grid community-based wind sub-projects commissioned		-------	-------
No. of households benefiting		-------	-------
Off-Grid Power Generation - Biomass:			
Installed capacity	Target unspecified in PAD	----	----
No. of off-grid community-based biomass sub-projects commissioned		----	----
No. of households benefiting		----	----
Energy Efficiency & Demand Side Management			
Private energy service companies	3-4 ESCOs	15	375.0

Note: * This plant was not in operation as at 30/06/2008

1. INTRODUCTION

1.1 Report Structure

Chapter 1 **Introduction**

Chapter 2 **Project Targets & Achievement**

Chapter 3 **Implementation Strategy**

Chapter 4 **Effects & Impacts – Community and Household Level**

Chapter 5 **Effects & Impacts – National Level**

Chapter 6 **Conclusions**

Chapter 7 **Lessons Learnt**

Chapter 8 **Recommendations**

1.2 Scope

The Renewable Energy for Rural Development (RERED) Project started its implementation in 01/10/2002. Although, the Project was originally planned to conclude on 30/06/2008[5] the project implementation period was extended until 30/06/2011 as it received additional funding in 2007. Resources Development Consultants (Pvt) Limited (RDC) started the *M*onitoring and *E*valuation *(M&E)* of this Project in the fourth quarter of 2004. From then until the first quarter of 2006, M&E reports were submitted quarterly. The Mid-Term Review covered the period up to 30/09/2006. Thereafter, M&E reports were submitted bi-annually ending with the one for the 6 months up to 30/09/2008. Although the Project has been extended until 30/06/2011, for the purpose of this report, monitoring is done only until 30/06/08 but impact is evaluated up to 30/09/2008. This Final Completion Report was prepared after 30/09/2008.

The Design for Monitoring & Evaluating the RERED project was finalized in consultation with the RERED AU and representatives of the World Bank in February 2005. As Project implementation proceeded and experience was gained, the M&E System was made operational with subsequent reviews and adjustments as suggested and recommended by the AU and the World Bank. The modified design reflected the lessons learnt through M&E and the needs of the AU and the World Bank. A very important direction given to the M&E Consultant by the AU and World Bank was to focus the monitoring and evaluation on the impact of the Project on the beneficiaries of the off-grid community-based hydro sub-projects and solar home systems (SHSs).

The Project Appraisal Document (PAD) has discussed the wide ranging objectives of the Project in considerable detail. The objectives most relevant to this Report are contained in Annex 1 of this report. These cover both the overall objectives as well as the objectives for the main components and sub-components.

The overall objectives of the Project are given in Box 1.1.

[5] **Project implementation period:** 5.5 years **Expected effectiveness date:** 15/09/2002 **Expected closing date:** 30/06/2008, *Project Appraisal Document (PAD),* World Bank South Asia Regional Office, 2002, p.1

Box 1.1: *Overall Project Objectives*[6]

This Project aims to

(i) Improve the quality of rural life by utilizing off-grid renewable energy technologies to bring electricity to remote communities and

(ii) Promote private sector power generation from renewable energy resources for the main grid.

The PAD included several components to achieve these overall objectives:

- Grid-Connected Power Generation using Renewable Energy
- Off-Grid Electrification using Solar Home Systems
- Off-Grid Community-Based Hydro / Wind / Biomass Sub-Projects
- Energy Efficiency and Demand Side Management (DSM).
- Cross-Sectoral Energy Applications
- Technical Assistance

The Project expected to leverage domestic financing as "a critical factor in maintaining the viability of renewable energy projects, especially those connected to the grid." [7]

Although all these were mentioned in the Design of the M&E, in subsequent discussions with the AU, the Consultants were requested to monitor physical progress and impact of only the following:

- Grid-Connected Power Generation using Renewable Energy
- Off-Grid Electrification
- Energy Efficiency

This report will focus on these and related factors and discuss the achievement of targets set for the main Project components. While some of these can be evaluated quantitatively others have to be evaluated qualitatively. As per PAD the expected Project outcomes are as follows:

- improved quality of life,
- increased rural economic activity,
- improved energy efficiency and demand side management,
- increased cross-sectoral energy applications (public institutions served by renewable energy),
- increased technical competence in the renewable energy sector,
- increased domestic financing (private sector participation in the renewable energy service industry)

The M&E Consultants were requested to concentrate on impact as the AU had in place a system of monitoring financial and physical progress of the Project components. Therefore, the main focus of this report is the impact of the Project on the quality of life of

[6] *PAD,* op. cit., p.2
[7] Ibid., p.10

the beneficiaries and rural economic development. The M&E reports were prepared according to the M&E Design document prepared by the Consultants and initially approved and subsequently modified by the AU. The benefits expected as a result of the Project are stated in Box 1.2.

Box 1.2: *Benefits and Target Population* [8]

The Project's principal beneficiaries are rural households and enterprises for whom increased access to adequate and reliable supplies of electricity will mean expanded productivity, higher earnings potential and a better quality of life, due not least to their greater ability to operate small appliances and to improve indoor air quality by reducing kerosene smoke.

Benefits to households switching from kerosene to solar lighting include greater convenience, improved safety, and improved indoor air quality. These benefits favor women and children, who spend the most time indoors. The targeting of grants will extend these benefits to women and children in lower income households as well.

The Project expected to achieve its rural development objectives mainly through the off-grid components of the Project and Innovation Solicitation projects.

The key performance indicators are:

- Measurable increases in incomes of households that gain access to electricity, assessed through periodic monitoring and evaluation.
- Installation of additional 85 MW of grid-connected electricity power generation capacity.
- Direct access to electricity for 100,000 households and 1,000 rural small and medium enterprises and public institutions through off-grid systems (solar, community hydro and biomass).

The sustainability of Project benefits depend on the institutional arrangements set up by the Project to enable stakeholders to play their roles. The establishment, operation and maintenance (O&M) and sustainability of off-grid community-based hydro sub-projects depend on VECSs. Developers were expected to establish these and strengthen their capacity. This report will pay special attention to assess their functioning as it is vital to the sustainability of these hydro sub-projects in which the communities have invested considerable sums of money, labour and expectations.

Box 1.3: *Village Electricity Systems* [9]

Participation and mobilization of the whole community is essential for long-term sustainability. While village hydros remain the least-cost solution for many isolated rural communities, high development and investment costs continue to be a barrier. To overcome these, increased productive activities, energy conservation, and streamlined project development to reduce costs are needed to enhance returns. At the village level…the community reaches all decisions with regard to electricity design, financing, tariffs, maintenance of the systems and amount of electricity to be used by each household in a participatory manner.

The replacement of kerosene with electricity has improved the home environment for the communities with off-grid community-based hydro sub-projects and SHSs. The

[8] *PAD,* op. cit., pp.11-12; These benefits are discussed in Sections 4.5 and 4.9

[9] *PAD,* op. cit.,, pp.15, 23

report will present the benefits gained from this. All off-grid community-based hydro sub-projects are "run-of-the-river" type with practically no storage facility. During day time, demand for electricity in the households is very low. Hence there is a potential to make available electrical energy during the day time at a nominal cost to power economic enterprises. The Project expected this would encourage economic activities to be developed in rural areas. *"It is expected that at least 500 commercial/industrial off-grid connections will be achieved during the course of the project."* [10] It was expected that the establishment of these enterprises and the employment generated by them would stimulate rural economic development.

The grid-connected hydro sub-projects saved foreign exchange and carbon emissions by using hydro power instead of imported fossil fuels and added capacity to national grid by generating much needed electricity. According to the licence granted to Developers to establish grid-connected power plants, they must sell the power they generate to CEB. Some of the communities around these sub-projects tend to be disappointed as they could not receive electricity from power plants constructed near them. The Developers have however carried out improvements to the village infrastructure to gain the goodwill of the community for their sub-projects.

The post-installation performance of off-grid community-based hydro sub-projects was evaluated. The problems faced by Developers in implementing these sub-projects and the views of beneficiaries on the work done by them will be presented in this report.

Energy Efficiency and DSM and capacity building are among other objectives of the Project. This Report will evaluate the progress made with regard to the first of these two Project components. The report will only touch on technical capacity building as AU has indicated to the Consultant that it was monitoring that component.

The report will present information on activities undertaken under the Project's "Innovation Solicitation" component but as the time that has lapsed since many of these activities undertaken under this component has been short, it is not possible to fully evaluate them.

1.3 Period Covered

The Project started in October 2002 and was originally planned to end after 69 months on 30/06/2008. The term "project duration" is used to refer to this period. The Consultants started monitoring and evaluating it from the last quarter of 2004 and their final Bi-Annual report covered the 6 months ending on 30/09/2008. This report covers the period from the last quarter of 2004 to 30/09/2008 which is referred to in this report as the "M&E period";

1.4 Methodology

As both quantitative and qualitative data and information were required to monitor and evaluate the aspects of RERED Project indicated above in Scope (Section 1.2), several methods were used to gather this data and information. [11]

To monitor and evaluate the impact of the Project on its beneficiaries, most of the data collected was quantitative. Questionnaire surveys were used for this purpose. They were used to gather baseline as well as impact data. In the case of off-grid community-based hydro sub-projects, baseline data was collected from sub-projects where work was

[10] Ibid. p.49

[11] Survey questionnaires and other instruments used to collect data and information are in Vol. II

in progress. In the case of SHSs, baseline data was collected from HHs that had applied for loans to install SHSs. When conducting impact surveys, some HHs were selected to be resurveyed in consecutive years to evaluate the impact over time. Data from these surveys was computerized and processed to obtain required tables.

Questionnaire surveys were also used to collect data from enterprises using electricity from off-grid community-based hydro sub-projects and SHSs. These questionnaires were designed to collect quantitative data as well as qualitative data and permitted respondents to present information they considered important. Some of these enterprises were ones started under the Innovation Solicitation sub-component. Content analysis was used to process this information.

Similar surveys were conducted in communities where Developers established grid-connected hydro sub-projects to find out what improvements in village infrastructure had been implemented by the Developers. This supplemented information collected from Developers of grid-connected hydro sub-projects through a similar survey. Content analysis was used to process this information.

A survey was conducted of the Developers of grid-connected hydro sub-projects to find out the problems they faced in implementing their sub-projects. A similar survey was conducted of Energy Service Companies. These used a check list type of questionnaire. Tabulation of quantitative data and content analysis of qualitative information were used to analyse this data.

Focus Group Discussions (FGDs) were conducted in off-grid community-based hydro sub-projects mainly to gather information on how VECSs were performing. These collected mainly qualitative information using a structured checklist type of questionnaire. Some VECSs were revisited in consecutive years to evaluate their progress. During these discussions, information was also collected on the performance of Developers because several VECSs complained about them. Apart from conducting discussions, records kept by the VECSs were also checked. As it made little sense to quantify views expressed at these discussions, content analysis was used to analyse the qualitative information gathered from these discussions.

Postal surveys were conducted to collect information from VECSs on the use of electricity in off-grid community-based hydro sub-projects and suppliers of SHSs on the removal of SHSs that had been installed. Tabulation of the data was used to analyse this data. Although it is difficult to verify the accuracy of data collected in this way they give us a useful overview of the situation.

Consultants visited a few off-grid community-based hydro sub-projects and HHs with SHSs to gain first hand knowledge of the impact of receiving electricity and the performance of VECSs, enterprises and Developers. This helped to interpret data and information collected through other methods. Consultants conducted interviews with key informants, - for example with villagers, VECSs and Federation of Electricity Consumer Societies (FECS) office bearers, senior management of Sri Lanka Sustainable Energy Authority (SEA), Provincial Council (PC) officials, CEB officials, PCI staff and SHS suppliers. They also attended quarterly meetings of Stakeholders and the VHWG.

The sample sizes proposed in the M&E design of the consultants together with their revisions and outlines of (successive) sizes of samples surveyed for M&E during the M&E period are presented in Annex 2. Based on it, Table 1.1 compares the planned sample sizes for baseline and impact surveys with what was actually surveyed. It shows that the emphasis had later been shifted to survey more HHs for the impact surveys than for the

baseline surveys. Because there was little variation among HHs surveyed for the baseline, there was no justification to retain a sample as large as what had been planned.

***Table 1.1*: Planned and Actual Sample Sizes for Baseline and Impact Surveys**

	Baseline Surveys			Impact Surveys		
	Planned	Actual		Planned	Actual	
		Report *	Sample Size		Report	Sample Size
Off-grid community-based hydro sub-projects	250 HHs	QPR 4/2004	25 HHs	Sample selected for baseline to be followed	QPR 4/2004	172 HHs
		QPR 4/2005	41 HHs		QPR 4/2005	60 HHs
		BPR 1/2007+	40 HHs		BPR 1/2007	110 HHs
		BPR 1/2008+	--		BPR 1/2008	100 HHs
		FCR	--		FCR	120 HHs
Total	**250 HHs**	**--**	**106 HHS**	**250 HHs**	**--**	**562 HHs**
Solar Home Systems	Original 2550 SHSs reduced to 850 in 2005	QPR 4/2004	328 SHSs	Sample selected for baseline to be followed	QPR 4/2004	797 SHSs
		QPR 4/2005	187 SHSs		QPR 4/2005	100 SHSs
		BPR 1/2007+	--		BPR 1/2007	50 SHSs
		BPR 1/2008+	--		BPR 1/2008	100 SHSs
		FCR	--		FCR	50 SHSs
Total	**850 SHSs**	**--**	**515 SHSs**	**850 SHSs**	**--**	**1097 SHSs**

Notes: * QPR = Quarterly Progress Report, BPR = Biannual Progress Report, FCR= Final Completion Report

+ Baseline and Impact surveys were conducted once a year, normally in the fourth quarter. In 2006 and 2007, although they were started in the fourth quarter, they were completed in the first quarter of 2007 and 2008. Hence 2006 does not appear in the above Table.

The experience gained and lessons learned with successive rounds of surveys for M&E resulted in improvement, revision and re-revision of data collection instruments and also in the design of new questionnaires. At the end, the M&E activities have generated a rich collection of questionnaires/forms that can be of use in similar future renewable energy projects. List of data collection instruments developed for M&E activities is in Annex 3.

Enumerators with previous experience in field surveys were employed for field data collection. They were provided with class room as well as hands-on training by the M&E Team Consultants before mobilizing them in the field. Sometimes, it was possible to engage the same team of enumerators for successive rounds of HH surveys and/or FGDs which provided opportunity to capitalize on the experience and familiarity they gained. The members of M&E Team, in turn, undertook field visits to off-grid community-based hydro sub-projects, HHs with SHSs and enterprises started under Project facilities as well as those initiated under 'Innovation Solicitation'. These visits provided the M&E Team with rich experience and first hand knowledge to understand the ground situation.

Overall, the respondents were co-operative and their response to surveys and request for information was satisfactory. Triangulation was used to verify the reliability and validity of data collected. This ensured that the reliability of data was at acceptable levels. Even with regard to postal surveys, although there were some shortcomings in the data provided, there is no reason to doubt the overall picture presented by them.

Depending on the size of the sample, either computer data analysis or manual data tabulation and analysis were employed. Computer data analysis was used particularly for

the baseline and impact surveys where the sample sizes were relatively large and it was also necessary to combine data from different surveys to compare and analyse them.

An annotated timeline of M&E activities conducted and reported by RERED Project components/sub-components is presented in Table 1.2. It highlights the range of topics addressed during M&E.

Table 1.2: **An Annotated Timeline of M&E Activities Conducted/Reported by Major Components***

Time Period	Grid-connected hydro sub-projects	Off-grid community-based hydro sub-projects	Solar Home Systems	Cross Sectoral Energy Applications: Innovation Solicitation
Qr. 4/2004	---	• Baseline survey of 2 sub-projects in which 25 HHs covered. • Impact survey of 16 sub-projects in which 172 HHs and 16 VECSs were covered.	• Baseline survey of 328 SHSs. • Impact survey of 797 SHSs	• Desk review of performance.
Qr. 1/2005	• Survey of a sample of sub-projects to monitor approval process • Survey of a sample of completed sub-projects to monitor post installation O&M	• FGDs conducted in 16 sub-projects (visited in Qr. 4/2004). Use of electricity was also assessed. • Survey of a sample of sub-projects to monitor approval process. • Survey of a sample of completed sub-projects to monitor post installation O&M	• Survey of a sample of SHSs to assess the time taken for installation after initial intervention by the supplier.	• - do -
Qr. 2/2005	• Survey of a sample of sub-projects to monitor approval process • Survey of a sample of completed sub-projects to monitor post installation O&M	• Postal survey of 6 VECSs having enterprises but only 01 VECS responded. • Survey of a sample of sub-projects to monitor approval process • Survey of a sample of completed sub-projects to monitor post installation O&M	• 20 SHSs having enterprises surveyed.	• - do -
Qr. 3/2005	---	• 9 VECSs surveyed to assess use of electricity in 13 enterprises. • Field visit to two sub-projects undertaken by Sabaragamuwa People's Foundation (SPF).	---	• - do -
Qr. 4/2005	• Survey of Developers to ascertain difficulties encountered. • Survey of sub-	• Baseline survey of 4 sub-projects in which 41 HHs covered. • Impact survey of 60 HHs selected from 172 HHs surveyed for impact	• Baseline survey of 187 SHSs. • Impact survey of 100 SHSs	• - do -

Time Period	Grid-connected hydro sub-projects	Off-grid community-based hydro sub-projects	Solar Home Systems	Cross Sectoral Energy Applications: Innovation Solicitation
	projects to assess village Improvements undertaken by Developers.	survey in Qr. 4/2004.		
Qr. 1/2006	• Survey of 5 sub-projects to assess village improvements made by the Developers and post-installation performance.	• Postal survey of 49 VECSs; 29 (or 59%) responded.	---	• Performance review of enterprises established by conducting field visits to Anamaduwa in Puttalam District.
Qr. 2/2006	No Report	No Report	No Report	No Report
Qr. 3/2006 (MTR)	• Evaluation of Post-Installation Performance • Assessment of Village Improvements undertaken by Grid-connected Hydro Developers	• 15 VECSs surveyed by conducting FGDs and to assess use of electricity in 16 enterprises. • Survey of Developers to ascertain difficulties encountered. • Evaluation of Post-Installation Performance	• Survey of 28 SHSs to evaluate the use of electricity for enterprises.	• Desk review of performance
BPR 1/2007 (Qr. 4/2006 & Qr. 1/2007)	---	• Baseline survey of 4 sub-projects in which 40 HHs covered. • Impact survey of 11 sub-projects in which 110 HHs covered. • 9 VECSs which attended training conducted by FECS was surveyed by postal questionnaire.	• Impact survey of 50 SHSs	• Performance review of enterprises established by conducting field visits to Balangoda in Ratnapura District.
BPR 2/2007 (Qr. 2/2007 & Qr. 3/2007)	• Analysis of economic benefits.	• Postal survey of 73 out of 88 VECSs; 48 (or 66%) responded. • 20 VECSs surveyed by conducting FGDs and to assess use of electricity in enterprises.	• Survey of 22 SHSs to evaluate the use of electricity for enterprises	• Performance review of enterprises established by conducting field visits to Anamaduwa in Puttalam District.
BPR 1/2008 (Qr. 4/2007 & Qr. 1/2008)	• Analysis of economic benefits.	• Impact survey of 10 sub-projects in which 100 HHs covered	• Impact survey of 100 SHSs	• Performance review of enterprises established by conducting field visits in Kegalle District.
BPR 2/2008 (Qr. 2/2008 & Qr. 3/2008)	---	• Postal survey of 103 out of 118 VECSs; 35 (or 41.3%) responded. • 10 VECSs surveyed by conducting FGDs.	---	• Performance review of enterprises established by conducting field visits in Matale District.
FCR Dec. 2008	• Survey of grid-connected	• Impact survey of 11 sub-projects in which 110	---	• Consolidation of previous findings.

Time Period	Grid-connected hydro sub-projects	Off-grid community-based hydro sub-projects	Solar Home Systems	Cross Sectoral Energy Applications: Innovation Solicitation
(Qr. 4/2008)	hydro Developers in which only 3 responded out of a total of 35 who could be contacted.	HHs covered. • Survey of off-grid community-based hydro Developers in which 2 responded out of a total of 9		

* **Note**: In addition to the above, the desk review of performance of Energy Efficiency & DSM, Technical Assistance, Capacity Building and Institutional Framework had been undertaken and reported in each Report**.** As there was no significant progress in wind and biomass sub-projects, they are not included here.

During the implementation of the M&E Design, the M&E Reports listed in Table 1.3 were documented and submitted. World Bank Review Mission prior to Mid-Term Review, observed that quarterly reporting does not provide opportunity to report substantial changes in Project outcomes and recommended that the frequency of M&E reporting should be altered from quarterly to biannual reports. During subsequent reporting, the M&E Team experienced that this was indeed a move in the right direction.

***Table 1.3*: M&E Reports Submitted**

Year	Titles of M&E Reports	Period Ending
2004	Quarterly Progress Report: 4/2004	31/12/2004
2005	Quarterly Progress Report: 1/2005	31/03/2005
	Quarterly Progress Report: 2/2005	30/06/2005
	Quarterly Progress Report: 3/2005	30/09/2005
	Quarterly Progress Report: 4/2005	31/12/2005
2006	Quarterly Progress Report: 1/2006	31/03/2006
	Mid-Term Review Report	30/09/2006
2007	Biannual Progress Report: 1/2007	31/03/2007
	Biannual Progress Report: 2/2007	30/09/2007
2008	Biannual Progress Report: 1/2008	31/03/2008
	Biannual Progress Report: 2/2008	30/09/2008
	Final Completion Report	30/09/2008

These reports were generally well received by the AU. The recommendations and issues highlighted in the M&E Reports were regularly addressed at two forums. They were periodically discussed and reviewed at meetings held by the AU with the M&E Team and also at the subsequent VHWG and Stakeholders' Meetings.

The World Bank Review Missions also reviewed the reports and had discussions with the M&E Team. These meetings provided useful direction and guidance to the M&E Team to improve and refine its M&E activities.

The M&E Team is of the opinion that the arrangement to outsource the M&E activities to an independent group is a good design feature of the Project. Undoubtedly, it has been an effective arrangement which has benefited the Project in a cost-effective manner.

2 PROJECT TARGETS & ACHIEVEMENT

As shown in Table 2.1, the Project has achieved its targets in almost all the main components and has exceeded the targets in some of them.

***Table 2.1*: Achievement of Project Targets as at 30/06/2008**

Component / Sub-Component	Project Target	Achievement at 30/06/2008	Achievement as % of Target
Grid-Connected Power Generation			
Hydro	85 MW grid-connected renewable energy	92 MW	109.4
Biomass		1 MW (One plant)	
Wind	20-25 MW project.	-------	-------
Off-Grid Community-Based Power Generation			
Hydro	100,000 HHs connected to electricity	4,487 HHs	103.2
SHSs		98,738 HHs*	
Wind	Target unspecified in PAD	-----	-----
Biomass	Target unspecified in PAD	-----	-----
Other Project Components			
Energy efficiency and DSM strategies	3 -4 private energy service companies	15	375
Public service institutions and rural industrial, commercial enterprises are served by renewable energy systems.	1,000 institutions and enterprises	826	82.6
Global environment benefits.	1.25 million tons of carbon avoided	1.19	95.6

Note: **Information gathered from companies that installed SHSs indicated that 10.8% are removed due to various reasons. When an adjustment is made for that, the number of HHs with SHSs is reduced to 88,074 and the total number of HHs receiving electricity from off-grid systems comes to 92,561 or 92.56% of the target. Some of these systems were sold to other HHs but numbers are not available.*

2.1 Grid-Connected Power Generation

By the originally planned end of the Project on 30/06/2008, 41 grid-connected hydro sub-projects with a capacity of 92.0 MW and 1 biomass sub-project (at Walapane) with a capacity of 1.0 MW had been completed with a combined capacity of 93.0 MW. The biomass plant at Walapane was shut down after about one year in operation as the tariff paid was inadequate.[12] The enhanced Small Power Purchase Agreement Tariff announced by the government has not yet been made applicable to this power plant. The application from the Developer to migrate from the previous tariff to the new tariff is being processed

[12] Personal communication from Lanka Transformers Ltd., the owner of the Walapane power plant.

by the SEA. Once the new tariff is made applicable to this power plant, this plant is likely to become operational.[13] The Project expected a more significant development of biomass powered electricity generation, as indicated in the PAD "*tapping into its large potential of locally available resources, biomass-based electricity generation will grow by about 12 MW over five years, promoting rural development by adding value through the usage of biomass supply contracts."* No grid-connected wind powered sub-projects have been funded during the Project period.

2.1.1 Progress Achieved during Project Period

The number of grid-connected hydro sub-projects approved and completed up to the originally planned end of the Project is given in Table 2.2. Of the 49 sub-projects approved, 41 (84%) had been completed.

***Table 2.2*: Cumulative Position of Grid-Connected Hydro Sub-Projects [14]**

Period Ending	Grid-Connected Hydro Sub-Projects		% Completed
	Approved	Completed	
31/12/2002	3	---	0
31/03/2003	9	---	0
30/09/2003	11	---	0
31/03/2004	16	7	43.8
30/09/2004	23	13	56.5
31/03/2005	37	16	43.2
30/09/2005	43	18	41.9
31/03/2006	41	22	53.7
30/09/2006	41	24	58.5
31/03/2007	45	31	68.9
30/09/2007	45	35	77.8
31/03/2008	49	39	79.6
30/06/2008	49	41	83.7

The number of sub-projects approved has varied to some extent from period to period (Table 2.3). The data shows an increasing trend in the number of sub-projects approved up to third quarter of 2005 followed by a decrease in approvals during the latter part of the Project period. This may suggest that the investment climate has not provided a strong incentive to invest.

[13] Personal communication from Enerfab Ltd., present custodian of Walapane biomass power project.

[14] *Section C. FMR – Project Progress Reports*, AU

***Table 2.3*: Approved Grid-Connected Hydro Sub-Projects**

Period Ending	Sub-Projects		Capacity		Increase %	
	No.	Increase	MW	Increase	Sub-Projects	Capacity
31/09/2004	23	---	58.5	---	---	---
31/03/2005	37	14	97.5	39.0	60.9	66.7
30/09/2005	43	6	120.0	22.5	16.2	23.1
31/03/2006	41	-2	108.5	-11.5	-4.7	-9.6
30/09/2006	41	0	108.5	0.0	0.0	0.0
31/03/2007	45	4	110.6	2.1	9.8	1.8
30/09/2007	45	0	110.6	0.0	0.0	0.0
31/03/2008	49	4	125.8	15.2	8.9	13.7
30/06/2008	49	0	125.8	0.0	0.0	0.0

Fig 2.1 shows that the gap between approved and completed sub-projects narrowed in 2007-2008 due mainly to fewer new sub-projects being approved during that period.

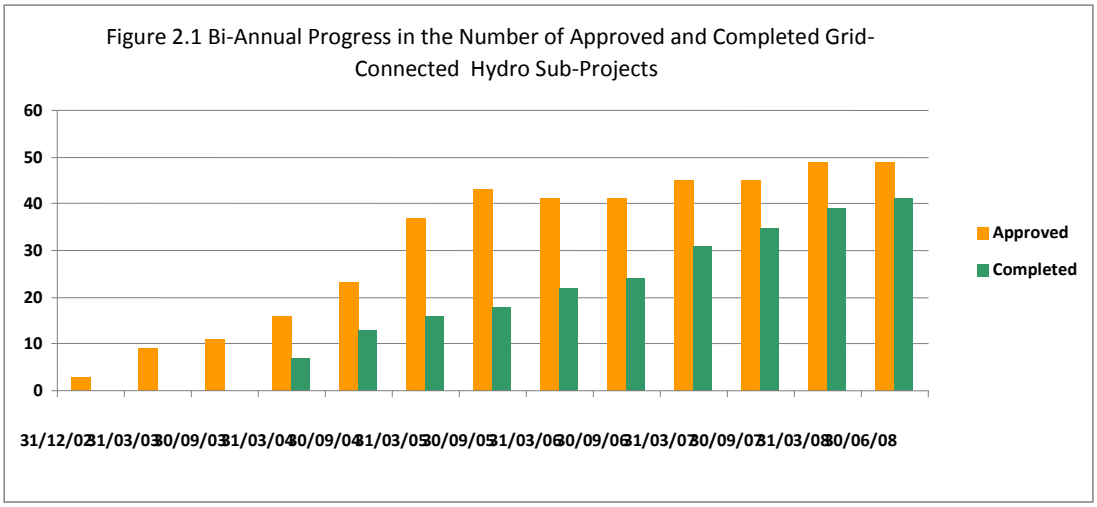


Table 2.4 shows the gap between the number of projects approved and completed more clearly in terms of capacity. The number of projects completed in 2007-2008 is higher (17) than in 2005-2006 (11). This gap between approved and commissioned capacity has decreased significantly since the early period of the project (41% as at 31/03/2005) and the previous reporting period (69%). Installed capacity was 92.0 MW as at 30/06/2008 which was 73% of the capacity approved. This is to be expected in any project cycle as there can be delays during start up phase but considering that RERED Project was a continuation of ESD Project, one would have expected a smoother passage.

***Table 2.4*: Grid-Connected Hydro Sub-Projects in Operation**

Half Year Ending	Sub-Projects		Capacity		Increase %	
	No.	Increase	MW	Increase	Sub-Projects	Capacity
31/09/2004	13		36.5			
31/03/2005	16	3	40.1	3.6	23.1	9.9
30/09/2005	18	2	45.7	5.6	12.5	13.9
31/03/2006	22	4	52.0	6.3	22.2	13.8
30/09/2006	24	2	55.0	3.0	9.1	5.8
31/03/2007	31	7	67.6	12.6	29.2	22.9
30/09/2007	35	4	77.6	10.0	12.9	14.8
31/03/2008	39	4	87.3	9.7	11.4	12.5
30/06/2008	41	2	92.0	4.7	5.1	5.4

Fig. 2.2 shows the gap between the capacity approved and commissioned.

Figure 2.2 Bi-Annual Progress in Terms of the Capacity of the Approved and Completed Grid-Connected Hydro Sub-Projects

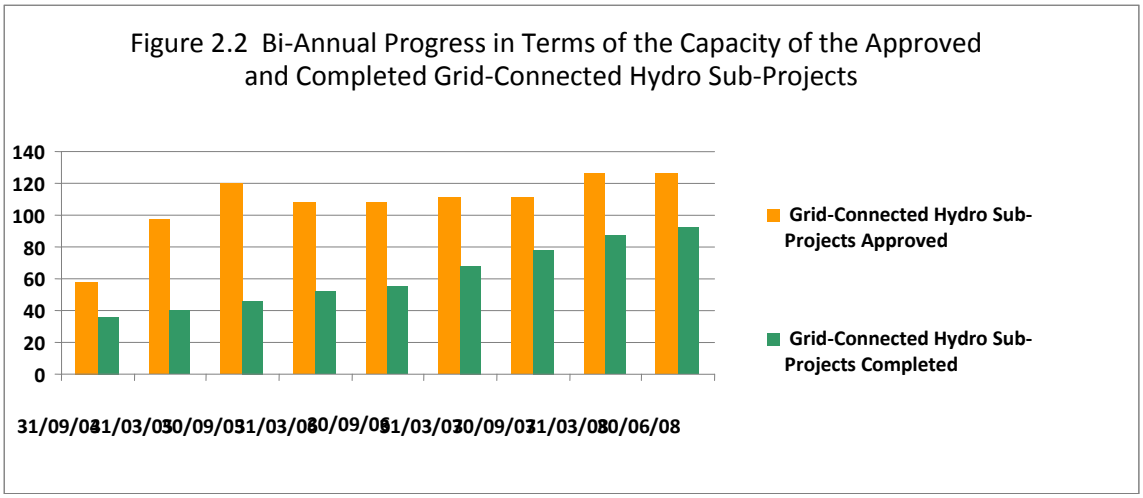
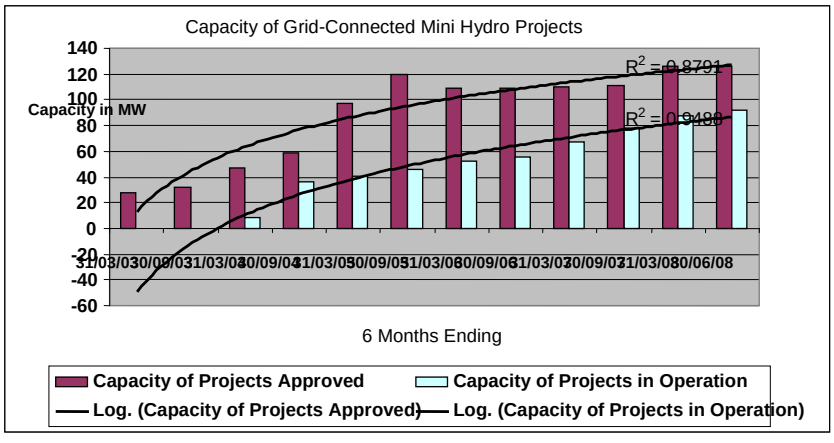


Figure 2.3 Bi-Annual Progress of Approved and Installed Capacity of Grid-Connected Hydro Sub-Porjects



2.1.2 Geographical Distribution of Grid-Connected Hydro Capacity

Due to the topographical and climatalogical conditions of the country, most of the approved capacity (81%) is concentrated in Ratnapura, Kegalle and Nuwara Eliya districts

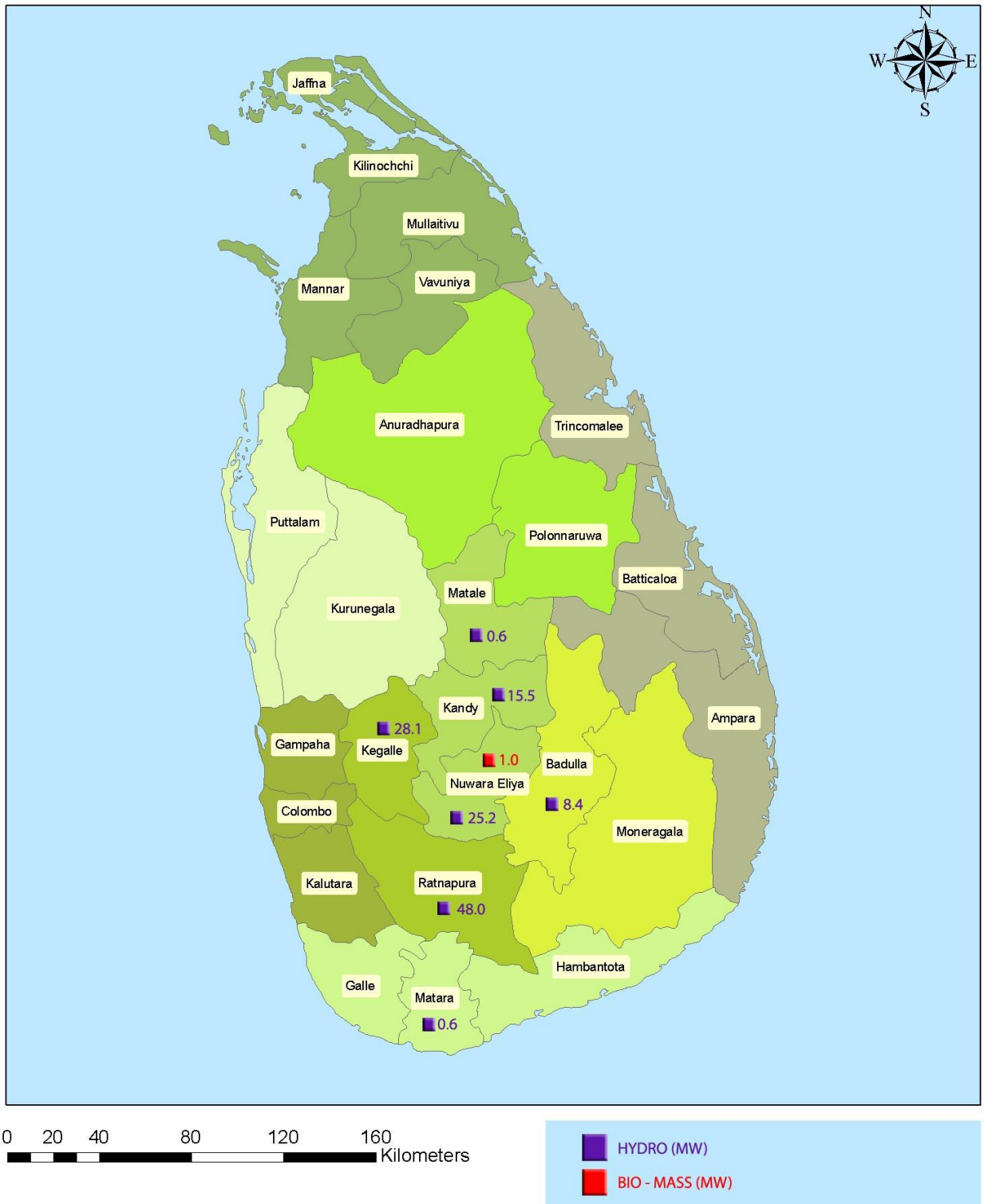
(Table 2.5). Hydro power projects with high head have lower specific capital cost (Rs. per kW of installed capacity) and projects with regular water flow have better plant factor thus generating more energy per annum. These favourable conditions prevail in the Districts mentioned in Table 2.5.

***Table 2.5*: Geographical Distribution of Approved Grid-Connected Sub-Projects by District**

District	MW	%
Ratnapura	48.0	38.2
Kegalle	28.1	22.3
Nuwara Eliya	25.2	20.0
Kandy	15.5	12.3
Badulla	8.4	6.7
Matara	0.6	0.5
Total	**125.8**	**100.00**

The distribution is shown in Map 2.1 below.

Map 2.1 **- Geographic Distribution of Grid-Connected Sub-Projects Approved under RERED as at 30 June 2008 (MW)**



2.2 Off-Grid Power Generation

RERED Project laid much emphasis on providing electricity to rural HHs through off-grid systems based on SHSs, off-grid community-based hydro, biomass and wind powered sub-projects. By 30/06/2008, 103,225 HHs had been provided with electricity from SHSs (98,738 HHs) and off-grid community-based hydro sub-projects (4,487 HHs). The number of HHs with SHSs as at 30/06/2008 was however less than 98,738, as SHSs had been removed from some HHs for various reasons. Information gathered from 6 companies that installed SHSs under the RERED Project relating to 47,849 SHSs installed showed that 5,167 (11%) had been removed. Adjustment for removal would place the HHs still having SHSs at 88,074 and the total number of HHs receiving electricity from off-grid systems would be 92,561. However as some of these SHSs have been sold to other HHs this number would be more. For the purpose of this report the HHs with SHSs will be taken as 98,738 without allowing for removals.

The Project envisaged several biomass powered electricity generation sub-projects. One pilot plant of 35 kW to provide electricity to 100 HHs was constructed by the Energy Forum at Badalkumbura but it had to be closed down shortly after coming into operation due to internal problems. However, this is not considered as a sub-project under RERED Project although it received technical assistance from it. This plant has now been relocated at Kakkapalliya in a coconut estate to provide electricity for a coconut defibreing facility.[15] There were no off-grid community-based biomass sub-projects set up under the Project as at 30/06/08 but the Project had created interest in biomass-based electricity and several projects that are not funded by the Project are in operation or being processed. Appendix 5 gives some examples; these also illustrate the success in encouraging private investment in the renewable energy sector that the Project aimed to promote. There were no off-grid community-based wind sub-projects in operation as at 30/06/2008. The approval given for an off-grid community-based 1-kW wind power sub-project to supply electricity to 10 HHs at Kiribbanwewa in Moneragala district has been cancelled.[16]

2.2.1 SHSs

Out of the HHs receiving electricity from off-grid sources, most have benefited from SHSs. The number of HHs that installed SHSs increased by 236% from 41,881 as at 31/12/2004 to 98,738 as at 30/06/2008. At the start of the Project, HHs in the Northeast, Sabaragamuwa and Uva Provinces received a government subsidy of Rs.10,000 to install SHSs. This made them affordable for low income families also. This was extended to cover all sources of renewable energy and all districts in the country from 01/01/2006. This would benefit off-grid community-based hydro sub-projects also but at the time of writing this report relevant authorities had not worked out as to how this grant facility would be implemented for off-grid community-based hydro or other projects.

Table 2.6 and Fig 2.3 show the number of SHSs installed bi-annually during the project duration. ESD Project helped to build up the solar power industry in the country and RERED Project envisaged developing it into a commercially viable and dynamic industry. One would have expected the sales of SHSs to increase as the Project progressed, particularly as the Government subsidy which was initially limited to three Provinces was made available countrywide; but only 28,941 HHs installed SHSs during the 2 years from 01/04/2006 to 31/03/2008 compared to 42,490 during the preceding two year period. This shows that sales were less in the latter part of the Project period instead of being more which suggests that the market for SHSs might be getting saturated.

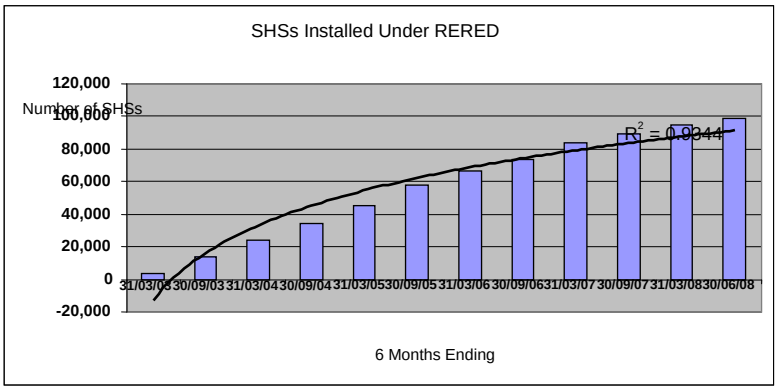
[15] Information gathered from Energy Forum (Gte) Ltd.
[16] *Section C. FMR – Project Progress Reports*, QE 30/06/2009, AU

***Table 2.6*: Bi-Annual Installation of SHSs**

Half Year Ending	No. of SHSs	Increase	
		No.	%
31/03/2004	23,777		
30/09/2004	34,035	10,258	43.1
31/03/2005	44,911	10,876	32.0
30/09/2005	57,988	13,077	29.1
31/03/2006	66,267	8,279	14.3
30/09/2006	73,604	7,337	11.1
31/03/2007	83,807	10,203	13.9
30/09/2007	89,108	5,301	6.3
31/03/2008	95,208	6,100	6.8
30/06/2008	98,738	3,530	3.7

One reason for the drop in sales of SHSs could be the continuing high price of SHSs in the local market despite the price of solar cells in the international markets dropping significantly. In fact, the cost of local systems has increased appreciably. The monthly instalment per household for a 40W SHS delivering 5 kWh per month is in the region of Rs. 2,000.[17] This is more than the regular monthly payment made for CEB grid connected HHs consuming 100 kWh per month!

***Fig. 2.4*: Bi-Annual Progress in Installing SHSs**



2.2.2 Off-Grid Community-Based Hydro Sub-Projects

The Project envisaged that there was a good potential to develop off-grid community-based hydro sub-projects, - *"A survey carried out in seven districts of Sri Lanka identified 853 sites suitable for construction of village hydro systems, of which 444 were found technically viable with a potential installed capacity of about 18 MW;"* [18] During the Project period 151 projects with a capacity of 1,428.0 kW were approved and 118 (78.2%) with a capacity of 1,168.1 kW have been completed. These projects provided electricity to 4,487 HHs.

Table 2.7 and Fig. 2.4 show the progress made by this component through the project duration. In the period up to 31/03/2006, 120 sub-projects had been approved and

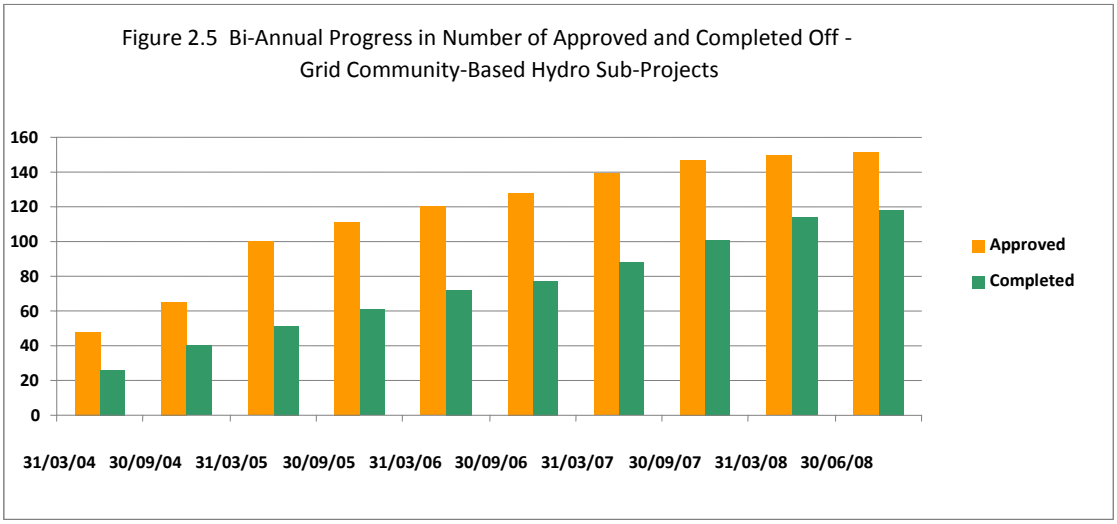
[17] Information from Energy Forum (Gte) Ltd.,
[18] *PAD,* op. cit., p.43

72 had been commissioned. Some of these were projects approved under ESD. In the two years and three months from then until 30/06/2008, only 31 sub-projects were approved and 46 commissioned.

***Table 2.7*: Off-Grid Community-Based Hydro Sub-Projects Approved and In Operation [19]**

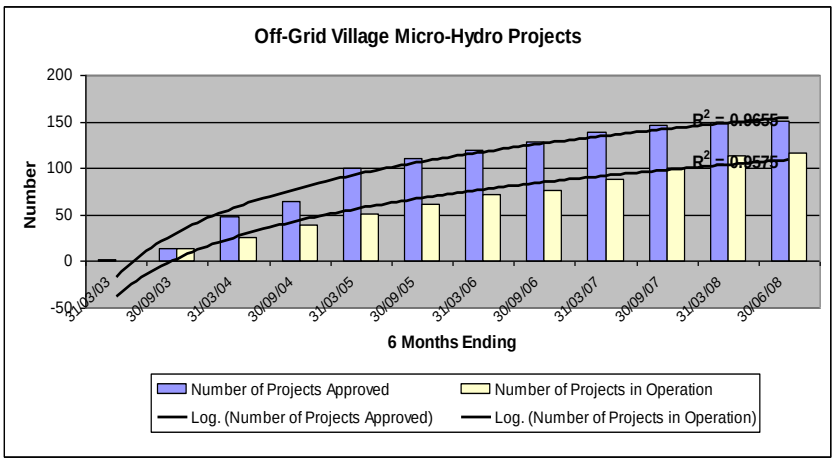
Half Year Ending	No. of Sub-Projects				Capacity kW			
	Appro-ved	% Inc-rease	In Oper-ation	% Inc-rease	Appro-ved	% Inc-rease	In Oper-ation	% Inc-rease
31/03/2004	48		26		563.3		285.6	
30/09/2004	65	35.4	40	53.9	748.1	32.8	431.4	51.1
31/03/2005	100	53.9	51	27.5	1,065.2	42.4	507.9	17.7
30/09/2005	111	11.0	61	19.6	1,129.3	6.0	601.8	18.5
31/03/2006	120	8.1	72	18.0	1,190.8	5.5	734.2	22.0
30/09/2006	128	6.7	77	6.9	1,256.0	5.5	772.1	5.2
31/03/2007	139	8.6	88	14.3	1,341.3	6.8	914.0	18.4
30/09/2007	147	5.8	101	14.8	1,403.7	4.7	1,045.4	14.4
31/03/2008	150	2.0	114	12.9	1,440.4	2.6	1,135.5	8.6
30/06/2008	151	0.7	118	3.5	1,428.0	-0.9	1,168.1	2.9

Figure 2.5 Bi-Annual Progress in Number of Approved and Completed Off - Grid Community-Based Hydro Sub-Projects



[19] Data from *Section C, FMR – Project Progress Reports* of AU and *RERED website.*

Figure 2.6 Bi-Annual Progress of Approved and Completed Off-Grid Village Hydro Projects



The gap between approved and commissioned projects has narrowed towards 30/06/2008. This is because in the 15 months up to 30/06/2008 only 12 new sub-projects were approved compared to 19 in the 12 months before that. In contrast to that, 30 sub-projects had been commissioned in the 15 months up to 30/06/2008 compared to 16 for preceding period. This was due mainly to AU taking remedial action to overcome barriers causing delays. Delays were caused in:

- obtaining approvals from Government agencies / Divisional Secretary
- obtaining land for the project
- obtaining environmental clearance from CEA
- obtaining financial assistance from the Provincial Councils where they have agreed to provide a grant.
- mobilising community support
- obtaining machinery and equipment
- failure of some developers to fulfil their obligations. (See Section 3.5.1 for more details.)
- obtaining loans from PCIs

Projects taking an unduly long time (i.e., more than one year after Design Verification) to be completed were discussed at the quarterly VHWG meetings. There were 26 such sub-projects which were discussed at the VHWG meeting of 14/03/2008 and remedial actions to expedite their completion were agreed upon collectively. AU follows up on individual projects to monitor whether agreed actions were being taken.

***Table 2.8*: Cumulative Position of Off-Grid Community-Based Hydro Sub-Projects [20]**

Half Year Ending	Off-grid Community-based Hydro Sub-Projects		% Completed
	Approved	Completed	
31/03/2003	2		0
30/09/2003	14	4	28.6
31/03/2004	48	26	54.2
30/09/2004	69	42	60.9
31/03/2005	100	51	51.0
30/09/2005	111	61	54.9
31/03/2006	120	72	60.0
30/09/2006	128	77	60.2
31/03/2007	139	88	63.3
30/09/2007	147	101	68.7
31/03/2008	150	114	76.0
30/06/2008	151	118	78.2

The list of approved off-grid community-based hydro sub-projects is given as Annex 4.

Off-grid community-based hydro sub-projects made up a small part of the RERED Project in terms of the allocation of funds, the contribution to the national economy[21] and reduction in carbon emissions but they have been appreciated[22] very highly by the beneficiaries despite several shortcomings.[23] Total amount of loans disbursed by PCIs as at 30/06/2008 was Rs.23.45 million to provide electricity to 3,277 HHs[24] which is the equivalent of Rs7,156 per HH. Further, loans disbursed by non-PCIs to provide electricity to 1,210 HHs amounted to Rs.10.96 million equal to Rs.9,058 per HH. Information gathered by Consultants during field visits indicated that individual HHs made a monetary investment of Rs.30,000 – 40,000 in addition to what they borrowed collectively. This represents a sizable investment for families in these communities. A part of this was reimbursed through the co-financing grant disbursed to VECSs by the Project at the rate of US$.400 per installed kW. For the total installed capacity of 1,186 kW as at that date, this was equal to US$ 467,240[25] which amounted to US$.104.13 per HH. Capacity related GEF grant / cost subsidy and Provincial Council grants have played a key role in the successful implementation of off-grid community-based hydro sub-projects.

For this sub-component to be continued after the Project, village communities would need a grant component as they cannot afford the full cost of a hydro project. The decision of the GOSL to extend the grant of Rs.10,000 per family to all forms of renewable

[20] *Section C. FMR – Project Progress Reports,* AU

[21] The value of the power generated and foreign exchange saved, though not computed, is very small compared to that of grid-connected hydro sub-projects or SHSs

[22] See Section 4.2 to follow.

[23] Frequent breakdowns, poor quality of lighting and weak VECSs as explained in the text.

[24] *Section C, FMR – Project Progress Report for QE 30/06/2008,* AU, Table C5

[25] These monetary values are expressed in US$ as the value of SLR against the US$ has fluctuated significantly during the period 2002 to 2008.

energy is a step in the right direction particularly as GOSL spends many times this amount per HH to provide grid electricity.

The benefits derived by the people from this investment, individually and collectively, have been very significant and far reaching. From that point of view, this is a sector that deserves higher priority. However, these sub-projects have been beset with serious problems which need to be overcome if they are to be an effective alternative to electricity from the national grid.

2.2.3 Geographic Distribution of SHSs and Off-Grid Community-Based Hydro Sub-Projects

It is important to note that there are HHs with SHSs in every district (Annex 6). However, three districts dominated the geographic distribution in 2004. They were Ratnapura, Moneragala and Kurunegala which had 44% of the total number of HHs with SHSs in the country. Even at the end of the Project they had the largest share but with a lower proportion (39%) due to the increased number of HHs with SHSs in other districts.

The number of HHs with SHSs had increased in every district during the project duration. The districts in which the percentage increase of SHSs was highest during this period were Kandy (433%), Mullaitivu (388%), Colombo (384%) and Kalutara (361%). This is because they had relatively few SHSs in 2004. The number of SHSs increased most in Ratnapura (7,904), Kurunegala (7,453), Anuradhapura (5,780) and Moneragala (5,230) districts.

Because of topographical and climatalogical reasons, off-grid community-based hydro sub-projects are limited to 10 of the 25 districts in the country as shown in Table 2.9. Among these districts, 83% of the planned and 79% of the completed capacity are in Ratnapura and Kegalle districts. Ratnapura district which straddles both the Wet and Dry Zones of the country has benefited significantly from both the grid-connected and the off-grid components of the Project.

***Table 2.9*: Geographic Distribution of Off-Grid Community-Based Hydro Sub-Projects**

District	HHs Provided with Electricity				Installed Capacity kW			
	Planned		Completed		Planned		Completed	
	No.	%	No.	%	No.	%	No.	%
Badulla	490	9	319	7	119	8	101	9
Galle	91	2	58	1	17	1	13	1
Kalutara	207	4	67	1	44	3	25	2
Kandy	139	3	76	2	36	3	18	2
Kegalle	1,459	28	1,316	29	311	22	295	25
Matale	72	1	---	---	18	1	---	---
Matara	53	1	38	1	9	1	4	0
Moneragala	119	2	119	3	26	2	30	3
Nuwara Eliya	144	3	44	1	35	2	9	1
Ratnapura	3,141	60	2,450	55	814	57	674	58
Total	**5,194**	**100**	**4,487**	**100**	**1,428**	**100**	**1,168**	**100**

Map 2.2 shows the geographic distribution of off-grid community-based hydro sub-projects and SHSs as at 30/06/2008.

***Map 2.2* - Geographic Distribution of Off-Grid Projects Approved under RERED as at 30th June 2008 ***

***** *Note*: Number of HHs provided with electricity

2.3 Other Project Components

2.3.1 Energy Efficiency & DSM

RERED had as its Project Vision, "*This sub-component will focus on accelerating the private sector delivery of energy efficiency services in Sri Lanka…*" [26] It aimed to do this by providing technical assistance to this sector and financing energy efficiency projects (see Box 2.1). The first ESCO was formed during the ESD Project. By the end of December 2004, there were 7 such ESCOs registered with the ECF which has been reconstituted in 2007 as the SEA.[27] ECF invited expressions of interest from ESCOs to register with the ECF by May 2005. Registered ESCOs which then totalled 7 expanded further with that round and qualified for concessionary finances offered under various schemes operated by the ECF. The ECF initiated a programme to build the capacity of ESCOs through training, market development and providing energy measuring instruments at affordable prices. By 31/03/2007 there were 12 ESCOs registered with ECF and this had increased to 15 by 30/09/2008 (Table 2.10) but only 7 of them were active.

Box 2.1: *Energy Efficiency and DSM* [28]

The project intends to provide TA and limited credit support for further private sector development for provision of energy-efficiency services, (p.9)…. Energy Services Companies (ESCOs) are appropriate private sector vehicles for implementing energy efficiency projects, but the industry needs to be nurtured through technical assistance.(p.16) An unplanned outcome of the project was the help provided by consultants to set-up the first private sector energy services company (ESCO), Lanka Transformers Limited (LTL). The total market size in the industrial sector alone is estimated to be on the order of US$ 160 million, and savings in that sector could run up to 960 GWh annually. (p.47)

This sub-component will focus on accelerating the private sector delivery of energy efficiency services in Sri Lanka through: i) technical assistance targeted at building capacity within the fledgling ESCO industry; ii) encouraging new ESCOs to enter the market through training and awareness programs; and iii) building capacity within commercial banks to appraise energy efficiency projects. In addition, the component will also fund technical assistance activities at the CEB DSM branch in support of their ongoing appliance-labeling program, DSM program design and evaluation efforts and demonstration projects for encouraging voluntary implementation of Energy Efficiency Building Codes. (p.47)

***Table 2.10*: List of Energy Service Companies as at 30/09/2008**

No.	Energy Service Companies	Services Provided	
		Energy Audit Services	Energy Efficiency Services
1	Professional MET Consultancy Services (Pvt) Ltd	√√	√√
2	Access Energy Solutions (Pvt) Ltd	√√	√√
3	Sri Lanka Energy Managers Association	√√	√√

[26] See Annex 1 of the *PAD,*

[27] ECF was replaced by the SEA by the Sri Lanka Sustainable Energy Authority Act, No.35 of 2007

[28] *PAD,* op. cit., pp. 9, 16 & 47

No.	Energy Service Companies	Services Provided	
		Energy Audit Services	Energy Efficiency Services
4	Resco Energy (Pvt) Ltd	√	√
5	VIS – CON Enterprises	√	√
6	Diesel & Motor Engineering PLC	√	√
7	Industrial Services & Training Centre	√√	
8	Energy & Environmental Management	√√	
9	National Cleaner Production Centre of Sri Lanka	√√	
10	EcoPro Technologies	√	
11	Enerfab (Pvt) Ltd	√	
12	Industrial Services Bureau		√√
13	Lakdinindu Power Engineering Company		√
14	Rotax Limited		√
15	Energy Management Systems (Pvt) Ltd		√

Note: √√ These are the more active companies among these ESCOs

Three ESCOs, Access Energy Solutions (Pvt) Ltd; Professional MET Consultancy Services; and National Engineering Research and Development Centre provided ECF information on the services they performed during 2006. Their services were:

- Preliminary Energy Conservation Studies – 25
- Comprehensive (Investment Grade) Audits - 15
- Projects Implemented – 2
- Training Courses (by one ESCO) – 166 participants in three courses on: Energy Savings in Boilers, Increase Energy Saving and Operator's Role in Energy Saving.
- Boiler Tuning & Flue Gas Analysis (by one ESCO) – 41 boilers
- Other Energy Related Activities (by one ESCO) - Improvements of Barns, Steam trap testing, Theoretical calculation of steam requirement and Electrical Harmonic Power Measurement

The potential for energy conservation as a result of the energy audits done by one ESCO was estimated at Rs.6.0 million. This indicates that considerable amounts of energy can be saved if large energy users become more efficient in using energy.

A fully fledged ESCO provided a total solution, from initial diagnosis, recommendation, implementation, training, monitoring and evaluation to end users to correct an energy wasting situation but some ESCOs provided only some of these services. A survey of ESCOs carried out by the M&E Consultants surfaced the following problems they faced:

1. Lack of funds for the projects
2. Delays in getting approvals for the facilities from commercial banks as most of the lending institutions do not know the available funds.
3. Delay in decision making by non-technical staff.
4. Lack of commitment and encouragement of the top management in high energy consuming organizations due to the lack of knowledge on energy conservation among them.

5. High product cost due to high import duties on energy conservation products.
6. Ineffective presentations by technical persons.
7. Lack of awareness especially among young engineers.

They also identified the support ECF[29] could give to promote their services:

1. Expedite arranging and finalising low interest facilities for projects.
2. Publicise implemented projects under ECF's recommendations.
3. Strengthen capacity of the ESCOs on new technologies.
4. Circulate among bulk energy consumers, a quarterly report on developments and achievements of ESCOs
5. Obtain from Secretary, Ministry of Finance, a duty waiver or concessionary duty rate for energy conservation products on the basis of supporting documents and recommendation given by ECF.
6. Have quarterly meetings with ESCOs for progress and achievements.
7. Conduct in-house awareness programmes for top management on benefits of energy savings.
8. Carry out walk-through energy audits.

The first refinance application for an energy efficiency sub-project proposal submitted by a PCI was approved during the QE 31/03/2005. RERED Project financed some energy efficiency projects during QE 30/09/2006 in addition to what the ECF has supported through its credit guarantee programme. Several leasing companies expressed interest in accessing funds for marketing energy efficient technologies to industrial and commercial end users. They initiated dialogue with certain ESCOs and possible areas of co-operation were examined.

A study undertaken by Energy Forum recommended energy efficiency measures for three teaching and base hospitals.[30] However, this initiative faced a problem of implementing the recommended guidelines and packages to achieve the objectives of the component due to lack of co-operation from the relevant authorities. This might have been due to a lack of a participatory approach which made the recommendation totally alien to the relevant authorities who did not have a sense of ownership. Also there were no incentives provided within the system or the Project to encourage the heads of these institutions to look for energy efficient measures or to apply recommended measures. The consultant, Energy Forum, AU, Ministry of Health and the ECF organised a workshop on energy conservation and energy efficiency for hospital directors and administrators during QE 30/06/2005.

Discussions with the SEA indicated that public organizations as well as private companies could decrease energy consumption by 30 – 50% but there is little appreciation of this among decision makers in those organizations.

Another action the Project initiated to promote energy efficiency was to assist the installation of a household refrigerator testing chamber. This was initially planned to be established at CEB but it was decided subsequently to install it at NERD. This has been held up until a comprehensive national appliance labelling programme is in place that will lead to a mandatory labelling scheme.[31]

[29] At the time of the survey ECF had not been replaced by SEA
[30] Based on information from *Section C, FMR – Project Progress Reports*
[31] Based on information from *Section C, FMR – Project Progress Reports*

2.3.2 Cross-Sectoral Energy Applications

The action described above under Section 2.3.1 was intended mainly to promote energy efficiency in Government hospitals but it can also be considered as a cross-sectoral energy application. The Project initiated a pilot energy project in the first quarter of 2005 to provide renewable energy to a hospital in Akkarayan and a school near Batticaloa.[32] This was delayed initially due to technical issues but has since been put on hold due to the unsatisfactory security situation that prevailed in the province. After normalcy was restored in the Eastern Province in 2007, alternative sites for the pilot project for the school and hospital have been identified. Work has been undertaken now to implement this project.

Contract has been signed with the Energy Forum to identify energy needs and develop energy packages in 3 selected Provinces. A consultant was contracted to report on potential impact of improved access to electricity and high priority energy.

Energy from off-grid community-based hydro sub-projects and SHSs has been used for several public institutions. As seen in Table 2.11 religious places and schools have benefited most from energy provided by these sub-projects. Impact surveys have indicated that this has encouraged socio-cultural activities in these communities.

***Table 2.11*: Use of Electricity from Off-Grid Community-Based Hydro Sub-Projects by Public Institutions According to Postal Surveys [33]**

Use Made of Electricity	All Surveys	
	92 VECSs	
	3,398 HHs	
Public Use	**No.**	**%**
School	15	22.1
Government Institution	1	1.5
Religious Place	46	67.6
Community Needs	6	8.8
Total	68	100.0

According to the available data, only 11 public institutions have been powered by SHSs, all of them religious places.

2.3.3 Innovation Solicitation

2.3.3.1 Project Expectations

An important expectation of the Project was to promote rural economic development by making electricity from off-grid community-based hydro sub-projects available for enterprises at an affordable cost. As stated in the *Project Appraisal Document* (See Box 2.2) this component was intended to motivate rural entrepreneurs to start enterprises by making them aware of opportunities and giving them necessary technical training and other support.

[32] Based on information from *Section C, FMR – Project Progress Report*

[33] Where data is available for the same VECS for more than one year, data for the most recent year has been taken into account.

Box 2.2: *Expectations of Innovation Solicitations Component* [34]

The AU will facilitate efforts to bring more MFIs and consumer credit institutions into the program by sponsoring an "innovation solicitation" process (p. 19) …. The first batch of TA will be organized by means of bidding out these activities through 'innovation solicitations' for the first 5 fuel supply projects combined with five feasibility studies for these sites. (p. 46) …. In parallel, the innovation solicitation approach will be applied to seek broader participation and new ideas. (p. 49) … (iv) conducting the innovation solicitations around rural development. (p. 52) For the "innovation solicitations" the AU will guide a series of the solicitations using advertisements in local newspapers and announcements distributed to key industry stakeholders and previous village hydro solicitation participants. Each of the several rounds of solicitations will build on the previous history, (p. 54)

Promotion of economic activities to support rural development was also an expectation of this component.

2.3.3.2 Project Activities [35]

According to the FMR for the quarter ending 31/03/03 AU called for Expressions of Interest in "Innovation Solicitation" and received 72 applications of which 40 were short listed. Subsequently, in two rounds, the AU selected some of the proposals from interested organizations and individuals. Several economic activities that supported rural economic development have been undertaken under this component. These could be broadly categorized into three groups:

1. Economic enterprises – The largest number totaling 48 fell into this category. These projects helped to start or develop enterprises in communities where electricity became available as a result of constructing off-grid community-based hydro sub-projects. Developers who were constructing such projects were offered an additional US$ 2,000 if they incorporated the establishment of an economic enterprise in their project design. Enexe (Pvt) Ltd. was a Developer that also undertook to establish enterprises in the communities in which they constructed these hydro sub-projects. It developed 11 economic activities in 5 villages.

   Proposals were canvassed from others through newspaper advertisements to establish economic enterprises in these project areas. Most of the VECSs were members of the FECS, whose relationship with the VECSs enabled it to undertake the promotion of a large number of economic activities in several project areas. Altogether, it established 30 economic activities in 19 villages. Considering the fact that FECS is a small organization with limited staff to service over 100 VECSs, it is questionable whether it could successfully undertake so much responsibility as AU also entrusts it with capacity building training programmes for the VECSs. Rural Energy & Environmental Consultation Services (REECS) established 7 economic activities in 3 villages.

2. Technological Innovations – Three (03) projects fell into this category. Two of these projects were undertaken by Dr. Kapila Weeratunga Arachchi. One of them was to introduce solar dryers to spice farmers and the other to introduce biomass dryers to dehydrate vegetables and fruits. The third project was undertaken by Practical Action, formerly known as the Intermediate Technology Development Group (ITDG) to

[34] *PAD.;*op. cit., page numbers refer to the pages of the document

[35] Information for this has been gathered from *Section C FMR – Project Progress Reports* of AU*,*

introduce solar dryers to collectors of medicinal herbs and to add value to their products through grinding them and making dipping bags.

3. Barter arrangement – This innovation was motivated by a desire to adapt to Sri Lanka what has been tried out successfully in Nepal. "*In addition, the Project will support the introduction of alternative schemes such as a barter-based system for poor households now being successfully piloted in Nepal. Through NGOs, poor households could be taught handicraft skills. These households also could be given solar home systems, and the handicraft products could be accepted by the NGO in payment. The NGO could sell the products through national/international outlets.*"[36] One (01) project fell into this category. Sewalanka Foundation, an NGO, implemented a project to provide SHSs to HHs that could not afford to buy them. The NGO trained them to make paper using locally available raw materials (banana fibre and Guinea grass) and organized its marketing.

[36] *PAD,* op. cit., *p.53*

3 IMPLEMENTATION STRATEGY

3.1 Composition and Roles of the Stakeholders

A wide range of individuals, institutions, organizations, and companies both in the state and private sector constituted the stakeholders who had a role and/or interest in the objectives and implementation of the Project. They functioned as the beneficiaries, implementers, equipment suppliers, service providers, regulatory agencies or institutions, consultants, and funding agencies as listed in Table 3.1. Firstly, the stakeholders have been divided into Primary and Secondary Stakeholders, the Primary Stakeholders being beneficiaries. The Secondary Stakeholders have been categorised according to the role they play in the implementation of the Project.

Although a Stakeholder Analysis, *per se*, was not undertaken at the inception of the M&E activities, an understanding of the stakeholders and their expectations, interests, influence and power relations was acquired by participating in the periodic Stakeholders Meetings (conducted by AU), conducting interviews and focus group discussions and interacting with them during office and field visits.

The beneficiaries of different Project components have benefited in different ways. Local communities were expected to play an active role in developing off-grid community-based hydro sub-projects. Where there has been effective stakeholder participation – more specifically, beneficiary participation – in the design, implementation, O&M and monitoring of the activities of off-grid community-based hydro sub-projects it has contributed to the success of the sub-projects. Such community participation was not expected in other components.

3.2 Implementation Procedures Followed

GOSL, in consultation with the World Bank, has appointed DFCC Bank as the RERED Project AU to implement the Project. To avoid conflicts of interest, the AU is independent of and separated from the PCI function of DFCC Bank. The AU is primarily responsible for the administration of the International Development Association (IDA)[37] credit line and GEF grant funds and provision of Project support.

3.2.1 Eligible Sub-Projects and Investment Enterprises

Sub-projects are investment projects utilising the credit and/or grant funding provided by the RERED Project. Eligible sub-projects are private investment proposals for:

- Grid-connected renewable energy power projects (with capacity not more than about 10 MW)
- Off-grid community-based renewable energy power projects
- SHS
- Other renewable energy investments
- Energy efficiency, conservation and DSM investments

[37] IDA is part of the World Bank

***Table 3.1*: Project Stakeholders**

Stakeholder Category		Stakeholders
1.0 Primary Stakeholders		1. Rural householders and Enterprises benefited by Project activities
2.0 Secondary Stakeholders	2.1 Project Management	1. RERED Administrative Unit (AU) within Development Finance Corporation of Ceylon (DFCC)
	2.2 Implementing Partners	1. Village Electricity Consumer Societies
		➢ *Following Participating Credit Institutions (PCIs)*: 1. Alliance Finance Co. PLC 2. Ceylinco Leasing Co Ltd* 3. Commercial Bank of Ceylon PLC 4. DFCC Bank 5. Hatton National Bank PLC 6. National Development Bank PLC 7. Lanka Orix Leasing Co PLC 8. Sampath Bank PLC 9. Sanasa Development Bank* 10. SEEDS (Guarantee) Ltd 11. Seylan Bank PLC 12. Non-PCIs 12.1. Ayagama Peoples' Fund 12.2. Bank of Ceylon 12.3. Cooperative Societies and Banks 12.4. Kandurata Development Bank 12.5. Sabaragamuwa Development Bank 12.6. Samurdhi Bank 12.7. Sanasa Societies 12.8. Ruhunu Development Bank 12.9. Rural Development Bank(s) 12.10. Seva Lanka Foundation 12.11. Uva Development Bank ➢ *Following Village Hydro Developers*: 1. Bio-Diversity Research Information & Training Centre (BRIT Centre)* 2. Ceylon MKN Eco Power (Pvt) Ltd* 3. Consultancy & Professional Services (Pvt) Ltd (CAPS) 4. Diriyashakthi Padanama* 5. Enexe (Pvt) Ltd* 6. ENCO (Pvt) Ltd 7. Engineering & Consultancy Services Institute (EACONS)* 8. Energy & Rural Development Consultation Services (ERDCS)* 9. Galigamu Janatha Padanama* 10. Human & Environmental Development Organisation (HEDO)* 11. Isuru Praja Sanwardhana Padanama* 12. Lanka Praja Isuru Sanwardhana Padanama* 13. Lamda Construction* 14. LEDCO Engineering* 15. Mr Ariyadasa Morapitiya* 16. Mr K A N Kodituwakku 17. Mr K H L C K Kariyawasam 18. Mr M Navaratne* 19. Mr Nihal Wimalaratne

Stakeholder Category		Stakeholders
		20. Mr P G A Kumara 21. Mr Pulasthi Ekanayaka 22. Mr R D K Ranasinghe (Ranasinghe Electronics)* 23. Renewable Energy Development Co (Pvt) Ltd (REDCO) 24. Rural Energy and Environmental Consultation Services (REECS)* 25. Sabaragamu Janatha Padanama* 26. Samanala Agencies 27. Sarvodaya Rural Technical Service (SRTS) - Technological Empowerment Division* 28. Sathmaga Seva Ayathanaya* 29. Sumithuro Ayathanaya* 30. Uva Graduate Resource Centre* 31. Vidullanka Ltd* ➢ *Following Village Hydro Equipment Suppliers*: 1. Economical Developed Equipment Network 2. ENCO (Pvt) Ltd 3. Enexe (Pvt) Ltd* 4. Hettigoda Energy Technologies 5. Katulanda Brothers 6. Lionel Hydro Power Industries 7. Malmessa Engineering Service* 8. Manatunga Hydro 9. Mr P L Saman Keerthi* 10. Renewable Energy Development Co (Pvt) Ltd (REDCO) 11. Sherly Tech 12. Srimali Motors & Engineers 13. System Engineers 14. Udayaratne Hydropower Engineering* ➢ *Following Solar Companies*: 1. Access Solar (Pvt) Ltd* 2. Alpha Solar Energy Systems (Pvt) Ltd 3. Ceylinco Renewables (Pvt) Ltd 4. E B Creasy & Co Ltd 5. Energy Work (Pvt) Ltd 6. Environ Energy Lanka Ltd (formerly Shell Solar) 7. High Tech Solar Systems (Pvt) Ltd 8. HPI Solar (Pvt) Ltd 9. Selco Solar (Pvt) Ltd* 10. Softlogic Solar (Pvt) Ltd 11. Solar Dynamics (Pvt) Ltd* 12. Sundaya Lanka (Pvt) Ltd 13. Suryavahini (Pvt) Ltd 14. Vidula Energy (Pvt) Ltd (formerly Vidul Energy) 15. Wisdom Solar (Pvt) Ltd
	2.3 Responsible Government Ministry	1. Ministry of Finance and Planning
	2.4 Industry Associations	1. Bio Energy Association of Sri Lanka 2. Federation of Electricity Consumer Societies 3. Grid-Connected Small Power Developers Association 4. Micro Hydro Developers Association, Sri Lanka 5. Solar Industries Association

Stakeholder Category		Stakeholders
	2.5 State Agencies / Institutions	1. Agrarian Services Department 2. Central Environmental Authority (CEA) 3. Ceylon Electricity Board (CEB) 4. Department of Co-operative Development 5. Department of Wildlife Conservation 6. Divisional Secretariats 7. Energy Supply Committee 8. Irrigation Department 9. Ministry of Power & Energy 10. National Water Supply & Drainage Board 11. Provincial Councils 12. Sustainable Energy Authority (SEA) (formerly Energy Conservation Fund) 13. Pradeshiya Sabhas
	2.6 Consultants / Technical Advisors	1. Financial Consultants (audit) 2. Cross Sectoral Energy Application Consultants 3. Equipment Testing and Certification Consultants 4. Industry Analysts, Market Survey and Feasibility Consultants (sector growth, industry surveys, customer satisfaction surveys, sector studies, policy framework, guideline development and technical assessments) 5. Innovation Solicitation Consultants 6. IT Consultants (website development and maintenance, software development and hardware maintenance) 7. Promotional and Advertising Consultants (publications, TV spots and press advertisements) 8. Training and Development Consultants (capacity building, technician and PCI training) 9. Verification and Compliance Consultants (design, installation, environmental, economic benefits, complaint investigation and physical asset verification) 10. Monitoring & Evaluation Consultants
	2.7 Funding Agencies	1. International Development Association (IDA) of World Bank 2. Global Environment Facility (GEF) of World Bank 3. Other sources of funding support include Provincial Councils and the General Treasury

* Not active as at 30/06/2008

An investment enterprise eligible for financing may be any private enterprise, non-governmental organisation (NGO), cooperative or individual operating in Sri Lanka. Subject to meeting PCI's credit worthiness assessment, they obtain medium or long-term sub-loans from PCIs to establish eligible sub-projects and procure assets. As defined in the Operating Guidelines, certain types of sub-projects qualify for grant assistance.

3.2.2 Procedures

Project administration is carried out by the AU. Loans for individual investments (sub-projects) are disbursed through PCI which could be banks or MFIs that make their independent credit assessments to ensure that sub-projects are financially viable, environmentally sound, meet required engineering standards and are economically justifiable. Counterpart funds for technical assistance are provided by the project beneficiaries and GOSL.

Two Special Dollar Accounts (SDAs) are maintained at the Central Bank of Sri Lanka to deposit the proceeds of IDA credit and GEF grant. The credit SDA is used to refinance PCIs, who approve sub-loans to sub-project beneficiaries following their own credit evaluation procedures while ensuring compliance with Project requirements. Once the sub-loan has been approved, PCIs forward a completed loan Refinance Application (RA) to the AU requesting commitment for a maximum of 80% of the approved sub-loan amount. As and when the PCI disburses funds against the approved loan, a Loan Disbursement Request (LDR) is forwarded by the PCI (with appropriate supporting documents) to the AU for obtaining a maximum refinance of 80% of the amount disbursed to the beneficiary. Release of grant funds by the AU is based on evidence of work done and, for routine operations a Grant Disbursement Request (GDR) will accompany supporting documents. Specific fund flow arrangements under the Credit Programme and details of supporting documentation for reimbursements are given in the Operations Manual and Operating Guidelines.

The RERED Project is designed to on-lend funds through intermediaries (PCIs) to sub-borrowers undertaking renewable energy sub-projects and energy efficiency investments. Technical assistance is available for development and implementation of grid-connected and off-grid renewable energy systems; this is funded by IDA credit and GEF grants. Given the relatively small size of individual procurements, established commercial practices would be the main mode of procurement under the RERED Project.

3.2.3 Procurement Oversight Arrangements

PCIs maintain details of the procurement methods used by sub-borrowers and monitor the utilisation of sub-loan funds through site supervision visits. The AU staff and IDA field supervision missions continue to review implementation of these procedures.

To enhance the fiduciary review process, the following additional safeguards were followed:

- PCIs verify procurement practices of sub-borrowers and submit a certificate of compliance that agreed procurement procedures had been followed for all cases where commercial practices have been adopted (COC-P).
- An external consultant/auditor hired by the AU will carry out post-fact reviews and asset verification for 100 percent of grid-connected sub-projects and 50 percent of off-grid sub-projects except for solar home systems (SHSs). In the case of SHSs, random checks are carried out on a regular basis for a limited number of systems (physical asset verification).
- The World Bank conducts sample post-fact audits as deemed necessary

Procurement of goods and works financed by IDA credit proceeds and GEF grant proceeds will follow the most recent version of Guidelines for Procurement under IBRD Loans and IDA Credits at the time of signing the agreement. Selection of consultants will follow the most recent version of Guidelines at the time of signing the agreement for the Selection and Employment of Consultants by the World Bank Borrowers.

3.2.4 Environmental and Social Safeguards

All sub-projects financed under the RERED Project are required to comply with World Bank Operational and Safeguard Policies, in addition to conformity with the environmental legislation of GOSL. Thus all sub-projects are required to conform to:

- The Environmental and Social Assessment and Management Framework (ESAMF) of the World Bank, and
- The terms of the Central Environmental Authority (CEA) as mandated by the National Environmental (Amendment) Act No. 56 of 1988 (NEA).

According to the CEA procedure, all sub-project proponents are required to complete a BEIQ. Upon reviewing the BEIQ, the CEA will determine whether any further environmental analysis is required or whether the proponent should prepare an Initial Environmental Examination (IEE) or an Environmental Impact Assessment (EIA). In addition to the CEA review, the Environmental Assessment (EA) prepared by the proponent will be reviewed by an Environmental Consultant for adequacy and compliance with the ESAMF. The AU maintains a panel of consultants for this purpose.

3.2.5 Environment Management Plan

Based on the project specific environmental assessments will be conducted once sub-projects are identified. Considering the simplicity and small scale of the proposed sub-projects, it is unlikely that any major or irreversible environmental impacts will be encountered. Therefore, the most important aspect of the Environmental Assessment (EA) will be the Environment Management Plan (EMP). The EMP should be prepared and finalised by the project proponent for each sub-project, taking into consideration comments from the CEA during its review and clearance process. The responsibility of monitoring the EMP rests with the CEA, as mandated by the NEA.

3.3 Institutional Framework for Off-Grid Community-Based Hydro Sub-Projects

Off-grid community-based hydro sub-projects are built, owned and operated by the communities themselves through VECSs that are set up for the purpose. These are located in remote areas where electricity access via the national grid is not financially feasible.

The RERED Project provides assistance to such VECSs to retain independent project preparation consultants (known as ‘Developers’) to prepare and commission such sub-projects. Project preparation assistance includes social mobilisation, VECSs formation, site selection, feasibility study preparation including technical and socio-economic aspects, submission of business plans and other documentation for bank loan negotiations, assistance in obtaining regulatory and local government approval, obtaining independent quotations and advice on selection of suppliers. Project implementation assistance will include training of the VECS members in operation, maintenance and record keeping and assistance in commissioning the scheme.

VECSs are free to obtain debt financing from a PCI or any other lending institution acceptable to the AU.

3.4 Grant Schemes Available

In addition to a project preparation grant of up to US$.6,000 paid on the achievement of defined milestones, the Developer receives an incentive payment of up to US$ 2,000 for demonstrated success in achieving agreed economic benefit targets.

The VECS receives a co-financing grant of US$400 per kW of installed capacity of the plant, after successful commissioning of the scheme and meeting the RERED Project technical specifications. The AU maintains a panel of Chartered Engineers for such installation verification.

3.5 The Developers: Their Role, Performance, Experience and Views

Developers played a key role with the project's focus on promoting private sector involvement in the renewable energy sector. In the case of grid-connected power generation sub-projects, Developers are the investors who have to obtain a LOI from the CEB and approvals from other relevant authorities to establish a sub-project.

In the case of off-grid community-based power generation sub-projects Developers established the initial link between AU and the village beneficiaries. As they were responsible for the planning, awareness creation, implementation and making sustainable institutional and technical arrangements for effective O&M, their positive achievements contributed to the success and sustainability of those sub-projects (as will be seen later in this chapter). The list of Developers of off-grid community-based hydro sub-projects has already been presented in Table 3.1 under "Implementing Partners". The beneficiaries of these sub-projects depended on Developers to make their dreams come true. They invested their hard earned funds but more importantly their hope for a better life in these sub-projects. Even the very poor HHs made their contribution, sometimes foregoing their essential needs, and underwent lots of difficulties as they also had to contribute their labour for the sub-projects to get electricity. Sheer determination and commitment of the people to realise their dream made everything possible.

RERED Project benefited from the lessons learnt from ESD in approving sub-project proposals presented by Developers. In order to get Project implementation underway the AU initially accepted sub-projects presented by Developers if they were feasible. However, the results they achieved varied according to their experience, technical competence and integrity. The views expressed by the members and office-bearers of VECSs about the work done by Developers are discussed in the following sub section (3.5.1).

3.5.1 Performance of Developers

In the case of grid-connected hydro sub-projects the Developers invested in them as commercial enterprises and it was in their interest to ensure that these sub-projects were established well so that they function profitably. If these sub-projects do not perform well, the Developers would be the losers as they have invested in them. This encouraged them to make every effort to ensure the success of these sub-projects.

The situation is different with the off-grid community-based hydro sub-projects. The Developers take the initiative in identifying feasible sub-projects and motivate the communities to establish them. The investment in these comes from the communities, RERED Project and other sources of funding such as the Provincial Councils. The Developers receive a maximum of US$.6,000 as a project preparation grant from the RERED Project to establish these sub-projects. By the time the Installation Verification is carried out they have received 50% of this grant and if the Installation Verification is successful, they receive another 30%. The balance 20% is paid 6 months after the sub-project has been commissioned if it has operated successfully. If problems occur after that period the losers are the communities as they must find money to carry out necessary repairs. Consultants have learnt during their field visits that a few Developers who have abandoned the work halfway have gained by not being truthful to the communities.

The information presented here is based on the views expressed by members and office-bearers of VECSs gathered in the FGDs. This information is qualitative and cannot be quantified meaningfully.

FGDs were conducted mainly to find as to how VECSs were performing but attention was also paid to examine the views of the members and office bearers of VECS regarding the performance of Developers. FGDs have indicated that many of the Developers were small organisations or individuals who were competent in the engineering aspects of the project but did not have the expertise or interest required to undertake the social mobilisation and organisational development.[38] Their main interest was to construct the project and collect funds due to them. While only a few Developers were competent in both aspects, one or two have even proved to be incompetent in both. A few competent Developers had played their role well.

Altogether 60 FGDs were conducted with VECSs during the period 2005 – 2008. As 21 of these FGDs were conducted in VECSs that were revisited to find out how they were performing, the FGDs covered only 39 different VECSs. Of these, 24 VECSs (62%) expressed dissatisfaction with the work done by the Developers.[39] One VECS reported that the Developer had abandoned the work halfway. Of the 39 VECSs, 15 had not expressed any views about the work done by the Developers. If some of them are also dissatisfied with the Developers, the proportion of VECSs dissatisfied with the work done by the Developers would be higher. The main reasons for this dissatisfaction are given in Table 3.2.

***Table 3.2*: Views Expressed About Developers by Participants in FGDs held in 39 VECSs**

Views Expressed by Participants	No.	% (N=39)
Expressed dissatisfaction with Developer	24	61.5
Reasons Given by Participants for Dissatisfaction *		
Developer abandoned work halfway	1	2.6
Believe Developer has cheated	2	5.1
Developer did not provide correct information	6	15.4
Developer not responding to requests for service	7	17.9
Capacity of the plant less than Planned	20	51.3
Delay in completing	3	7.7
Poor quality work	4	10.3
Frequent power failures / breakdowns	16	41.0
No training for Caretaker	5	12.8
Installing old/sub-standard machinery	6	15.4
Not functioning for a long time	2	5.1

*** Note**: Multiple responses allowed.

[38] Consultants came to this conclusion on the basis of their knowledge and experience about rural institutions and information gathered through visits to sub-projects by them and FGDs

[39] Consultants have not interviewed Developers and machinery/equipment suppliers to investigate the complaints made against them by those participating in FGDs as it was beyond the scope of their assignment.

Although the information presented above shows the overall position of how the VECSs felt about the work done by Developers, their views varied significantly in different years (see Annex 7). According FGDs conducted in 2005 more than 67% were not happy with the work that Developers and their sub-contractors had done. A majority of Developers lacked competence in social mobilization and organizational development and a few even lacked the competence in the most critical technical aspects needed for off-grid community-based hydro sub-projects. The FGDs showed that about 40% of the Developers had created high expectations of these hydro sub-projects among rural communities instead of creating a proper awareness of their benefits and limitations.

The beneficiaries were not properly informed of the financing arrangements of the sub-projects, particularly about the project grant. According to FGDs, some Developers did not inform the people what benefits they were receiving under the project. Although the co-financing grant is paid direct to the VECSs as only a few members of the community are involved in the VECS, the community at large is not aware of this. Further some Developers had created the impression that the grant VECSs get from the Project is something that the Developers are providing for the VECSs. FGDs conducted in 2006 revealed that five (5) out of the fifteen (15) VECSs were unhappy with the developer. Most (73%) of the VECSs complained that the installed capacity was less than the planned capacity.[40] Hence 4 - 5 sub-projects (about 31% in that cohort) deliver a poor service and some members of these sub-projects have stopped paying their loan instalments. In 2 of these VECSs the Developer was the same and he was also the machinery supplier in the third. 5 out of the 15 sub-projects (68%) were facing problems with their machinery/equipment. Several VECSs complained that the generator/ICG was burnt out. In two sub-projects the VECS indicated that the machinery/equipment needed to be replaced. Suramya Purnaloka and Ellapita Ella sub-projects faced maintenance problems soon after the sub-projects started functioning. Ellapita Ella was subsequently revived by another developer under RERED. The perception of the VECSs was that this was due partly to the poor quality of equipment and work done by the Developers. They had faced a major problem of maintenance due to the breakdown of their equipment. One Developer totally failed in the planning and implementation and later abandoned the sub-project. [41]

According to the 2006 FGDs, more than 50% of Developers seem to have brought the people together with the objective of mobilising the required resources to construct the sub-project and collecting their payment. They had not made any serious effort to strengthen the VECSs and did not service the communities after collecting their payment. This has affected the capacity of these organisations to manage the sub-projects. This affected the quality of service they provided adversely causing much dissatisfaction among their members.

On the other hand, there were no complaints about the work done by Developers who developed Dothaluoya, Welewatta, Sagaraweeoya, Namal Poornaloka and Lihiniella sub-projects. The communities were satisfied with the work they had done. These were organizations and persons who had previous experience in community development. Those sub-projects and VECSs are the ones which are functioning well within the sample for that round of FGDs. This shows that the performance of the sub-projects and the VECSs depends very much on the quality of the work done by Developers and emphasises the importance of selecting competent and reliable Developers and equipment suppliers.

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40 As presented in Table 3.4 the installed capacity in 42% of the sub-projects was below the planned capacity. As reported to enumerators by the VECSs in the post Installation survey, the generated capacity was 14% less than the planned capacity for the 15 off-grid community-based hydro sub-projects surveyed. .

41 Suramya Purnaloka Electricity Consumer VECS

In 2007 the situation was more satisfactory according to the findings of FGDs. Out of 20 VECSs 5 expressed, dissatisfaction with the work done by Developers. In 2008 about 60% have expressed dissatisfaction with the role played by the Developers. This dissatisfaction arose mainly due to frequent breakdowns in the sub-projects, lack of transparency in dealings with VECSs, low electricity output and non-responsiveness of Developers and/or equipment suppliers to the requests made by VECSs for services.

It should, however, be noted that the views expressed by the participants of the FGDs are the opinions formed by them with their limited technical knowledge. The changes that take place in the office bearers of the VECSs also affect their perceptions of the developers. The incoming office bearers have little or no knowledge of the role played by the Developer and hence tend to portray the Developer as the root cause of all the problems.

3.5.1.1 Grid-Connected Hydro Developers

The problems faced by Developers of grid-connected hydro sub-projects were different from what Developers of off-grid community-based hydro sub-projects faced. They had little involvement with the communities where the sub-projects were located except to gain their goodwill. This was necessary as these sub-projects utilized the same source of water to generate power as the communities used for their domestic and agricultural needs. As the water used by these sub-projects to generate electricity is returned to the streams, the only communities affected are those located between the point of diversion (the weir) and the point of discharge. Only one community out of the 20 affected by grid-connected sub-projects complained that it experienced water shortage during the dry season.

According to the report submitted by the Grid Connected Small Power Developers Association, the average construction period is 18 months. The construction of these sub-projects was delayed due to several reasons. Table 3.3 shows the reasons given by the Developers for delays in completing the sub-projects.

Table 3.3: Reasons for Delay in Completing Grid-Connected Hydro Sub-Projects

Reasons for Delays	No. (*)	% (N = 20)
1. CEB – Grid Interconnection	7	35
2. CEB – Grid Substation Capacity Expansion	4	20
3. CEA Approval	3	15
4. Acquisition of Crown Land	3	15
5. Acquisition of Private Land	3	15
6. Local Authorities	2	10
7. Forest Department Approval	1	5

***** *Note*: Multiple responses allowed.

In addition, these reasons were also mentioned by them:

1. Adverse weather.
2. An NGO has an injunction order on the proposed project for utilizing an existing waterfall.

3. Acquiring the license to use explosives is cumbersome - resolved in 6 months
4. Issues with land titles
5. Political interference
6. 2 years for approval from Land Reforms Commission (LRC)
7. 7 month delay and cost over-run of SLR 6.5 M because of revision of CEB proposal
8. Delay in converting one year permit to bankable long term lease, despite cabinet decision and approval pending felling of trees for construction of transmission line.
9. No incentives were given to any institution and therefore approval process took 2 years to complete
10. Rs.3 M paid for line upgrade which has not yet been utilized by CEB. Energy generated is absorbed however.
11. No positive response to requests by Developers to expand Grid Substation capacity to absorb power generated by them
12. Delay in provision of gird connection line
13. Assistance given by government agencies to expedite approvals has become less when compared to the start of the Project
14. The recognition and support given to the Developers by relevant organizations to carry out project activities has decreased.
15. The approval granted by CEA to construct the sub-project is only for one year. If this has to be extended for a second year, obtaining that extension gets delayed.
16. In some cases there has been a delay in obtaining the required finance;

Apart from the reasons for delays mentioned above the main findings of the survey were:

- The most serious problem faced by Developers of grid-connected hydro power sub-projects is the issue of grid interconnection because sub-stations are unable to absorb additional power. The Ministry of Power & Energy has consented to meet 50% of the cost of grid substation expansion. The delay in this activity is that a loan from ADB for grid substation expansion is on hold until the PUCSL is made functional. Expansion of installed capacity is also not encouraged by the PUCSL for this reason. This limits the generation of power through grid-connected hydro sub-projects even though there is untapped potential in this sector.
- Two Developers had issues with loan disbursements. One said that the co-ordination between banks in the case of syndicated loans is very poor which adversely impacts the construction schedule. The other said that debt draw down was sporadic and the particular bank had problems with the RERED Project.
- The approval process for grid-connected hydro power sub-projects can take from six months to three years from the point of obtaining the LOI. The average time taken by Developers in the sample interviewed was one year.
- A variety of issues plague the progress of sub-project as evident from the feedback obtained. The approval process causes many delays. There is no government authority to support the grid-connected hydro power industry to resolve these issues.[42] The Developers have to resort to their own devices to find a timely solution to their problems which leads to the propagation of increasingly unsavoury practices.

[42] SEA is expected to play this role in the future.

3.6 Performance of VECSs[43]

118 community-based off-grid hydro sub-projects had been commissioned from the start of the Project on 01/10/2004 till 30/06/2008 providing electricity to 4,487 HHs. This could not have been achieved if not for the participatory approach adopted by the RERED Project. The key players in this implementation strategy were the members of the communities and the Developers. As expected in the PAD, Developers played the facilitator's role for the development of VECSs and the VECSs mobilised the communities to participate in the planning, implementation and O&M of these sub-projects. In communities where the Developers did not have social mobilisation and organisational development experience and skills, few members of the community assumed a leadership role and obtained the support of others to contribute labour and materials to build the sub-project. The members of the community were individually responsible for the loan the VECS obtained from a PCI or a non-PCI and the VECS received the grant from the Project AU on completion of the sub-project.

The 118 sub-projects that have been commissioned are operating at varying levels of performance. Their success and sustainability depends mainly on:

- the suitability of the design to harness the hydro power available to meet the needs of the community which is evaluated by the AU before approving the sub-project for co-financing;
- quality of construction of the sub-project which is also evaluated by the AU;
- quality of the machinery and equipment installed; it was not possible to test these at the start of the Project but facilities are now available for this and the Developers are required to test them;
- quality of the service depends on how well the caretakers have been trained to do O&M and the co-operation of the consumers in observing the rules made by the VECS for the use of electricity

For the HHs that receive electricity from these sub-projects it has been a great benefit which they appreciate highly. Some sub-projects have experienced problems due to the shortcomings of Developers as discussed in Section 3.5.1 and weaknesses of VECSs as discussed in this Section. The highlighting of these should not detract from valuable contribution made by this sub-component but should serve to find ways to minimise them and enhance its value to the communities. .

The lack of knowledge and experience in social mobilisation and organisational development among Developers (discussed in Section 3.5.1) has contributed to create weak VECSs in many off-grid community-based hydro sub-projects.

The successful performance of these sub-projects depended on the performance of VECSs. That, in turn, depended on the extent to which Developers were successful in:

- creating awareness among the community about the project and the need to work collectively to achieve its objectives,
- mobilising community support for the project and the organisation that will be responsible for its O&M, and
- developing the knowledge and skills necessary to manage the organisation and project.

[43] Information presented in this section is what has been gathered from FGDs, impact surveys and field visits by Consultants.

Few competent Developers not only assisted the communities to set up VECSs that functioned smoothly but also created awareness and capacity within the community to manage VECSs well by providing them with the correct information about the project, needed skills and a clear idea of the role of different stakeholders. Few operating problems would arise where the hydro sub-project a VECS takes over from a Developer has been constructed well and the knowledge transfer has taken place successfully.

It was evident from the FGDs and impact surveys that soon after the sub-projects were handed over to VECSs, the poorly constructed ones had lots of maintenance difficulties. This situation has in turn affected the functioning of some of the VECSs over time with the loss of confidence among the members due to poor service. It was evident from FGDs that some Developers used to work only with a few leaders in the village without getting the active participation of the majority for planning and implementation of the projects. They seem to have not considered or thought that the awareness creation and getting the participation of all members are equally important for their sustainability as completing the sub-projects on time.

In some sub-projects the VECSs seem to have functioned well at the beginning owing to good leadership. They had found good leadership by chance from among the community leaders or from among the active youth. However, with the change of that leadership over time, the VECSs faced problems as there was no second and third level of leadership to take over the management due to lack of an organizational development programme. In some cases, abandoning the VECS by some members due to loss of confidence with the poor service or getting electricity from the national grid has also weakened VECSs. During all the FGDs, the members have indicated the lack of management capacity within the membership as a major reason for the weakening of the majority of VECSs and also the need for capacity building in order to ensure the sustainability of VECSs.

"At the commencement we thought that a village electricity project could only be a dream. After the installation there were frequent breakdowns which created disillusion among some. But the leadership of the VECS was able to explain the position to the members and strengthen their resolve to overcome the difficulties. Now we have electricity round the clock and this has helped in strengthening the bonds within the community." S.H. Upali Ranasinghe – a member of the Aruna Welfare Society managing the Pahala Weleboda project.

Some VECSs exist only in name with the off-grid community-based hydro sub-projects managed by one or two influential persons in the community. In such cases, members have complained that, although they have all contributed to constructing the project, it was being managed as if it was the private property of those persons. In most VECSs record keeping is not done properly and members are not aware of the financial transactions due to lack of transparency. Although there are restrictions on the use of electrical appliances in the evening and night when the load is too heavy on the system, some VECS office-bearers are too weak to enforce them and a few members flout these rules to the detriment of the other consumers. In some VECSs, the offenders include the office-bearers themselves. While a few well managed VECSs operate and maintain the sub-projects well to provide a good service and have accumulated a financial reserve to meet any eventuality, the majority of the VECSs are weak financially and find it difficult to undertake necessary repairs when needed.

While assessing the performance of VECSs the M&E team was able to identify the following 13 characteristics of effective performance of VECSs.

1. Adoption of a well formulated Constitution with authority for the Executive Committee to impose penalties on consumers who do not abide by the rules governing membership and use of electricity.
2. Proper understanding of the Constitution by all members.
3. Preparation and implementation of an Annual Plan by the Executive Committee.
4. Regular General and Executive Committee meetings.
5. Majority of the members attend General Meetings.
6. Maintenance of transparency in the conduct of the affairs of the VECSS, especially in financial matters. Presentation of information on income and expenditure at General Meetings.
7. Regular auditing of accounts by an internal Audit Team appointed from among the members annually
8. Imposition of penalties on consumers who infringe rules regardless of their status. Majority of the membership appreciate imposition of penalties.
9. Appointment of office-bearers from among members who demonstrate commitment.
10. Commitment of the successive office-bearers, caretakers and the general membership to adhere to the Constitution and general functions of the VECS.
11. Continued support by the Developer for an extended period after the project has been commissioned and the cordial relationship it maintains with VECS. This has helped to get prompt services at times of break-downs, etc.
12. Supply of electricity to non-members for special occasions such as a weddings, funerals, etc.
13. Paying attention to factors contributing to sustainability of the power station and VECS.

Compared to these characteristics it was found during the 2005 FGDs that nearly 70% of VECSs were on a weak footing. The findings of FGDs in 2006 showed some improvement in the situation compared to 2005. About 42% of the VECSs functioned well while 51% of the 31 VECSs were weak. However, in most of these sub-projects the minimum O&M seem to have been carried out for the functioning of schemes by one or two members who have taken leadership while a majority of the members have not taken much interest in participating in decision making and other activities. In most of these cases the majority of the members were not happy with the leadership and the way in which the VECSs were functioning and they complained that the leadership had not been transparent and was very authoritative in decision making. The members further informed that they were helpless under these circumstances as the VECS is controlled by a few powerful individuals who operate the sub-project for their benefit. They feel that there should be some external authority to supervise VECSs to which they can complain about irregularities.

Although the FGDs revealed dissatisfaction about the performance of some VECSs, impact surveys carried out among HHs in off-grid community-based hydro sub-projects showed a considerable variation in the proportion of the HHs (72 – 91%) that had expressed satisfaction with the performance of VECSs in different years (Table 4.8).

In the 20 FGDs that were conducted in 2007 the situation seems to be quite different from that the previous years. More than 90% of VECSs seem to have functioned well. Except two VECSs all the others had been able to collect the targeted income from the members, repay the loans without defaulting and maintain the sub-projects. Eighteen out of the twenty VECSs were able to save money and about seven opened fixed deposits for future development and maintenance. 5 VECSs had saved more than Rs.100,000 after repaying all the loans.

According to the members who participated in the FGDs, all VECSs, except two, conduct regular meetings where attendance rate exceeds 70% of the total membership. The membership of the VECSs respects the decisions taken by the committees responsible for O&M and adheres to the rules and regulations made by them with regard to the use of electricity and maintenance work. Eighteen out of the 20 sub-projects have operators or a committee to look after O&M of the sub-projects. However none of them have a proper training or knowledge to undertake small repairs. Everyone who participated was of the view that the lack of members or people close by with adequate technical knowledge to repair the village hydro projects is a serious disadvantage faced by them when the repairs are required. Therefore, it is very much needed to make some arrangements to ensure that such services are available locally and to train members of VECS to attend to small repairs.

More than 90% of the members who participated at FGDs were of the view that mobilization of the community for this work has increased the unity and confidence among the HHs to undertake other community development work. 6 out of 20 VECSs have been engaged in road development work and construction of community halls for the benefit of communities and one VECS has been able to even undertake small contracts in the village.

The formation of VECSs has given an opportunity to women and the youth of the villages to participate actively in the development process. In the Sagara Wee Oya VECS in Berennawa, Yatiyantota, the female participation is very prominent. Around 75% of the membership attends the meetings which are held on a regular basis. The statements of accounts are presented at each meeting. This VECS is growing in strength and is contemplating in venturing into welfare activities as well. The President of the VECS, Mr. R.M. Gunasekera, is very confident of the future of the VECS.

> *"I did not imagine that we would be fortunate enough to have electricity during our lifetime. Our village is in such a difficult area. This facility has brought together the families in the village and they are happily enjoying this privilege. Compared to the other VECSs in the village our VECSs is in a steady position. Members willingly participate in the maintenance activities. We have settled the bank loan and at present have a bank balance of about Rs.80,000. We also intend to start a welfare programme through the VECSs" R.M. Gunasekera-President of the VECS*

Mr. K.K. Ravindra Lakmal, President of the Gilimale Eksath Aloka ECS, who is a youth, has this to say about the functioning of the VECSs and the involvement of the youth (See box).

> *"There are many traditional societies in our village. But, they do not deliver results. The leaders in these societies are our elders. They have lots of personal affairs to attend to. Therefore, they do not have enough time to attend to social work. However, our VECS is led by the youth. We also have personal commitments but, at the same time, we have more energy to work. We have our own good attitudes to uplift our village. We want to serve our village during our tenure of office. We all believe we can achieve our goals through the VECS"*

VECSs that are led by committed persons acceptable to the community have a better rate of success. The involvement of such individuals in the affairs of the VECS helps overcome the difficulties faced by the VECSs in the provision of electricity and O&M.

Aruna Welfare VECS which manages the Pahala Weleboda sub project in Imbulpe, Ratnapura, has been in existence even before the advent of the sub project and the president has been holding office for a good length of time. He has delivered the goods and is well respected by the community. Mr. S. H. Jayasekera, President of the VECS, says:

> *"Generally the CBOs in our country are weak. Even our members initially did not have much confidence in our VECS. Through word and deed we managed to change their perceptions and attitudes and build up a strong VECS. It is through dedication that we managed to bring it up to this level and we consider it as a great achievement. As our VECS is a strong one we have managed to obtain assistance from other sources as well".*

However, it was noted that some of the VECSs are faced with the problem of long-term sustainability. Members of these VECSs are not happy with the VECSs as they were not transparent, democratic and participatory in decision making and fail to provide the service for which they were set up. Further a majority of new office-bearers who have been elected to these VECSs lack the knowledge and capacity to manage.

Some of the shortcomings that had come to light through the FGDs and discussions with the key informants are:

- Meetings are not held regularly. In some instances meetings have not been held for over one year. This could be either due to the apathy of the members arising out of poor service delivered or the autocratic manner of one or two key office bearers.

- Records and books of accounts are not properly maintained due either to lack of knowledge or lack of transparency. In a large number of VECSs visited for the evaluation the books were not made available for inspection. They had given some excuse; such as the person who has the books is not available or the previous committee had failed to hand over the books.

- One or a few persons holding on to power: The persons who initiated action in bringing electricity to the village consider it as their domain and do not allow others to play an active role in the affairs of the VECSs. (In some instances this has a positive effect as these persons are committed and take personal interest in sustaining the achievements. Members too acquiesce to this situation.)

- Absence of a proper system of handing over documents: Very often the outgoing office bearers do not pass on the knowledge gained and the documents to the successors. There was an instance where the present office bearers were not aware of even simple details such as the rate of interest of the loan that the VECS had taken for the project and did not have a copy of the loan agreement that they signed with the bank. They were not aware of the agreement that the VECS had signed with the machinery supplier and its conditions or what action they can take if the supplier failed to deliver machinery of required quality on time.

- Failure to collect the dues from the members: This arises mainly in instances where the service provided is poor and leads to a vicious cycle.

- Operators are not properly trained. Although action has been taken by the developers and machinery suppliers to train one or two members to function as operators the knowledge is lost once new persons assume the roles of operators. They are not in a position to attend to preventive maintenance or attend to minor repairs.

Udawadiya VECS in Badalkumbura is in a remote village with little contact with the outside world. The persons who played a leading role in obtaining electricity and set up the VECS have now obtained electricity through the national grid and have no further interest in the VECS. The present set of office bearers has little knowledge of the functioning of the VECS or in community mobilisation. The plant has broken down over one year back and the estimate for repairs is around Rs. 600,000. Although the Provincial Council has agreed to release Rs. 200,000 as a grant for the repairs, the VECS is not in a position to raise the balance amount.

It is not difficult to get a community together to fulfil the desire they have to obtain electricity and to register them as a VECS but it is very much more of a challenge to develop their capacity to run an organisation well. The findings from FGDs highlight the importance of developing social capital in the communities to enable them to manage their VECSs and hydro sub-projects effectively. Evidence available indicates that many Developers did not have the capacity to do this. Insufficient attention has been paid to this aspect of a Developer's responsibility in establishing off-grid community-based hydro sub-projects.

The performance of VECSs may become weak due to a number of reasons. Such a situation cannot be considered as unusual. However, some outside assistance at the proper time could help to rejuvenate the VECSs and get them to perform their tasks more efficiently. In this connection it could be suggested that the FECS be strengthened to visit the VECSs and attend their annual general meetings to guide them and ensure transparency and smooth functioning.

Another avenue that could be explored is to get the assistance of the officer in charge of the subject of community development in the DS office to assist the VECSs in their areas of authority. Establishment of closer linkages with the DS office from the inception of a sub-project could be an important step in obtaining proper services of the developers and machinery suppliers and in ensuring the proper functioning of the VECSs and in assisting them to overcome the difficulties they may encounter in discharging their duties.

As the existence of healthy VECSs is of crucial importance for the sustainability of the sub-projects it is important for the AU to develop systems to monitor their performance in social mobilisation and organisational development similar to the very good systems in place to monitor the financial, physical and technical performance of Developers.

3.7 Post-Installation Performance and Sustainability

The benefits that people gain from off-grid community-based hydro sub-projects depend on their post-installation performance and sustainability. Post-installation performance can be gauged from the actual (compared with the designed) power generated, the frequency of breakdowns, time taken for repairs and the quality of the power supply. The satisfaction of the people with the supply of electricity that they receive is a very relevant criterion from the point of view of impact. This depends on the quality of

power and the O&M of the sub-projects. While sustainability of these sub-projects depends on O & M, it also depends on the performance of the VECSs which has been discussed in Section 3.6 above and the financial strength of the VECSs. So the long-term sustainability of the investment in off-grid community-based hydro sub-projects depends on several inter-related factors. If there are weaknesses in any of them, the chances of success are very low.

The load factor is determined by the capacity of the projects, the number of HHs served by them and the use of electricity by the HHs. According to the data collected by AU and presented in its quarterly FMRs the difference between the designed and installed capacity of off-grid community-based hydro sub-projects is significant. The installed capacity of the 118 sub-projects that were in operation as at 30/06/2008 was 1,168.1 kW. Their planned capacity was 1,151.6 kW. Although the overall installed capacity exceeded the planned by 16.5 kW (1.43%) this conceals significant variations between the planned and actual capacities of the specific sub-projects.

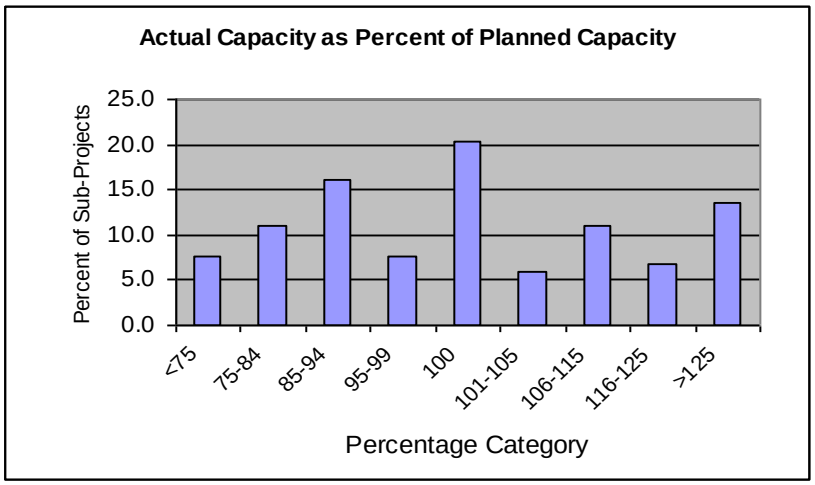
As seen in Table 3.4 and Fig.3.1, only 20.4% of the sub-projects conformed to the planned capacity. 61% fell within plus or minus 15% of the planned capacity. In as many as 42.4% of the sub-projects, installed capacity was below planned capacity and in 37.3% the installed capacity exceeded the planned capacity. While the installed capacity of 18.6% of the sub-projects was less than 85% of what was planned, in 13.6% installed capacity exceeded the planned capacity by over 25%.

Table 3.4: **Actual Installed Capacity of Off-Grid Community-Based Hydro Sub-Projects as a Percentage of Planned Capacity**[44]

Percentage	No. of Sub-Projects	%	Deviation (cumulative)
<75	9	8	-43
75-84	13	11	-35
85-94	19	16.	-24
95-99	9	8	-8
100	24	20	0
101-105	7	6	+6
106-115	13	11	+17
116-125	8	7	+24
>125	16	14	+38
Total	118	100	

Fig. 3.1**: Performance of Off-Grid Community-Based Hydro Sub-Projects**

[44] Data from *Section C. FMR – Project Progress Report, Q/E 30/06/2008,* AU



The installed capacity in 50 sub-projects was less than the planned capacity. In 4 of these the number of HHs that received electricity was more than what was planned and in 20 the number of HHs remained the same. This together with the use of electrical appliances has increased the demand beyond the installed supply. This might have contributed to the lights being dim as complained by HHs in several sub-projects. Some of the VECSs had dealt with the problem of HHs using excessive amounts of electricity by advising the offenders and, in some projects, fining them. However, some VECSs are unable to enforce them as the offenders include the office-bearers themselves. This creates dissatisfaction among users who might even refuse to pay their monthly dues.

The main complaints reported regarding the supply of electricity were:

1. Lights are dim at night
2. Less power generated during rainy season – debris blocks flow of water
3. Power interruption - posts fall down during heavy rains
4. Because some HHs used too much electricity (use of irons) others had problems
5. Several complaints about I.G.C. being burnt
6. Generator being burnt out

Many VECSs face difficulties in O&M because of weaknesses in the training they have received from the Developers. In some cases the training gained has not been passed down to the successors. Further they believe that the machinery and equipment installed by the machinery suppliers are of poor quality. They attribute frequent breakdowns and costly repairs to this. Sometimes, VECSs have not been able to afford the necessary repairs. This has led to long interruptions in the power supply, sometimes as long as one year. Some VECSs complain that even for a minor repair they have to seek the assistance of the developer/machinery supplier and wait for a long time, sometimes as long as one week, for the repairs to be attended to. There is no possibility of checking the quality of repairs either. The charges for the labour and spares are also considered to be high.

To overcome some of the difficulties Lihini VECS of Bulathkohupitiya makes its own purchases of spares by sending an officer to Colombo. The officials of the VECS are of the opinion that they save a considerable amount of money through this process.

One option to overcome the problem of lack of technical know-how in the village is to install a system of providing higher level training to one or two persons from the region to service a cluster of VECSs and equip them with the necessary tools to attend to the repairs promptly.

Until recently, there was no way to test turbines and IGCs used in off-grid community-based hydro sub-projects, but RERED Project has supported the development of the capacity of NERD Centre to test and certify these and Developers are now required by the AU to get this certification.[45] Several VECSs complained that they experience much difficulty in obtaining repair services from the Developers and machinery suppliers. This problem has been aggravated by the lack of technicians at the local level with adequate knowledge to carry out repairs.

Another problem that VECSs face during operation is the need to replace the wooden poles used to carry the transmission lines. These poles need to be replaced after about two years and many VECSs do not have sufficient funds or the commitment of the members to replace these. Therefore some temporary measures such as stringing the lines from trees are adopted in certain cases. However it was noted that if the VECSs are functioning well and if there is unity among the consumers there is always the possibility of the consumers getting together to attend to this matter or there is the possibility of obtaining assistance from outside.

Aruna Welfare VECSs of Pahala Weleboda was able to obtain a grant from the Protected Area Management & Wild Life Conservation Project to replace the wooden poles with concrete poles. Similarly in the case of Dothalu Oya VECS of Balangoda the Provincial Council has agreed to contribute Rs.1,000/- per concrete pole cast by the VECS.

Table 3.4 shows some of the relevant data for the 18 VECSs surveyed to assess their post-installation performance.[46] As expected, the amount of electricity sold depends mostly on the capacity of the project and the equipment idle time due to problems affecting the machinery and equipment. However it is also affected by the amount of water available which depends on the seasonal rainfall. A total of 6,429 idle hours were reported by the 18 VECSs; this was made up of 227 idle hours reported by 6 VECSs for September-November 2005 and 6,202 idle hours reported by 12 VECSs for April-June 2006. The average for the 18 VECSs was 357 idle hours or the equivalent of 14.9 idle days. However, there was a big variation among the projects ranging from 0 idle hours in 3 projects to 1,820 idle hours or 75.8 idle days in one project. However, it should be noted that some projects do not operate for 24 hours

***Table 3.4*: Post Installation Performance of 18 Off-Grid Community-Based Hydro Sub-Projects[47]**

	Total for All VECSs (18)	Average per VECS	Lowest for any VECS	Highest for any VECS
Capacity (kW)				
Nominal	250.5	13.9	5	30
Generated	215.1	11.95	3	27
Consumers (Number)	1,034	57.44	8	128
Consumers / kW		4.69	2	10
kWh sold for quarter	44,689	2,483	210	8,880
Due from consumers (Rs)	997,550	55,419	19,800	180,000

45 *Minutes of the Quarterly Stakeholders Meeting Held on 14/03/2008*

46 The figures presented in Table 3.4 should be considered as indicative as they refer only to 6 VECSs for September – November 2005 and 12 VECSs for April – June 2006

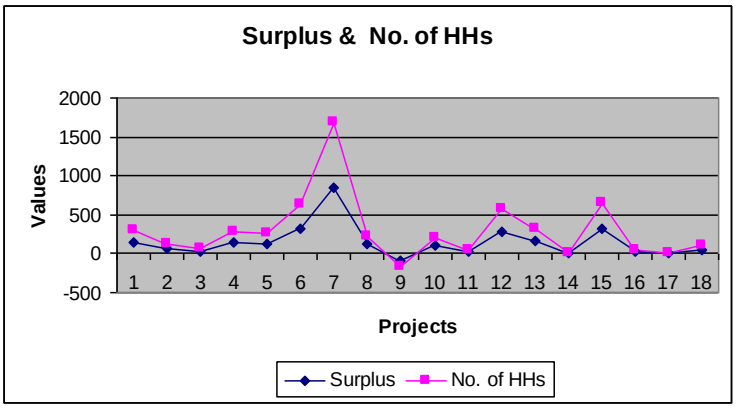
47 Data collected through the Post-Installation Survey of a sample of off-grid community-based hydro sub-projects

Paid by consumers (Rs)	978,490	54,361	1,860	180,000
Amount due/consumer (Rs)	322		10	760
Amount paid/consumer (Rs)	316		5	760
O&M cost for quarter (Rs)	160,300	8,906	1,950	27,000
Net Surplus	818,100	45,450	-11,640	165,000
Idle Hours	6,429	357	0	1,820

Overall, the consumers in these VECSs had paid 98% of what was due from them for the relevant quarters. The income derived from these payments provided a surplus of Rs. 818,100 for the 18 VECSs after allowing for O&M costs which amounted to an average of Rs.45,450. As 12 (66.7%) of VECSs reported a surplus of over Rs.10,000 for the relevant quarter, it is reasonable to conclude that they can sustain themselves financially. However, the surplus was less than Rs.5,000 in 5 VECSs. Sagara Wee Oya VECS reported a net deficit of Rs.11,640 for the relevant quarter due to the amount paid by consumers falling far short of the amount due in-spite of supplying 1,520 kW of electricity to 33 consumers.

VECSs have to meet repair costs of machinery, equipment and power distribution lines from time to time. They must generate a surplus of revenue over and above their O&M costs to meet these expenses. This is important to sustain their sub-projects. This is influenced by the revenue they can collect which depends on whether the members are satisfied with the supply of electricity, O&M costs and the number of HHs to which the sub-project supplies electricity. Fig 3.2 seems to suggest that the number of HHs served by a sub-project affects the surplus it generates. This implies that sub-projects with a larger number of consumers have a greater possibility of financial sustainability. However, if lights become dim due to low voltage reaching the HHs, consumers become dissatisfied and, in some cases, have refused to pay their monthly dues which would affect sustainability adversely. Another implication of this is that as sub-projects get smaller it becomes more important for VECSs to minimise O&M costs.

***Fig. 3.2*: Relationship between No. of HHs and Financial Surplus[48] retained by VECSs**



The surplus many VECSs reported includes what the consumers have to pay as loan instalments. This is reflected in the amounts consumers pay monthly. On the basis of the amount due for the relevant quarter reported by the VECSs, the average monthly

[48] The surplus in rupees has been transformed by dividing the figures by 500 to obtain comparable values for the two variables for graphing

payment due is Rs.322. In 5 VECSs the monthly payment is Rs.100 or less and is as low as Rs.10 in one. The highest reported was Rs.760. According to the data collected from 29 persons doing enterprises in VECS areas the monthly rates they pay are different.[49] According to them, the average monthly payment for domestic use of electricity was Rs.204. The lowest monthly payment reported was Rs.20 and the highest Rs.450.

Interestingly, the lowest monthly rate reported in both cases was from Gayirenagama VECS. However, in the case of reporting on Post-Installation Performance, the rate was Rs.10 but in the enterprise survey, it was Rs.20. Similarly, the highest rate was reported from Samagi Dilena VECS. Again, the amounts reported differed: Rs.760 in the Post-Installation Performance survey and Rs.450 in the enterprise survey. It should be borne in mind that the two surveys were not conducted at the same time.

Too little rain as well as too much rain had caused decrease in power generation. Too much rain had blocked the flow of water because of stones and branches that had been carried down. This had been overcome by clearing the obstructions. Technical problems and electricity poles falling down due to heavy rain had caused power interruptions in two projects. Equipment had been repaired and fallen poles had been replaced. Most VECSs had been able to deal with these problems but the number of idle hours in 6 VECSs (33.3%) exceeded 350 for the relevant quarter and part of this could be attributed to the adverse weather conditions.

Overall data suggests that well managed and run sub-projects are able to sustain themselves and provide for future eventualities. In this sample they made up more than half the VECSs. However, FGDs and other surveys placed this number at less than half the VECSs. It is not possible to explain this discrepancy without undertaking a special study which was beyond the scope of this assignment. The level of success shown by both sets of data is not satisfactory for such an important component of the Project. Several shortcomings listed below need to be overcome to raise this number to more acceptable levels.

- Weaknesses in social mobilisation and organisational development
- Lack of a system to monitor and evaluate organisational development
- Lack of a quality assurance system for machinery and equipment at the initial stage of Project implementation
- Lack of adequate follow up in technical and management capacity building
- Lack of effective system to respond to complaints made by VECSs

[49] Data on monthly rate charged by the VECS was collected from two sources – 18 VECSs and 29 persons operating enterprises. Both rates are given to show the discrepancy. It was beyond the scope of our assignment to reconcile these.

4 EFFECTS & IMPACTS – COMMUNITY AND HOUSEHOLD LEVEL

4.1 Village Improvements Brought About by Grid-Connected Hydro Sub-Projects

Grid-connected hydro sub-projects have been envisaged as entirely commercial enterprises that investors undertook to supply electricity to CEB. Although the communities where these projects are located do not benefit directly from the electricity they generate because of restrictions placed on Developers by CEB, the Developers have attempted to ensure that the communities gain some benefit by improving their infrastructure. [50]

The main benefit was the construction or repair of roads and bridges. This was necessary at many sites to transport the machinery and equipment needed to construct the sub-project. This has been the most common improvement that benefited the communities. The communities agree that this has not only improved access to facilities in nearby service centres but also improved access to the villages. In some of the villages people have benefited from pipe borne water supply, construction of houses, school facilities and community centres and improving facilities at places of religious worship.

According to the survey conducted in 7 villages 74 persons had been employed during the construction of the grid-connected hydro sub-projects (average of 10.6 per village). Depending on the needs of specific sub-projects, the number had varied between 8 and 11 according to the information gathered from grid-connected Developers. Apart from employing people from the village for construction, these sub-projects also employed 3 – 4 persons on a continuing basis for operation and maintenance.

Some communities gained more than others depending on the Developer. Of the 15 villages visited 13 had benefited from road and bridge improvements. While most of the villages have benefited only from an improvement in access, 3 villages had multiple benefits. One village did not gain any benefit. Improvement of access has increased farm-gate prices in 12 out of the 15 villages and created opportunity to start enterprises in 8 villages. For example tea green leaf which is produced in many of these villages received a higher price.

***Table 4.1*: Grid-Connected Hydro Sub-Projects Surveyed to Ascertain Village Improvements Carried out by Developers**

No.	Name of Grid-Connected Hydro Sub-Project	District	Name of Developer
1	Hulu Ganga	Kandy	Eco Power Pvt Ltd
2	Korawaka Oya	- do -	Santak Power Pvt Ltd
3	Sanquhar Estate	- do -	Hydro Power Free Lanka Pvt Ltd
4	Assupiniella	Kegalle	Nividhu Assupiniella Pvt Ltd
5	Kandureliya	- do -	Kanduraliya Hydropower Pvt Ltd
6	Miyanawita	- do -	Midland Energy Pvt Ltd
7	Nakkawita	- do -	Weswin Construction Nakkawita Pvt Ltd
8	Wee Oya	- do -	Powerbase Technology Pvt Ltd

[50] . This is based on a survey of Developers of 20 grid-connected hydro sub-projects and 15 villages in which these Developers had made improvements. Project numbers mentioned refer to the list of 20 sub-projects surveyed.

No.	Name of Grid-Connected Hydro Sub-Project	District	Name of Developer
9	Kiruwana Oya	Matara	Niwalabase Hydro Power Pvt Ltd
10	Alupola	Ratnapura	Eco Power Pvt Ltd
11	Way Ganga	- do -	Didul Pvt Ltd
13	Erathna	- do -	Vallibel Power Erathne Ltd
14	Gampolawalakanda	- do -	Pantak Power Ltd.
15	Rathganga - Phase I	- do -	Pan Asian Power Pvt Ltd

It is interesting to note that none of the Developers reported dissatisfaction among the communities regarding their construction of the grid-connected hydro sub-projects. The Developers reported that eight (53%) communities were highly satisfied and the remaining seven (47%) communities were satisfied. The communities in the 10 projects where field investigations were carried out to verify this information confirmed what the Developers had stated.

Developers had also helped some individual families with housing, electricity, water supply and employment but the contribution of most of the Developers has been community facilities such as schools, religious places, hospitals and community centres. Villagers said that the construction of projects has been environmentally friendly and confirmed that their relationship with the developers was cordial.

Box 4.1 below records the responses received from the affected communities on the benefits received from the sub projects. Only in the communities where sub-project Nos. 6 and 9 were located did the people express dissatisfaction. In both of these, apart from the failure of the Developer to fulfil promises, the quality of the construction was poor. As a result the relationship between the community and the Developer was strained. Where sub-project No. 9 was located some people found if difficult to get water after the sub-project was constructed. These failures have strained the relationship between the Developer and the community.

***Box 4.1*: Villagers' comments on the improvements to the community by grid-connected hydro sub-projects[51]**

Project 1 Providing water to school and several houses. Repairing temples. Providing electricity to 5 houses. Improving the road to the school has facilitated transport of tea leaf. Constructed community hall and road leading to it. 20 employed in construction; subsequently 4.
Project 2 Construction of road has facilitated travel. Irrigation channel repair has benefited 125 families. Constructed building for temple and pre-school, toilets for school. No problem with project. 16 employed for construction; 4 subsequently.

[51] Although information was collected from Developers of 15 grid-connected hydro sub-projects, only in 10 of the villages in which these sub-projects were located was information gathered from the people.

Project 3

Road construction and widening has facilitated travel and access to village. Provided cement for Samurdhi housing project. About 10 employed during construction; 4 subsequently. Village shop provides meals for project staff. Villagers have no displeasure as it is a small construction.

Project 4

Construction of road to project has facilitated travel for village and transport of tea leaf; this has improved prices. Improved facilities at village hospital and school building; Helped 25 with housing. 25 employed in construction; subsequently 6. Environmentally friendly construction.

Project 5

A new bridge and road have facilitated travel. Houses for 3 families. Computer for school. Buddha statue for temple. Employed 25 in construction; 6 subsequently. Environmentally friendly construction.

Project 6

Only the road leading to the power house was repaired to some extent. It has broken already due to lack of maintenance - no benefit from it to the villagers. 10 worked during construction stage; only 4 since then. As a portion of the temple land was inundated, developer promised to construct a building for the temple but what was constructed is not adequate compensation. Construction is not satisfactory and building lacks facilities.

Project 7

Has constructed a good Community Hall. Has repaired several minor roads in the village. Several other improvements - providing equipment to the science lab in the school; helping in temple repair; jobs for several youth. Villagers have a very favourable opinion about the project.

Project 8

Most villagers are very satisfied with the project and say it has brought many benefits. They say that it has helped to develop the village and establish a name. Community Hall has been constructed well. The road which was in a bad condition is being repaired. Has constructed a concrete bridge. This helps villagers to travel. Other roads and bridges are also repaired. Some experience difficulty in getting water in dry seasons but this is not a big problem. Only a few were dissatisfied saying the company makes a lot of profit but village gets little.

Project 9

Priest of the temple says the project brought no benefit, only a disservice - no reasons given. Construction of bridge not completed. Supposed to cost Rs600,000/- villagers think it would not cost even Rs100,000/-. Developer had promised a water supply; at the start there was some preparation but nothing has happened since then. Few villagers got jobs till the construction was over. Villagers were in favour of the project because of the benefits it promised but this has not happened. As a result of the project some villagers cannot get water during dry seasons.

Project 10

Although developer indicated only two improvements, more improvements have been made. Villagers are pleased that the main road providing access is being constructed well. Has constructed a school building. They have paid good compensation to villagers from whom they obtained land and built about 100 houses for those who lost their houses and some others who lived in shanties. Cleared road when earth slip blocked it. Employment for several youth. The Project Manager is very considerate and gets on well with villagers. There is no conflict over water.

4.2 Socio-Psychological Impacts of Receiving Electricity

Impact evaluation has shown that people have benefited greatly from receiving electricity under the RERED Project. However, the communities where grid-connected sub-projects were established could not receive electricity directly from them because Developers could provide electricity only to the national grid under the licence granted to them to establish grid-connected hydro sub-projects. Preventing the communities from benefiting from the electricity that is generated utilising the local resources appears unfair. This creates resentment in these communities and Developers implemented infrastructure development such as repairing or constructing roadways in the locality to gain their goodwill as described in Section 4.1. It is hoped that the PUCSL would address this issue soon.

Electricity from off-grid community-based hydro sub-projects and SHSs had a direct impact on the lives of the beneficiaries. Most significantly it influenced their perspective on life. Electricity for lighting had been a dream that they never thought could be realised during their lifetime according to the members of some VECSs who participated at FGDs and the realisation of it through off-grid community-based hydro sub-projects and SHSs was described by them as “a reawakening of their lives”.

The electricity provided by some of the VECSs has not come up to the expectation of their members. However, even they shared the feeling expressed above by others who received a satisfactory supply of electricity. The psychological stimulation within the family members generated by access to better lighting and to information and entertainment made possible through radio and TV had an impact on the behaviour of family members; the relationship among them has improved and they have taken a positive initiative to improve their home environment. Although the socio-psychological impact can only be described in qualitative terms, its significance is far reaching.

Lighting was the main use made by almost all the HHs in these remote villages that received electricity from off-grid community-based hydro sub-projects. Before receiving electricity, these HHs used kerosene for lighting and batteries to listen to the radio and watch TV. When they had kerosene lamps for lighting, light was not pleasant or adequate and it caused illness and accidents. Hence the people who lived in these houses did not live in a pleasant environment. Better lighting and TV made possible by the availability of electricity created a more pleasant and happy environment at home. It benefited particularly the children and women who spend most of their time at home.

In the villages that received electricity from off-grid community-based hydro sub-projects, electricity made changes in the evening routine of the families. Before electricity, these villages were in the dark after sunset with no lights outside to light the road ways. After electricity, adult male family members spent more time with the family instead of going out to while away for relaxation. According to impact survey of 2008, in 20% of HHs the husbands had reduced going out of the house in the evening and 80% of the housewives further said that the husbands devoted more time to the family. Before receiving electricity they had no opportunity to use even simple electrical appliances but after receiving electricity these HHs had the opportunity to use electrical appliances for comfort and convenience. This benefited mainly women.

4.2.1 Customer Satisfaction

As far as off-grid community-based hydro sub-projects and SHSs are concerned the main beneficiaries have been the rural HHs in remote villages. Several stakeholders

were involved in implementing these sub-projects.[52] Some like Developers, Solar Companies, VECSs, FECS, PCIs and PCs provided services and/or funds. Others like CEA, Department of Agrarian Services and Divisional Secretaries had to approve the sub-projects before they could be constructed. .Among them, VECSs played a key role in fulfilling the expectations of HHs in these sub-projects while solar companies and financial institutions played a key role in fulfilling the expectations of HHs with SHSs. The level of satisfaction of customers of off-grid community-based hydro sub-projects and SHSs is determined by the quality and the timeliness of the services provided by these stakeholders.

Based on all the baseline and impact surveys Tables 4.2, 4.3 and 4.4 present the major personal and community benefits expected by the beneficiaries from having electricity from off-grid sources of electricity and the extent to which they have been realised.

***Table 4.2*: Expected and Realised Personal Benefits from Off-Grid Community-Based Hydro Sub-Projects[53]**

Benefit	% HHs Expecting It	% HHs Realised Expectation
Better Lighting	100	76
Opportunity to watch TV	71	56
Opportunity to use appliances	69	49
Savings on fuel	79	80
To start enterprises	0	2
Increased study time for children	72	56

***Table 4.3*: Expected and Realised Personal Benefits from SHSs[54]**

Benefit	% HHs Expecting It	% HHs Realised Expectation
Better lighting	93	87
Opportunity to watch TV	82	67
Savings on fuel	69	21
To start enterprises	8	0
Increased study time for children	66	21

There is much similarity in what benefits HHs expected from receiving electricity regardless of the source from which they received it. According to Tables 4.2 and 4.3, most HHs had realised their expectations but the extent to which the expectations were realised varied between the two sources of electricity. A higher percentage of HHs with SHSs (87%) realised their expectation of better lighting compared to HHs receiving electricity from off-grid community-based hydro sub-projects (76%). This difference in impact was even more clearly seen in the impact surveys conducted in 2008. According to them only 70% among

52 Stakeholders are listed in Table 3.1
53 Information gathered from Off-Grid Community-Based Hydro Sub-Project Baseline and Impact Surveys
54 Information gathered from Village-hydro Baseline and Impact Surveys

HHs in off-grid community-based hydro sub-projects responded positively to the question of better lighting while 99% of HHs using SHSs have responded positively. It is clear that more HHs with SHSs enjoyed better lighting than HHs in off-grid community-based hydro sub-projects. However, in impact surveys carried out in off-grid community-based hydro sub-projects in different years, 70 – 77% of the HHs said that they were satisfied with the supply of electricity (Table 4.8). Those HHs that were dissatisfied gave as reasons for their dissatisfaction the frequent breakdowns in supply, lights being dim and inability to use electrical appliances.

Savings on fuel (kerosene) was an expectation of a higher percentage of HHs (79%) that received electricity from off-grid community-based hydro sub-projects than from SHSs (69%) but only 21% of the HHs with SHSs stated that they have made savings compared to 80% of HHs in off-grid community-based hydro sub-projects. Although more than two-thirds of the HHs expecting to receive electricity from SHSs or off-grid community-based hydro sub-projects expected that children will be able to study longer, only in 21% of the HHs with SHSs was this expectation realised compared to 56% in HHs that received electricity from off-grid community-based hydro sub-projects.

Almost no HHs expected to start enterprises in both sources of electricity and the realisation of this expectation was equally low. This may be due to the lack of awareness among the HHs with regard to the opportunities for enterprises that would be available with electricity. However, as electricity is not the only input that is needed to promote enterprise development, it is not surprising that the availability of electricity did not promote enterprise development as expected in the Project Appraisal Document.

Only in the case of off-grid community-based hydro sub-projects was the community aspect significant as the community had to work collectively to construct, operate and maintain such projects. Community members had some expectations of community benefits as a result of having these sub-projects. What these were and the extent to which they have been realised are shown in Table 4.4. Increased feeling of security and a stronger feeling of togetherness brought about by working together to construct the project are important benefits they gained but the extent to which they have benefited is less than they expected. The increase in socio-cultural activities has exceeded their expectations.

***Table 4.4*: Expected and Realised Community Benefits from Off-Grid Community-Based Hydro Sub-Projects[55]**

Benefit	% HHs Expecting It	% HHs Realised Expectation
More organized village	90	77
Safety	86	68
Increased income	62	53
Increased socio-cultural activities	51	73

As shown in Section 3, consumers in the off-grid community-based hydro sub-projects were generally satisfied with the service they received from the facility. Similarly the satisfaction level was high in the case of SHS users although some HHs expressed dissatisfaction about the services provided by the solar companies. The difficulty in contacting them and lack of regular visits by them are the reasons given for poor services.

[55] Information gathered from Village-hydro Baseline and Impact Surveys

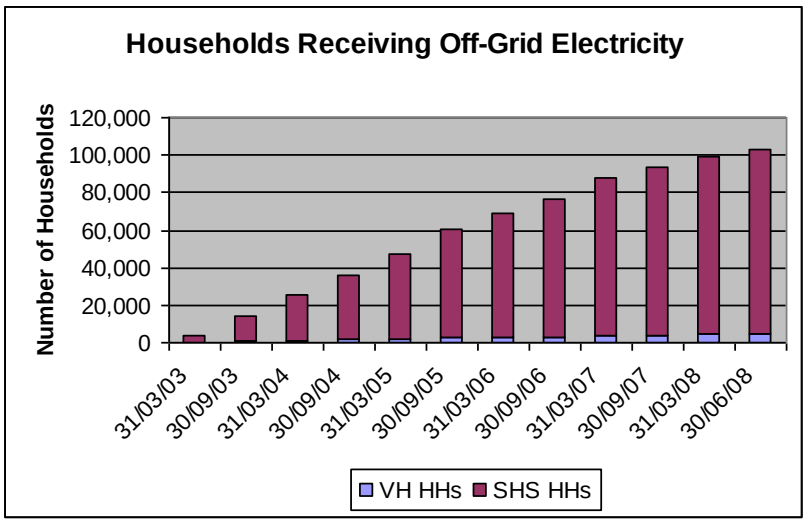
4.3 Uses of Electricity

Several uses have been made of electricity from SHSs and off-grid community-based hydro sub-projects, especially from the latter source.

4.3.1 Domestic Lighting

Domestic lighting is the main benefit people gained from off-grid sources of renewable energy. The number of HHs that switched from kerosene to electricity from these sources for domestic lighting increased from 3,660 (all from SHSs) as at 31/03/03 to 103,225 HHs (98,738 HHs from SHSs and 4,487 HHs from off-grid community-based hydro sub-projects) as at 30/06/2008. As the average number of persons living in a HH was 4.5[56], this benefit has been gained by nearly half a million persons or about 2.5% of the national population. The progressive increase in the number of HHs is shown in Fig. 4.1. Most (96%) of these HHs receive electricity from SHSs.

***Fig. 4.1*: Increase in the Number of HHs Receiving Off-Grid Electricity [57]**



4.3.2 Other Domestic Uses of Electricity

4.3.2.1 Off-Grid Community-Based Hydro Sub-Projects

Tables 4.5 and 4.6 show data collected through postal and impact surveys[58] on the domestic use of electricity for lighting and other purposes. According to Table 4.5 the use of electricity for TVs and electric irons was the most widespread after lighting. Table 4.6 also gives a similar picture although the proportions are less. Use of electricity for radio/cassette recorders is the most widespread apart from lighting according to Table 4.6.

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56 Computed from the data on the number of members in the family in surveyed HHs

57 Data from *Section C. FMR – Quarterly Project Progress Reports,* AU

58 Data was collected through postal surveys from VECSs; data collected through impact surveys was from individual HHs.

***Table 4.5*: Domestic Use of Electricity from Off-Grid Community-Based Hydro Sub-Projects According to Postal Surveys[59]**

Domestic Use Made of Electricity	All Surveys	
	92 VECSs	
	3,398 HHs	
Domestic Use	**No.**	**%**
Lighting	3,381	99.5
TVs	2,895	85.2
Irons	2,629	77.4
Fans	513	15.1
Water Pump for house	18	0.5

Table 4.6 also shows that HHs used several other electrical appliances. Electric kettles / immersion heaters were used by almost one-fourth of the HHs. Far fewer HHs used electric rice cookers or refrigerators. This probably reflects their life style more than their affluence.

***Table 4.6*: Domestic Use of Electricity from Off-Grid Community-Based Hydro Sub-Projects According to HH Impact Surveys**

Domestic Use Made of Electricity	VH Impact Surveys	
	2004, 2006, 2007 & 2008	
	452 HHs	
	No.	**%**
Lighting	452	100.0
TV	336	74.3
Radio/Cassette Recorder	391	86.5
Electric Iron	308	68.1
Electric Fan	78	17.3
Electric Kettle/Immersion Heaters	110	24.3
Refrigerator	11	2.4
Electric Rice Cooker	47	10.4
Water Pump for house	7	1.6

Table 4.7 shows the use of electricity by HHs one year and five years after receiving electricity. As all the HHs had used electricity for domestic lighting at both periods of time; there is no change over time. The increase in its use for TVs, has been marginal (4%) as the HHs used TVs even before receiving electricity. In the case of HHs using electricity for electric irons, the increase is greater (12.3%) as they could use them only after electricity was received. It is difficult to know why the use of electricity for fans and pumping water has decreased over time without a specific study.

[59] Where data is available for the same VECS for more than one year, data for the most recent year has been taken into account.

***Table 4.7*: Use of Electricity from Off-Grid Community-Based Hydro Sub-Projects - One Year & Five Years after Commissioning [60]**

Use Made of Electricity	12 VECSs Started in 2004 and Surveyed in 2005		11 VECSs - Started in 2002+2003 and Surveyed in 2008	
	462 HHs		497 HHs	
Domestic Use	**No.**	**%**	**No.**	**%**
Lighting	462	100.0	497	100.0
TV	390	84.4	441	88.7
Irons	317	68.6	402	80.9
Fans	101	21.9	72	14.5
Water Pump for house	7	1.5	0	0.0

The FGD conducted in the village of Athuraliya in Gilimale shows that the main impacts of the project are in the improvements of the quality of life and income of the beneficiary households. The improvements in the quality of life of the beneficiary households are mainly reflected in the increased use of electronic devices and electric household appliances. Almost all the households possess colour television sets while more than 50% have electric irons. The use of Television sets has had a chain impact on the attitudes, conditions of housing and the education of the children of the beneficiary households in Athuraliya. The use of Television has become a gateway for the beneficiary households' access to global information. Television has motivated children to pursue education by seeing global opportunities and women for good house-keeping, health and hygiene and the protection of the family. It has changed the role of women within the family and outside.

"Now we have electricity in our village. Therefore, we are happy. Earlier, we used to get up late in the morning and felt lazy to cook breakfast with a kerosene lamp. Often our children used to eat unhealthy food from the village tea boutique on their way to school. But, now we get up early in the morning and cook breakfast at home. Our children get a healthy meal before they go to school. We also save money. I would say, electricity has lit our lives." - A mother and the Treasurer of the VECS

The consumers of electricity from the Sagara Wee Oya project in Yatiyantota are full of praise for the benefits brought about by the project. Most of the parents see a bright future for their children as TV has opened their eyes to the world.

After obtaining electricity we came to know through television what is happening in the outside world. We realized that we have a long way to go and I have been telling my children to learn the good things about the world and aspire to reach a higher standard. P.W. Somawathi – a member of Sagara Wee Oya project.

4.3.2.2 Solar Home Systems

Apart from lighting, electricity from SHSs was used only for radio/cassette recorders and TVs. Before SHSs were installed these were used with batteries. Impact surveys show that 86% of HHs had battery powered radio/cassette recorders and 66% had battery

[60] Although the VECSs in the two years are not the same, as they make up almost 10% of the VECSs and HHs receiving electricity from off-grid community-based hydro sub-projects, they represent the sampled universe adequately and can be compared.

powered TVs. After SHSs were installed HHs that had radio/cassette recorders decreased to 68% and HHs with TVs increased to 70%. Charging mobile phone batteries is a more recent use made of electricity.

The use of electricity for lighting and other purposes has improved the quality of life of these people in various ways as can be seen in different sub-sections under Section 4.4.

4.4 Impact on Quality of Life

Electricity from SHSs and off-grid community-based hydro sub-projects has made a marked difference to the quality of life of the beneficiaries. Domestic lighting has played the most significant role in improving it. In spite of some shortcomings, it has provided better lighting, enabling children to study longer at night, facilitating the work of women and improving the family and community relationships. Tables 4.8 and 4.9 summarise the findings in key quality of life indicators over the Project duration. These are discussed in this Section.

4.4.1 Children's Study Time

As expected by the beneficiaries, impact surveys showed that domestic lighting helped children in the HHs that received electricity from SHSs or off-grid community-based hydro sub-projects to study longer at night. This would help to improve their educational standards. Understandably, there has been little variation in that during the duration of the Project.

4.4.1.1 Off-Grid Community-Based Hydro Sub-Projects

According to baseline surveys carried out in different years, 72% of HHs (it varied between 50 – 90% in different years) considered the ability of their children to study longer as an important benefit of electricity. The children studied 1.9 hours (it varied between 1.7 – 2.0 hours in different years) in the night according to baseline surveys. According to impact surveys carried out between 2004 and 2008, the mean study time was 2.9 hours after electricity was received. Thus their study time had increased by 1 hour as a result of having better lighting. The FGDs conducted also confirmed the increase of study time and the value placed on it by the parents.

4.4.1.2 SHSs

According to the baseline surveys of 4/2005 and 1/2007, the mean length of time children studied in the night was 2.4 hours and it had increased to only 2.6 hours after receiving electricity according to all the impact surveys. However, according to the "Before SHS" and "After SHS" data in the impact surveys, the increase in study time varied between 1.1 – 1.5 hours in different years.

4.4.2 Access to Information and Entertainment

4.4.2.1 Off-Grid Community-Based Hydro Sub-Projects

According to baseline surveys of 4/2004 and 1/2007, the overall proportion of HHs using electricity for TVs and radios was 73% (varied between 50 – 75% in different years) and 98% (varied between 70 – 100% in different years) respectively prior to receiving electricity. Therefore, the increase was quite small compared to other indicators. Impact surveys indicated that 74% used electricity for TVs and 87% used it for radios. The cost of using them has, however, been reduced and convenience increased after receiving electricity as they did not have to take batteries outside for charging. It should also be noted that the HHs had to use black and white TVs prior to the supply of electricity particularly in HHs receiving electricity from off-grid community-based hydro sub-projects..

Summary Findings of Successive Impact Surveys

Table 4.8: **Summary Findings of Successive Impact Surveys: Off-Grid Community-Based Hydro Sub-Projects**

Impact Indicator	Impact Surveys Undertaken [and Size of Households (HHs) Surveyed]					Range of Impact
	QPR 4/2004 (172 HHs)	QPR 4/2005 (60 HHs)	BPR 1/2007 (110 HHs)	BPR 1/2008 (92 HHs)	FCR (110 HHs)	
Average increase* in study time of students in the night	1.6 hours	1.3 hours	1.4 hours	1.1 hours	1.5 hours	1.1 – 1.6 hours
Average cost of using energy sources before receipt of electricity (Cost of Kerosene + Cost of Charging Battery)	Rs. 327	Rs.330	Rs. 337	Rs. 326	Rs. 337	Rs. 327 - 337
Average cost of using energy sources after receipt of electricity (Cost of Kerosene + Cost of Charging Battery)	Rs. 68	Rs.86	Rs. 79	Rs. 77	Rs. 79	Rs. 68 - 86
Increase* in proportion of HHs using TV	12.8%	40.0%	26.4%	29.0%	36.4%	13 – 36%
Increase* in proportion of HHs using electric iron	68.6%	70.0%	71.8%	76.1%	59.1%	59 – 76%
Proportion of HHs using electricity to boil water	25.6%	83.3%	70.9%	44.6%	17.3%	17 – 95%
Proportion of HHs reporting saving on expenditure on fuel	83.7%	78.3%	85.5%	92.4%	70.9%	71 – 92%
Proportion of HHs reporting that the village got more organized and work together	93.0%	80.0%	60.0%	88.0	67.3%	60 – 93%
Proportion of HHs reporting that the villagers feel safe	61.6%	78.3%	67.3%	87.0	77.3%	62 – 87%
Proportion of HHs which are 'highly satisfied' or 'satisfied' with the supply of electricity ***	61.0%	70.0%	NA**	NA**	77.3%	70 – 77%
Proportion of HHs which are 'less satisfied' with the supply of electricity ***	39.0%	30.0%	NA**	NA**	22.7%	23 – 30%
Proportion of HHs reporting the performance of VECSs as 'good' or 'satisfactory' ***	90.7%	71.7%	NA**	78.3%	75.4%	72 – 91%
Proportion of HHs reporting the performance of VECSs as 'less satisfactory' ***	7.6%	28.3%	NA**	17.4%	24.6%	8 – 28%

Note: * Increase compared to before receiving electricity; ** NA = Not Available; *** These figures refer to the responses by HHs obtained from impact surveys of HHs and present a more favourable situation in off-grid community-based hydro sub-projects than the information gathered from FGDs presented in Section 3.6

***Table 4.9*: Summary Findings of Successive Impact Surveys: Solar Home Systems (SHSs)**

Impact Indicator	Impact Surveys undertaken [and size of sample SHSs surveyed]				Range of Impact
	QPR 4/2004 (797 SHSs)	QPR 4/2005 (100 SHSs)	BPR 1/2007 (50 SHSs)	BPR 1/2008 (100 SHSs)	
Average increase* in study time of students in the night	NA**	1.1 hours	1.5 hours	1.3 hours	1.1 – 1.5 hours
Average monthly cost of using energy sources before installing solar system [Cost of Kerosene + Cost of Charging Battery + Other Expenses]	Rs. 397	529	Rs. 570	Rs.428	Avg Monthly saving on lighting = Rs. 120/- (kerosene, battery charging, loan instalment)
Average monthly cost of using energy sources after installing solar system but without the monthly instalment for SHS	Rs. 299	23	Rs. 34	Rs. 121	
Increase* in proportion of HHs using TV	NA**	41.0%	24.0%	30.0%	24 – 41%
Proportion of HHs reporting saving on expenditure on fuel	65.2%	93.0%	98.0%	97.0%	65 – 98%
Proportion of HHs reporting greater convenience for housewife	85.6%	94.0%	94.0%	87.0%	86 – 94%
Proportion of HHs reporting the performance of after sales services by Solar System Supplier as 'good' or 'satisfactory'	NA**	72.0%	68.0%	31.0%	31 – 72%
Proportion of HHs reporting the performance of after sales services by Solar System Supplier as 'less satisfactory'	NA**	25.0%	24.0%	67.0%	24 – 67%

Note: * Increase compared to before receiving electricity; ** NA = Not Available;

Access to information and entertainment has improved as a result and it has contributed to improve the knowledge and enjoyment of people in these remote villages, particularly of children and women. It has also encouraged young male members to spend their evenings at home.

4.4.3 Housing Condition

Housing conditions are a reliable indicator of the income level of families. Because of that, it is often used as a surrogate indicator for income as collection of income data is unreliable in surveys of this nature. Data collected in baseline and impact surveys are presented in Tables 4.10 and 4.11. There is a significant improvement in the condition of houses after receiving electricity. These HHs have been motivated to improve their houses because electricity has enabled them to keep their houses cleaner as they are not blackened by smoke from kerosene lamps.

4.4.3.1 Off-Grid Community-Based Hydro Sub-Projects

***Table 4.10*: Conditions of Houses in Off-Grid Community-Based Hydro Sub-Projects Before and After Receiving Electricity**

Component	Baseline 4 Qr/2004 and 1 Qr/2007 % of HHs	Impact 2007 and 2008 % of HHs
Thatched roof	4	1
Asbestos or tile roof	94	96
Clay walls	22	10
Brick, Cement block and Kabok[61] walls	78	86
Clay floors	22	18
Cement and tile floors	78	82

In terms of housing a majority of HHs that benefited from off-grid community-based hydro sub-projects do not belong to the low income category. According to the baseline surveys more than 60% of the houses are of a permanent nature with more than 3 rooms. According to impact surveys of 2007 and 2008 the situation with regard to roofs and walls has improved increasing the proportion of houses with permanent roofs and walls to more than 80%. According to the 2008 survey 8.2% have undertaken improvements to the houses after electricity was received and there were extensions (77%), repairs and alterations (22%). 44% of the HHs gave the reason for improvement as the need for better appearance for their houses.

These improvements indicate an increase in the income of these HHs but there is no evidence to suggest that it was due to receiving electricity. Many of the areas in which these off-grid community-based hydro sub-projects are located are characterised by small-holder tea cultivation and the prices of tea green leaf has been quite high during the period under review. This could account for their increased income.

[61] Blocks cut out of weathered laterite

4.4.3.2 SHS

According to the baseline surveys of 4 Qr/2005 and 1 Qr/2007 more than 50% of HHs were permanent with more than 3 rooms and more than 78% had permanent roofs and walls. According to the impact survey 2008 this situation has improved in all aspects of housing increasing the proportion of permanent houses to 90% and houses with more than 3 rooms to 87%. Nearly 30% have undertaken improvements to houses and 74% of them have given the reason for improvement as the need to have a better appearance for their houses.

Table 4.11*: *Conditions of Houses with SHSs Before and After Installing SHS

Component	Baseline 4 Qr/2004 and 1 Qr/2007 % of HHs	Impact 2007 and 2008 % of HHs
Thatched roof	8	5
Asbestos and tile roof	91	93
Clay walls	15	14
Brick, Cement block and Kabok walls	83	86
Clay floors	33	29
Cement and tile floors	62	70
More than 3 rooms	75	na

4.5 Economic Benefits

In addition to its beneficial impact on the quality of life, electricity from off-grid community-based hydro sub-projects and SHS also brought economic benefits to the HHs that received electricity from these sources of renewable energy. The most direct benefit is the savings they make by either not using or using less kerosene for lighting and the saving they make by not having to charge batteries they used to watch TV or listen to radio/cassette players. In addition to this, they have benefited from the impact of electricity on family income, making it possible to work longer and additional employment. These are discussed in the following sections.

4.5.1 Savings on Kerosene and Other Energy Sources

4.5.1.1 Off-Grid Community-Based Hydro Sub-Projects

According to the baseline conducted in 2005, the average monthly consumption of kerosene for lighting in off-grid community-based hydro sub-projects was 8.1 litres per HH which cost Rs.245. In addition to that, they spent Rs.85 on charging batteries used to listen to their radio/cassette player and watch TV making a total of Rs.330 per month before electricity was available. This decreased to 2.4 litres after electricity became available representing a monthly saving of 5.7 litres per HH valued at Rs.172 according to the impact surveys (Table 4.10)[62]. Thus they spent only Rs.73 per month on kerosene after receiving electricity. They spent another Rs.13 on charging batteries incurring a total cost

[62] *QPR 4/05* – Section 5.2.2.4

of Rs.86 per HH (Rs.73 for kerosene + Rs.13 to charge batteries). This enabled them to save Rs.244 (Rs.330 –.86).

***Table 4.10*: Saving in the Use of Kerosene in HHs in Off-Grid Community-Based Hydro Sub-Projects**

Year	Amount of Kerosene (litres)			Cost of Kerosene (Rs.)		
	Before Electricity	After Electricity	Saving	Before Electricity	After Electricity	Saving
2005	8.1	2.4	5.7	245.00	73.00	172.00
2008	6.0	1.8	5.0	260.00	77.00	183.00

4.5.1.2 SHSs

During 2005 HHs that installed SHSs had used 11.0 litres of kerosene a month for lighting costing Rs.361 according to the baseline survey. They had spent another Rs.168 on charging batteries for their TVs and radio-cassette players making a total of Rs.529. According to the impact survey, after SHSs were installed, the consumption of kerosene was only 0.7 litres per month representing a monthly saving of 10.3 litres of kerosene valued at Rs.338. 93% of the HHs had not spent anything on charging batteries after installing SHSs. Thus the total cost was only Rs.23 for 0.7 litres of kerosene. They saved Rs.506 a month (Rs.529 – 23). Table 4.11 shows the saving in kerosene in HHs with SHSs.

***Table 4.11*: Saving in the Use of Kerosene in HHs with SHSs**

Year	Amount of Kerosene (litres)			Cost of Kerosene (Rs.)		
	Before Electricity	After Electricity	Saving	Before Electricity	After Electricity	Saving
2005	11.0	0.7	10.3	361.00	23.00	338.00
2008	7.0	3.3	5.0	258.00	121.00	137.00

In 2008 the amount of kerosene used before receiving electricity was 6.75 litres which was reduced to 1.74 litres after electricity was received, thus saving 5 litres valued at Rs.184. The saving in kerosene reported in 2008 was much less than the saving of 10.3 litres reported in 2005. As no information was reported on charging batteries, if we assume the cost to be the same as in 2005 (Rs.168), the total cost would be Rs.426. After SHSs were installed the cost of kerosene decreased to Rs.121. As HHs did not spend on charging batteries after installing SHSs, the total cost would be the same thus saving Rs.305 a month.

4.5.2 Adult Working Hours

4.5.2.1 Off-Grid Community-Based Hydro Sub-Projects

There were questions in both baseline and impact surveys regarding saving time, opportunity to start home based economic activities and the time when adults go to sleep at night and get up in the morning before and after electricity was received to find out if there was any saving in time. The answers to these questions do not show any significant change in working hours before and after electricity. According to baseline surveys of 4 Qr/2004 and 1 Qr/2007, 12% and 2.5% respectively anticipated a saving in time with electricity. According to the impact survey of November 2008, 21% of HHs said that they

saved time. According to FGDs, 90% of the men engaged in farming and agriculture processing activities such as cinnamon peeling gained 2 - 3 hours per day as a result of the availability of electricity. The contribution made by this additional working hours to the economy is discussed in Section 4.5.3 of this report. In the case of women who are playing a multiple role in the household, they found that their work became more convenient (77%) and it made it possible to work longer hours.

4.5.2.2 SHS

According to baseline surveys of 4 Qr/2005 and 1 Qr/2007, 22% and 41% of HHs respectively said that they anticipated saving time after electricity. According to 2008 impact survey 22% of HHs have identified saving in time as a benefit that they gained after electricity was received. Yet it may not be that effective as in the case of off-grid community-based hydro sub-projects due to the limited availability of power.

4.5.3 Family Income

As farming is the main source of income of the HHs receiving electricity from SHSs and off-grid community-based hydro sub-projects there is little possibility for them to increase their family income through electricity. In various HH surveys conducted during the M&E period, the proportion of HHs engaged in farming has always been above 75% and had varied up to 87%. Apart from casual labour, also in farming, there were few other sources of income in these remote rural areas.

HHs could earn additional income if there were opportunities for the productive use of the longer hours people were able to work due to electric lighting. Even though HHs might not have the opportunity to use this time productively, its economic value could be computed on the assumption that the additional amount of time available to work as a result of this is 3 hours per day per HH. On the basis of 250 working days per annum, a HH could work an additional 750 hours per annum. Assuming the value of a working hour is Rs.40 this is equal to Rs.30,000 per annum or Rs.2,500 per month if it was possible to use this time for productive purposes.

Assuming that all the HHs gain this benefit of working longer hours we have computed the value of the additional input of labour made possible by the availability of electricity using the above figure as the basis (Table 4.12). On this basis the additional nominal income gained by the families receiving electricity from off-grid community-based hydro sub-projects is computed at Rs.140.8 million. This is only a notional income as people in these villages have limited or no opportunity to use this time productively.

It is not possible to compute similar information for HHs with SHSs as they did not report being able to work longer hours except in a few enterprises.

Table 4.12: Value of Additional Input of Labour [63]

Quarter	HHs at Quarter End	HHs for Computation	Additional Income/ HH/Mon	Total Income for Quarter (Rs)
31/03/2003	--	--	--	--
30/06/2003	--	--	--	--

[63] To simplify the computation we have assumed that the number of HHs receiving electricity in any quarter is the number that had been connected to the village electricity grid at the end of the previous quarter. Of course, the actual number would be higher as sub-projects come into operation at various times. Our estimate might, therefore, be an under-estimate.

Quarter	HHs at Quarter End	HHs for Computation	Additional Income/ HH/Mon	Total Income for Quarter (Rs)
30/09/2003	841	--	--	--
31/12/2003	1,305	841	2,500	2,102,500
31/03/2004	1,279	1,305	2,500	3,262,500
30/06/2004	1,557	1,279	2,500	3,197,500
30/09/2004	1,974	1,557	2,500	3,892,500
31/12/2004	1,979	1,974	2,500	4,935,000
31/03/2005	2,187	1,979	2,500	4,947,500
30/06/2005	2,490	2,187	2,500	5,467,500
30/09/2005	2,656	2,490	2,500	6,225,000
31/12/2005	2,855	2,656	2,500	6,640,000
31/03/2006	3,036	2,855	2,500	7,137,500
30/06/2006	3,056	3,036	2,500	7,590,000
30/09/2006	3,200	3,056	2,500	7,640,000
31/12/2006	3,432	3,200	2,500	8,000,000
31/03/2007	3,642	3,432	2,500	8,580,000
30/06/2007	3,867	3,642	2,500	9,105,000
30/09/2007	4,038	3,867	2,500	9,667,500
31/12/2007	4,137	4,038	2,500	10,095,000
31/03/2008	4,331	4,137	2,500	10,342,500
30/06/2008	4,487	4,331	2,500	10,827,500
30/09/2008		4,487	2,500	11,217,500
			Total for the full period	**140,872,500**

4.6 Enterprises Using Electricity

The number of enterprises using electricity from SHSs was reported *as 654* in Section C of FMR – Project Progress Report for Quarter ended 30/09/2007. It has not been possible to verify this data as there is no reliable way to collect comprehensive and up to-date data. The Consultants could not undertake this task as the 98,738 SHSs that have been installed are distributed throughout the country. Several solar companies install SHSs but collecting this type of data is not a priority for them. Neither is it for SEEDS which provided financing for 65%[64] of the SHSs installed. The problem is much less severe in the case of off-grid community-based hydro sub-projects but it was not possible for the Consultants to survey all the 118 sub-projects that had been commissioned as at 30/06/2008 within the available resources. However, postal surveys have been conducted and data collected for 92 VECSs is presented in Table 4.15.

[64] Information from AU

***Table 4.15*: Use of Electricity from Off-Grid Community-Based Hydro Sub-Projects for Enterprises[65]**

Productive Use Made of Electricity	All Surveys	
	92 VECSs	
	3,398 HHs	
	No.	%
Water Pump for farming	5	7.8
Shop with Fridge/ Freezer	7	10.9
Flour/Chilli grinding	2	3.1
Food Processing	3	4.7
Computer Centre	1	1.6
Electronic Repairs	2	3.1
Communication Centre	1	1.6
Battery Charging	1	1.6
Barber Saloon	2	3.1
Tailoring	5	7.8
Carpentry shed	7	10.9
Shop	28	43.8
Total	**64**	**100.0**

Although it is not possible to quantify, the evidence available suggests that many of these enterprises existed before electricity became available and they served the needs of the community. 55% of the 29 enterprises that had been surveyed had been started before electricity became available. This probably applies to enterprises in Table 4.15 also. Grocery shops which form the bulk of the enterprises that use electricity from SHSs and off-grid community-based hydro sub-projects were able to use it for lighting in the evening. A few shops receiving electricity from off-grid community-based hydro sub-projects had invested in refrigerators and were able to sell products that required refrigeration. Carpentry sheds and saloons that were there had invested in electrical tools and equipment and availability of electricity had made it possible for a few villages to have grinding mills and communication centres.

Enterprises receiving electricity from off-grid community-based hydro sub-projects paid a very reasonable charge varying from Rs.100 – 500 a month to the VECS but they experienced several problems. The complaints that most enterprises made were the unreliability of the supply, frequent breakdowns and low voltage. This had forced some enterprises to close down.

Most were micro-enterprises owned and run by men in their thirties with family labour. Electricity had enabled them to work longer hours. Survey of 25 enterprises showed that more than 80% of the enterprises benefited from the reduction of cost of fuel and being able to work longer hours due to the availability of cheap lighting from hydro electricity.[66]

[65] Based on postal surveys conducted by Consultants. Where data is available for the same VECS for more than one year, data for the most recent year has been taken into account.

[66] This is based on what was reported in *Monitoring & Evaluation of the Renewable Energy for Rural Economic Development Project, Bi-Annual Report* (6 Months Ending 30th September 2007), Section 5.3.2.2, Resources Development Consultants Ltd.

Their income has increased due to savings in costs of production rather than to increased sales. That is to be expected, in these remote villages which must depend on local market demand than on the capacity to produce. This is an important reason why electricity from off-grid community-based hydro sub-projects did not lead to the development of enterprises in these villages as expected and their capacity to generate employment has been quite limited. This also applies to enterprises using electricity from SHS.

Few enterprises visited by Consultants that had been promoted under the Innovation Solicitation component had run into difficulties problems connected with the power supply and insufficient understanding of the local conditions

4.7 Employment Creation

Employment was generated by the Project at community and HH level through

- the construction and O&M of off-grid community-based hydro sub- projects
- the construction and O&M of grid-connected hydro sub-projects
- enterprises and
- self employment[67]

Employment generated at the local level by the installation and maintenance of SHSs will also be considered here.

The 118 off-grid community-based hydro sub-projects that had been completed by 30/06/2008 and 33 that were being constructed have generated a substantial amount of employment at the community level. This is part of the voluntary contribution that the community makes towards the cost of the sub-project. The information available on this community labour contribution is not adequate to compute the volume of employment generated

Grid-connected hydro sub-projects employ 8 – 11 persons from the community during construction which lasts 18 months on average.[68] On this basis, one sub-project generates 3,600 person-days if 8 persons were employed or 4,950 person-days if 11 persons were employed. Therefore, the 41 grid-connected hydro sub-projects that had been completed up to 30/06/2008 have generated between 147,600 or 202,950[69] person-days of. The value of this employment can be estimated at Rs.44 – 61 million on the basis of Rs.300 per person-day. This represents an income of Rs.1.1 – 1.5 million for each of the communities where these sub-projects were constructed.

Grid-connected hydro sub-projects employ 3 – 4 persons on a regular basis for maintenance after the sub-projects are commissioned. This generates 90 – 120 person-days a month on the assumption that they work 30 days in a month. This brings Rs.27,000 – 36,000 a month on a continuing basis for the community. The 41 completed sub-projects altogether generate Rs.1.1 – 1.5 million a month for these communities.

The installation of SHSs has generated the largest volume of employment because 98,738 SHS had been installed up to 30/06/2008. On the basis of information gathered

[67] In villages like these the distinction between enterprise and self-employment is not clear; usually an enterprise employs at least one paid employee whereas self-employed work on their own

[68] This information has been gathered from grid-connected hydro sub-project Developers through a survey conducted by the Grid Connected Small Power Developers Association and from villages surveyed by the Consultants to check on benefits gained from grid-connected hydro sub-project Developers

[69] This is a notional computation to estimate the value of labour used by grid-connected hydro sub-projects. If 8 are employed and work 25 days a month = 8 x 41 x 18 x 25 = 147,600 days; if 11 are employed and work 25 days a month – 11 x 41 x 18 x 25 = 202,950 days

from suppliers of SHSs[70] the installation of these SHSs would have generated 444,000 person-days or 18,000 person-months of employment. As this work is carried out by more skilled personnel the volume of employment generated by the installation of SHSs could be valued at Rs.222 million on the basis of Rs.500 per person-day.

Contrary to expectations, the availability of electricity has not stimulated development of enterprises. In the case of electricity from SHSs, it has only enabled existing enterprises to use it for lighting. Grocery shops which make up 70% of the 654 enterprises[71] employ family members and there is no evidence that they generated additional employment. This is not surprising as additional employment could not be generated as demand is limited in these remote rural areas.

The same is true for the estimated 82 enterprises in villages receiving electricity from off-grid community-based hydro sub-projects.

Nearly 50% of the enterprises are grocery shops, a few of which used electricity to power refrigerators. Carpentry sheds that already existed started using electricity to power machinery. A few grinding mills had been started after electricity became available and some of them complained that their machines were damaged by shortcomings in the power supply.

4.8 Economic Impacts

The rural economic development the RERED Project aimed to achieve was:

- a growth in economic activity and
- an increase in employment and family income.

Off-grid community-based hydro sub-projects were constructed mainly for domestic lighting. It was envisaged that they could generate power during day time without incurring additional cost that could be used cheaply for economic activities. As shown in Section 4.6, there was only a very limited increase in the number of enterprises as a result of having electricity and they did not generate much employment or additional income. Their impact on the rural economy can be considered to be marginal.

With regard to family income, the benefit has come mainly from longer working hours and savings on kerosene. Although the value of longer working hours was estimated at Rs.2,500 a month in Section 4.5.3 as the opportunities to use this time are limited in these villages, it is more a notional income than extra money in their hands for most of the families. Therefore it has not had much impact on the rural economy. As reported in Section 4.5.1, the saving of expenditure on kerosene and battery charging has been estimated at Rs.250 a month for HHs in off-grid community-based hydro sub-projects and Rs.300-500 in HHs with SHSs. The full benefit of this saving will be gained after these HHs have repaid the loans they obtained to construct the hydro sub-projects or to purchase SHSs.

Another source of income in the communities where grid-connected hydro sub-projects are located is the employment provided by the construction and O&M of these sub-projects. This provides an income for 8 – 11 families during the construction period and 3 – 4 families thereafter.

[70] 3 person-days to install one SHS unit; 1.5 person-days for support activities related to installing a single SHS for transport, documentation, etc., used 25 day month to compute person-months.

[71] As it has not been possible to get accurate and comprehensive up to-date data, this is only the latest available information.

4.9 Environmental Impacts

Environmental impact has been felt mainly through the savings in carbon emissions as a result of not burning fossil fuels. This was achieved by grid-connected hydro sub-projects which used hydro power to generate electricity that was supplied to the national grid. The benefit from this was mainly at the national level and will be presented in Section 5.3.

Benefits at HH and community level were felt from SHSs and off-grid community-based hydro sub-projects. 41,213,066 litres of kerosene has been saved by the 103,225 HHs receiving electricity from these sources (Annex 10). This is the equivalent of an overall saving of 14,719 tonnes of CO_2 for the people living in those houses. This benefit is the equivalent of 2.0 kg less of CO_2 a month for HHs in off-grid community-based hydro sub-projects and 3.6 kg less of CO_2 a month for HHs with SHSs as a continuing benefit.[72] As it is not possible to get accurate data through this type of surveys, the findings should only be considered as indicative of the benefit gained. This is most beneficial for their health, - *"Epidemiological studies in developing countries have linked exposure to indoor air pollution from dirty fuels with at least four major categories of illness: acute respiratory infections (ARI) in children; chronic obstructive lung diseases such as asthma and chronic bronchitis; lung cancer; and stillbirths and other problems at birth…..When it happens, the well-documented transition up the energy ladder from dirty to clean fuel will greatly reduce the threat from indoor air pollution in developing countries."*[73]

However, because of problems VECSs experience in the O&M of off-grid community-based hydro sub-projects, there are frequent and sometimes prolonged breakdowns in the power supply. This reduces the above benefit by making it necessary to use kerosene for lighting. This problem is less serious among HHs using SHSs but they also experience poor quality of lighting due to not managing their SHSs properly especially during rainy / cloudy seasons. This makes it necessary for them also to use some kerosene for lighting but impact surveys showed that it was much less than what HHs receiving electricity from off-grid community-based hydro sub-projects used. In addition to this, better lighting reduces the strain of studying on the eyes of school going children and reduces their vulnerability to problems associated with sight.

Communities have realised the importance of conserving the environment in order to get enough water for their hydro sub-projects. This has made them more concerned about conserving the watershed of the streams that provide water for their hydro sub-project. This has also helped to reduce soil erosion. Consultants have not investigated these environmental impacts as they are beyond the scope of this assignment.

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[72] This is based on data reported in Annex 10 derived from baseline and impact surveys; saving in kerosene for the final quarter has been divided to get the monthly saving for off-grid community-based hydro sub-projects and SHSs and this has been divided by the number of HHs using electricity from these two sources. Conversion of kerosene to CO_2 is @ 2.8 litres of kerosene = 1 kg of CO_2

[73] *World Resources 1998-99: Environmental Change and Human Health,* A joint publication by the World Resources Institute, the United Nations Environment Programme, the United Nations Development Programme, and The World Bank. 1998.

5 EFFECTS & IMPACTS – NATIONAL LEVEL

5.1 Economic Value of the Power Generated

Value is added to the national economy by the generation of power through grid-connected and off-grid community-based hydro sub-projects and SHSs. Of these the grid-connected hydro sub-projects make the largest contribution to the national economy.

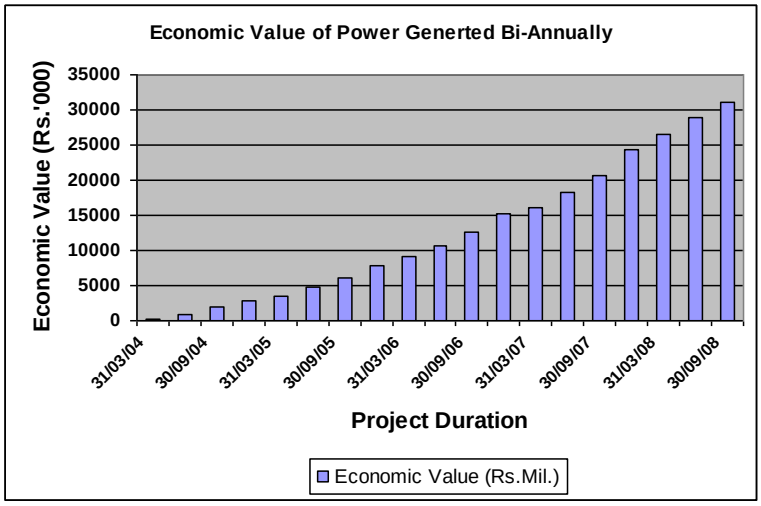
5.1.1 Grid-Connected Hydro Sub-Projects

10 grid-connected hydro sub-projects had been approved as at 31/03/2003. Of these 7 with an overall capacity of 8.0 MW were generating electricity as at 31/03/2004. The value of the power they generated was estimated at Rs.202 million for the quarter ending 31/03/2004. By 30/06/2008 there were 41 sub-projects in operation with a capacity of 92 MW and generating power valued at Rs.2,287 million for the quarter ending 30/09/2008.

***Table 5.1*: National Economic Benefit from Grid-Connected Hydro Sub-Projects**

Half Year Ending	(in Million Rs.)	
	For Period	Cumulative
31/03/04	202.39	202.39
30/06/04	740.74	943.13
30/09/04	911.76	1,854.89
31/12/04	1,069.62	2,924.51
31/03/05	662.28	3,586.79
30/06/05	1,109.50	4,696.29
30/09/05	1,340.64	6,036.93
31/12/05	1,776.80	7,813.73
31/03/06	1,232.97	9,046.70
30/06/06	1,641.53	10,688.23
30/09/06	1,966.92	12,655.15
31/12/06	2,619.79	15,274.94
31/03/07	740.20	16,015.14
30/06/07	2,284.00	18,299.14
30/09/07	2,432.00	20,731.14
31/12/07	3,630.00	24,361.14
31/03/08	2,208.00	26,569.14
30/06/08	2,287.18	28,856.32
30/09/08	2,287.18	31,143.50

***Fig 5.1*: Economic Value of Power Generated by Grid-Connected Hydro Sub-Projects**



The economic value of the power generated by this component up to 30/09/2008 was Rs.31,143 million. The 41 sub-projects that were in operation as at 30/06/2008 will contribute power valued at approximately Rs.9,150 million a year. With the increasing cost of fuel, the value of the power generated would be higher in the future.

5.1.2 Off-Grid Community-Based Hydro Sub-Projects

It has not been possible to compute the economic value of power generated by off-grid community-based hydro sub-projects due to the variability in their performance. The amount of power they generate depends on the water availability which varies seasonally, the O&M of the machinery, whether power is generated during day time and for how long, etc. Furthermore, frequent breakdowns have been reported by some VECSs and several of them do not keep proper records. All these shortcomings preclude a reliable assessment of the power generated by these sub-projects.

Considering that the installed capacity of these sub-projects is less than 1.5% of the installed capacity of grid-connected hydro sub-projects, the economic value of the power they generate is very marginal but for the communities that get electricity from them, they are of great value even though it cannot be quantified.

5.1.3 SHSs

Individual SHSs do not generate a great deal of power but collectively the SHSs that have been installed under the RERED Project generate a significant amount of power that contributes to the national economy. The economic value of power generated by SHSs bi-annually and foreign exchange saved as a result of not using fuel during the Project duration is shown in Table 5.*2*.

Table 5.2*: *Economic Value of Power Generated and the Foreign Exchange Saved by SHSs

Half-year Ending	SHSs Commissioned during the period	Total Wp	Price of Diesel (Rs. / litre)	Economic Value for the period from SHSs Commissioned during the period (Rs. Mil)	Economic Value. for the period from all SHSs Commissioned up to that period (Rs. Mil).	Cumulative Economic Value from all SHSs from 1st Period to that period (Rs. Mil).	Foreign Exchange (FE) Rate	FE saved for the period from the SHSs Commis--sioned during the period (US$)
31/03/2004	23,777	1,126,148	32	11.84	11.84	11.84	101.19	58,494
30/09/2004	10,258	483,636	36	5.72	17.56	29.40	101.19	28,261
31/03/2005	10,876	440,951	44	6.37	23.93	53.33	100.5	31,709
30/09/2005	13,077	2,050,735	46	30.99	54.92	108.25	100.5	154,172
31/0320/06	8,279	683,314	50	11.22	66.14	174.39	103.6	54,167
30/09/2006	7,337	295,272	64	6.21	72.35	246.74	103.6	29,960
31/03/2007	10,203	420,693	60	8.29	80.64	327.38	108.3	38,282
30/09/2007	5,301	207,081	75	5.10	85.74	413.13	112.43	22,689
31/03/2008	6,100	245,423	80	6.45	92.19	505.32	107.27	30,063
30/06/2008	3,530	139,767	110	2.53	94.72	600.04	107.25	11,773
30/09/2008	--	--	110	--	47.36	647.40	107.25	5,887
				Total	**647.39**			**465,457**

The number of SHSs installed as at 31/03/2004 was 23,777 which had a total capacity of 1.13 MWp. This number had increased to 98,738 SHSs by 30/06/2008 with a total capacity of 4.363 MWp which generated 6,370 MWh of electricity per year with an estimated value of Rs.286.65 million per year.[74] This will be the continuing annual contribution to the national economy by SHSs installed under the RERED Project.

5.2 Savings in Foreign Exchange

If alternative sources of renewable energy are not utilised to generate electricity, this power has to be generated by thermal plants using imported fuel. Hydro-power, wind and biomass were considered as alternative sources of renewable energy and hydro-power was envisaged as the most important in the short-term. Of the total RERED Project cost of US$.133.7 million, 90.3 million (68%) was apportioned to grid-connected investments; of the foreign costs of US$.82.3 million, 55.8 million (67.8%) was similarly apportioned[75]. These plants have contributed most to save foreign exchange totalling US$.164.59 million up to 30/09/2008.

[74] A kWp of SHS produces about 5 kWh of electricity per day. With battery charging and discharging, this will deliver 4 kWh per day. Hence the 4.363 MWp of Solar systems would have produced 4x 4.363x365= 6,370 MWh per year. If generated through small diesel generators, this would have consumed 6,370,000 x 0.45 litres of diesel. Based on a market price of Rs. 100 per litre of diesel, this would have a value of Rs. 286.65 million per year.

[75] **PAD,** Annex 3

***Table 5.3*: Foreign Exchange Saved by Grid-Connected Hydro Sub-Projects**

Quarter Ending	Grid Connected	Foreign Exchange	Foreign Exchange Saved in the Quarter	Cumulative Foreign Exchange Saved from 01/012004
	(MW)	Rs. / US$	US$ Million	US$ Million
31/03/2004	**8.0**	**101.19**	**0.81**	**0.81**
30/06/2004	**29.1**	**101.19**	**2.97**	**3.78**
30/09/2004	**36.5**	**101.19**	**4.11**	**7.88**
31/12/2004	**39.0**	**101.19**	**5.88**	**13.76**
31/03/2005	**40.13**	**100.50**	**2.99**	**16.75**
30/06/2005	**41.7**	**100.50**	**5.68**	**22.43**
30/09/2005	**45.7**	**100.50**	**6.87**	**29.30**
31/12/2005	**48.2**	**100.50**	**9.10**	**38.41**
31/03/2006	**52.0**	**103.60**	**4.97**	**43.38**
30/06/2006	**53.0**	**103.60**	**8.08**	**51.46**
30/09/2006	**55.0**	**103.60**	**10.23**	**61.69**
31/12/2006	**59.58**	**103.60**	**12.68**	**74.36**
31/03/2007	**67.6**	**108.30**	**3.42**	**77.78**
30/06/2007	**67.6**	**108.30**	**9.22**	**87.01**
30/09/2007	**77.6**	**110.00**	**9.35**	**96.35**
31/12/2007	**78.70**	**112.43**	**10.21**	**106.56**
31/03/2008	**87.3**	**107.27**	**9.84**	**116.40**
30/06/2008	**92.0**	**107.25**	**21.97**	**138.37**
30/09/2008	**92.0**	**107.26**	**21.97**	**160.34**

Generation of power using wind and biomass under the Project had not taken off due to various reasons but there are signs now of increasing interest in generating power using biomass. It is possible to expect that these plants will contribute to saving foreign exchange in the future.

SHSs also generate small amounts of power. Although they have not contributed in a substantial manner to saving foreign exchange, the foreign exchange saved by the use of SHSs up to 30/09/2008 has been estimated at US$.465,457 (Table 5.2)[76]. In comparison, it is only 0.22% of what grid-connected hydro sub-projects have saved.

5.3 Reduction in Carbon Emissions

Reduction in the emission of CO_2 is the major environmental benefit that has been achieved by using hydro and solar power for power generation. As stated under Section 4.8 the overall saving in carbon emissions achieved as a result of using less kerosene for lighting in HHs receiving electricity from SHSs and off-grid community-based hydro sub-projects is 14,719 tonnes of CO_2 up to 30/09/2008 (Annex 10). This benefit is the equivalent of 2.0 kg reduction of CO_2 a month for HHs in off-grid community-based hydro

[76] The values for foreign exchange saved are based on the assumption that 50% of the sale price of diesel is foreign exchange and the balance is local taxes.

sub-projects and 3.6 kg[77] reduction of CO_2 a month for HHs with SHSs. This is a continuing benefit these HHs will feel and is very beneficial for the health of the people in those communities. More people will gain this benefit with construction of more off-grid community-based hydro sub-projects and the installation of more SHSs.

The grid-connected hydro sub-projects save considerably more carbon emissions as they avoid the use of much larger quantities of fuel oil which would have been required to generate the same amount of electricity with fuel oil powered plants.

Table 5.4: ***Savings in Carbon Emissions Due to Power Generated by Grid-Connected Hydro Projects***[78]

Period	Savings in Carbon Emissions – Tonnes of CO_2	
	For Period	Cumulative
2003	Not available	Not available
2004	165,000	165,000
2005	224,000	389,000
2006	257,600	646,600
2007	283,807	930,407
01/01/2008 -30/09/2008	249,251	1,179,658

Their saving for the period from 2004 to 30/09/2008 is estimated at 1.18 million tonnes of CO_2. [79]

5.4 Energy Efficiency & Demand Side Management

As a result of the encouragement provided by the Project, 15 ESCOs have been registered with SEA (formerly ECF). The activities undertaken by them have been presented in Section 2.3.1. M&E Consultants have not evaluated the impact of the activities undertaken by them as it was not within their purview.

5.5 Cross-Sectoral Energy Applications

The Project undertook several activities presented in Section 2.3.2 to promote cross-sectoral application of renewable energy but due to various problems they encountered that have been discussed in that Section, their impact is minimal. The availability of electricity from off-grid community-based hydro sub-projects and SHSs to schools and religious places has helped educational and socio-cultural activities in the communities that benefited from this facility but M&E Consultants have not evaluated the impact of these activities as it was not within their purview.

5.5.1 Innovation Solicitation

Although a relatively small sub-component in the RERED Project, it is significant in promoting rural development. It was aimed at supporting enterprise development in

[77] Derived by dividing the amount of kerosene saved in the final quarter for each source of renewable energy by the number of HHs receiving electricity from that source and 3 to get the per month rate. Relevant data is in Annex 10 based on survey findings.

[78] Table 3.2 from BPR 2/2004 has been reproduced here as Table 5.4

[79] This has been computed from electricity generated by grid-connected hydro sub-projects for 01/01/2004 to 30/09/2008 @0.8 kg CO_2 per 1 kWh of electricity Data from Annex 1 of BPR 2/2008

communities by introducing technologies using renewable energy for productive purposes. Several proposals have been implemented by promoters since 2003. They were from:

1. Enexe (Pvt) Ltd.
2. FECS.
3. Rural Energy & Environmental Consultation Services (REECS).
4. Dr. Kapila Weeratunga Arachchi
5. Practical Action, formerly known as the Intermediate Technology Development Group (ITDG).
6. Sewalanka Foundation.

5.5.1.1 Economic Activities[80]

According to the data provided by FECS, Enexe (Pvt) Ltd., and REECS to AU, 48 economic activities had been started by them in 27 villages. According to the data collected from 92 VECSs by the Consultants through several rounds of postal surveys, there were only 68 enterprises in them altogether. This implies that there were only 20 enterprises in the 65 VECSs that were not covered by economic activities started by FECS, Enexe (Pvt) Ltd., and REECS. Surveys of enterprises, impact surveys and FGDs conducted by the Consultants showed that most of the enterprises in these communities had existed even before electricity was received. This indicates that most of the 68 enterprises reported by VECSs should have existed by the time electricity was received suggesting that efforts by these promoters to start up new enterprises had not been very successful.

This is not surprising as promoting economic enterprises is a fairly complex task that requires long-term involvement and quite specialised skills. Neither Enexe (Pvt) Ltd., nor FECS had such experience or expertise. Further, FECS had initiated 34 economic activities in 20 villages but eventually established only 30 in 19 villages. This is remarkable considering that it had only one full-time staff when the Consultants interviewed it in May 2005 and also undertook training of VECS office-bearers and members and also provided other services to the VECSs. Enexe (Pvt) Ltd. had subsequently experienced internal problems and its status seemed uncertain.[81]

The following are assessments FECS has provided about some of the enterprises it has helped to start under the Innovation Solicitation programme:

1. Janith Communication in the Kitulriti Ella off-grid community-based hydro sub-project. (Started in September 2003). Although in terms of income, it generates only about Rs.800.00 per month, this has provided the community with access to telecommunication facilities. Before it was started people had to go to Deraniyagala.
2. Thusitha Tailors in the Kitulriti Ella off-grid community-based hydro sub-project. (Started in September 2003). This enterprise is generating Rs.1,500 – 2,000 income per month. It was closed down after 8 months as the person died.
3. Devmini Garments that started in Beraliyadola off-grid community-based hydro sub-project in December 2004 has been generating a monthly income of about Rs.

[80] Reports submitted by organizations / individuals who undertook sub-projects and field visits by Consultants.

[81] Consultant gathered from Ranjith Perera that the Company was looking for a place to rent for its office.

6,000 to 9,000. It had also contributed Rs.2,300 to the VECS since it started till September 2006.[82]

4. A shop selling refrigerated food started in June 2004 in Saptha Kanya off-grid community-based hydro sub-project has increased its monthly profit from about Rs.800 in the first three months to nearly Rs.5,000 by the end of the first year.[83]
5. Managoda Kuda Parimana Jala Viduli Paribhogika Samithiya reported on two economic enterprises, - Managoda Communications and Weerasena Saloon.[84] According to this report the communications centre had yielded a profit of Rs.10,443 over the first five months and the saloon had generated a profit of Rs.2,600 for the same period. These enterprises also paid the VECS Rs.1,750 during a 7-month period. Apart from these financial benefits, these enterprises made services available to the communities.[85]

The Consultants visited some of the locations where FECS had started enterprises and their observations are given below.

1. A saloon the Consultants visited in Egoda Amanawela had started using electrical equipment with the help of FECS. Saloon's income increased considerably but since then the off-grid community-based hydro sub-project had frequent breakdowns and had not functioned for the past 6 months. At the time of the visit in March 2008; very few customers visit the saloon and his monthly income has declined.
2. A Grinding Mill in the same area (Samanala Gilme) that was visited in March 2008, had also started with FECS support; it has not been functioning for the past several months due to power supply problems. Earlier the motor in the mill had burnt down due to insufficient power and the entrepreneur had to replace it.
3. A Computer Centre in the adjoining village (Pahala Olu Ella) visited by the Consultants in March 2008 was quite successful. It had also been helped by FECS and another donor and was run by a teacher attached to the school. Classes were held in the school outside school hours. The course it offered conformed to GCE "Ordinary" level syllabus. The fees paid by the students covered the costs and more than 100 had been trained up to the time of the interview in March 2008. It had no problems with the power supply as the off-grid community-based hydro sub-project was working well.
4. An enterprise in the same village has been making pumpkin preserve (*puhul dosi*) successfully. FECS had helped this enterprise to use electricity which is used only for lighting and sealing the polythene packs. It employs 4-6 persons when a load of pumpkin is brought. At the time of the visit in March 2008, production had been stopped as the cost of raw materials had gone up and he could not produce at a competitive price. He needed to increase his scale of production to be competitive but did not have the required working capital.

Most of these enterprises were run by the owners with some help from family members. Only the enterprise making pumpkin preserve employed non-family members but that was also not on a full-time basis.

Communication Centres had been successful as it was difficult for people in these remote villages to access phone facilities. This situation has changed drastically in the past few years with the spread of mobile phones. The demand for services provided by

82 Report provided by AU
83 Report provided by AU
84 Report provided by AU
85 Report provided by AU

Communication Centres has decreased because of this and they are no longer economically viable.

When a Consultant interviewed Enexe (Pvt) Ltd., the company had started a few projects and but some of the economic activities it had started did not satisfy AU's economic profitability criteria:

1. It considered the Computer Centre it set up in Pahala Welaboda in 2005 was justified though it did not meet the AU profitability criterion because the village community saw a computer for the first time and the youth in the village learnt to use it. At the time the Consultants visited it in May 2007, it was no longer operational. The main reason was the loss of interest among students in the village to attend classes. They preferred to attend computer classes in Balangoda when they go there for other tuition classes. There were other problems also: difficulty in getting the computer repaired, finding teachers to conduct classes and breakdowns in the power supply.
2. A grinding mill in the same village was also visited in May 2007. It was operating but frequent interruptions in the power supply were a problem. The owner makes a small profit from the sale of chillies and spices which he grinds and packets and sells through shops in the village. The owner had to incur expenses because his machinery was damaged due to low voltage.

Consultants have also gone through the reports submitted by Enexe (Pvt) Ltd., on the following three innovation projects[86] in Imaoyatenne village[87]:

1. Sithumini Tailors had generated an income of Rs.15,291 for a 21-month period.
2. A computer centre that had been started in April 2004 had generated Rs.1,920 during the first 6 months of 2005.
3. A grinding mill that had been started in April 2005 had earned an income of Rs.6,258 in the first 6 months of 2006.

From the point of view of Promoters/Developers of these innovation projects, it was quite profitable as the Project paid them US$ 2,000 for each successful economic activity started by them. They were expected to create awareness among prospective village entrepreneurs and provide them with the necessary technical and business advice and skills. Entrepreneurs were expected to find the investment and working capital themselves but some Promoters/Developers provided part of the capital to encourage the entrepreneurs to start an economic activity. Consultants learnt during their field visits that the follow up support from the Promoters/Developers was very limited. This is not surprising as they had undertaken large numbers of economic activities in several villages even though their capacity was limited.

See Annex 11 for further details.

5.5.1.2 Innovative Technology

Dr. Kapila Weeratunga Arachchi and the ITDG (now Practical Action) introduced solar dryers and biomass heated dryers to add value to medicinal herbs, spices, vegetables and fruits by drying them in a more hygienic and effective manner.

[86] At the time the Consultant interviewed the Company, the person who provided information could not give details. He agreed to send more details but failed to do so even after a few reminders. Subsequently the Consultant phoned the Company, there was no response.

[87] Sub-project or VECS name has not been mentioned in the report; it is a small sub-project with a capacity of 6 kW serving 28 HHs

The project to introduce solar dryer technology to collectors of medicinal herbs to dry their products undertaken by Practical Action is quite successful. Practical Action from the time it was ITDG had been very involved in technological innovation and was a pioneer in introducing off-grid community-based hydro projects in Sri Lanka. The experience it had gained in mobilising and organising people and developing their individual and collective capacities had played an important role in the success it achieved.

The medicinal herb collectors were farmers in the area who did this when they were not cultivating their fields. They had dried these in the open and the product was contaminated with dust and other impurities. Herbal medicine traders paid a low price for their products. The solar dryers were quite effective in improving the quality of the herbal products and they could also dry larger volumes of medicinal herbs. The solar dryers were managed and operated by the Society[88] that Practical Action helped the collectors to form. It was possible to do this successfully as farmers had been organised earlier under the Isuru Scheme. Practical Action linked them to manufacturers of *ayurvedic* products who paid a higher price for the better quality products they produced. These manufacturers also encouraged the farmers to grow medicinal plants in their fields during the off-season and provided necessary inputs and advice. Practical Action followed up by helping the collectors to grind their products and make them into dipping bags and linked them to the Rural Enterprise Network (REN) that enabled them to market their products more profitably. The benefits that the producers were getting were quite visible to the Consultants who visited this project. It has helped the collectors to improve their houses, buy TVs and motor cycles and install solar panels for house lighting.

The cost of the solar dryers was an issue with this project. Loans had been provided by Practical Action to purchase the solar driers which had been given initially at a subsidised price. There was no evidence that these loans are being repaid. No additional dryers had been purchased by the farmers subsequently. No economic feasibility study had been done to find out how profitable they would be if producers had to purchase them commercially. Practical Action had undertaken an economic analysis to assess the economic viability of these dryers but the Consultants did not succeed in getting the findings of this analysis.[89] While it is quite clear that this sub-project has been successful, there is little evidence of any procedure to replicate this in other areas and among other groups of producers.

A Consultant visited some spice farmers in Matale and Kandy districts to find out the impact of the solar dryer technology for spice drying that had been introduced by Dr. Kapila Weeratunga Arachchi. He came to the conclusion that it has had very little impact due to several reasons. Although the drier was technologically sound, as the harvesting season in this area coincided with the rainy season, there was insufficient solar energy to dry the spices to the required standard. Also the smallholders had little need for these dryers as they sell their crop to traders even before harvesting and the traders take the spices to the Dry Zone for drying. The solar dryers provided initially were affordable to the larger farmers as 50 – 60% of the cost had been covered by grants from the Matale REAP[90] but since then no farmer had purchased a dryer. This was because the difference in price for spices dried in the solar dryers did not justify the investment required. The Department of Export Agriculture in Matale was also not promoting this technology; instead it was promoting cement floors for open drying for small producers and biomass dryers for larger producers. (Details in Annex 12)

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88 Osu Thuru Nipadawannange saha Reskarannange Samitiya, (Medicinal Herbs Producers and Collectors Society)

89 There has been no response to requests to send the findings to the Consultant.

90 Rural Economic Advancement Project

Sewalanka Foundation implemented a pilot project to adapt to Sri Lanka the barter system that had been successfully piloted in Nepal to provide SHSs to poor households. According to the reports submitted by Sewalanka Foundation, it taught the HHs to make paper from locally available raw materials which it marketed. With the income from the sale of paper and the Rs.800 they saved monthly on kerosene, the people paid for the SHSs. As at 30/03/2008, 53 beneficiaries had repaid 40% of the SHS obligation through the barter scheme. Under this arrangement Sewalanka Foundation has installed SHSs in 100 HHs as planned. This sub-project was progressing satisfactorily.

5.6 Technical Capacity

Developing the capacity of stakeholders to continue the activities that the Project had set in motion is also an important objective of the Project. Its objective as stated in the PAD is "*Introduce and promote renewable energy technologies that are commercially established in other countries but not yet commercial in Sri Lanka and integrate new stakeholders into the project. …. Technology introduction, promotion, and capacity building will be undertaken primarily in the context of the relevant components.*"

A detailed evaluation of Project activities to strengthen technical capacity is beyond the scope of this assignment. What are presented here are those aspects that the Consultants considered were relevant to the Project impact on beneficiaries.

The Project has taken steps to strengthen the capacity of NERD to undertake technical support for renewable energy sector and due recognition of its capacity. It received ISO 17025 certification under IECQ/PVGAP for its Solar PV laboratory. RERED Project met 80% of the cost of this Accreditation and Certification. RERED Project supported NERD to develop facilities to test turbines and induction generator controllers (IGCs). It is now mandatory for all manufactures and Developers to test turbines and IGCs before they are installed in off-grid community-based hydro sub-projects. RERED Project bears the cost of testing.

The Project supported the development of capacity in the country to test the energy efficiency of household refrigerators. This was to be achieved by installing a household refrigerator testing chamber; initially at CEB but later it was decided to install it at NERD. This has been delayed until a mandatory labelling scheme is in place in the country. NERD staff has also benefited from programmes carried out by the Project to strengthen their capacity. In its turn NERD has carried out several training programmes for Developers and manufacturers of machinery to strengthen their capacity to improve the quality of their work and products, under RERED capacity building programmes.

An area that has needed capacity building has been the village institutions set up to build, operate and maintain off-grid community-based hydro sub-projects. Initially the Developers were required to mobilise, organise and train VECSs. As stated in the PAD, "*The Project has been designed with a significant social mobilization component that insures that the initiative for developing and implementing community off-grid renewable energy projects comes from the village.*"[91] However, except for a few sub-projects implemented by NGOs that had experience in community-based development, most of the Developers lacked expertise required for social mobilization. This issue has not yet been resolved.

Developers were expected to train VECSs in organisational management and development, i.e., to conduct meetings, keep minutes and other records, account keeping, practice transparency in financial transactions, operate and maintain the sub-project. Many

[91] The statement from *PAD* on the role of social mobilisation**,** p.24

Developers did not do this adequately as they also lacked knowledge in organisational development and management. This was a serious shortcoming of Developers that many VECSs faced. Also when office-bearers changed or the operator left the village, the new office-bearers and operators lacked the required knowledge. To overcome this, FECS was contracted to conduct 10 training courses in 2004 to strengthen the management capacity of 300 VECSs office-bearers and other members. In fact it trained 314 representatives from 120 VECSs. It was contracted again in 2006 to conduct 10 more training courses to strengthen the capacity of office-bearers and members from VECSs that had not received training earlier. This had been reduced to only 8 training courses and FECS trained 265 office-bearers and members from 65 VECSs through them.

The data that the Consultants collected through a postal survey from a sample of VECSs that had attended the FECS training courses showed that these VECSs considered the training provided was relevant and useful and 89% of them said it was very useful. Most VECSs had gained knowledge on managing their VECSs, maintaining their accounts properly and carrying out O&M of their power houses. These figures can be considered only as indicative as the sample size was small.[92]

Several VECSs complained that they experienced difficulties because many Developers/machinery suppliers did not respond to requests to repair their machinery/equipment and there were no skilled persons locally to do that. To overcome this problem the AU supported NERD to develop a course to train technicians in town centres close to off-grid community-based hydro sub-projects to repair village hydros. Technicians who successfully complete this course will be registered as RERED VH Technicians to undertake such repairs. The Project is planning to do this.

Support is available at Project cost for technical training and capacity building in all aspects relevant to the Project components. Although this is announced regularly at Quarterly Stakeholders Meetings, so far insufficient use has been made of this facility by stakeholders. The Consultants have not monitored or evaluated other aspects of technical training as it was beyond the scope of their assignment.

[92] 48 VECSs had attended the training by that time. Survey questionnaires were posted to 18 of these and 9 responded.

6 CONCLUSIONS

M&E carried out by the Team shows that the RERED Project has been successful in achieving its overall objectives which were stated as follows in the PAD:

(i) Improve the quality of rural life by utilizing off-grid renewable energy technologies to bring electricity to remote communities and
(ii) Promote private sector power generation from renewable energy resources for the main grid.

The availability of electricity from SHSs and off-grid community based hydro sub-projects has improved the quality of life of nearly half a million people living in rural areas in several ways (see Chapter IV for details). They have summed up the impact on them as "a reawakening of their lives". Apart from the improvement in the quality of life, the Project has also created a favourable investment environment to harness renewable energy resources. A substantial investment has been made by individual HHs in SHSs and off-grid community-based hydro sub-projects and by equipment suppliers to meet the demand for 98,738 SHSs and 118 off-grid community-based hydro sub-projects. In addition to this investment in off-grid power generation, a very large amount of investment has been made by companies in 41 grid-connected hydro sub-projects. Investment has also been made in strengthening the capacity of 15 ESCOs.

Apart from the private investment enabled by the Project directly, private sector investment has also been forthcoming for wind and biomass powered projects without support from the Project.[93] The initiatives taken by the Project have encouraged these activities that will continue after the end of the Project. This is important as the Project aimed at promoting private sector investment in renewable energy.

6.1 Target Achievement

6.1.1 Quantitative Achievements

The extent to which the Project has achieved the targets of its main components, as summarized in Table 6.1, is commendable. It has exceeded the targets set for the installed capacity of grid-connected power plants and HHs to be electrified from off-grid power generation. Because of delays in obtaining various approvals from Government agencies, the commissioning of grid-connected power plants and off-grid community-based hydro sub-projects was somewhat delayed and only 84% of the approved grid-connected power plants and 78% of the approved off-grid community-based hydro sub-projects were completed as at 30/06/2008..The target for these components could have been exceeded by a higher margin if these procedures were streamlined to obtain approvals faster. The target for the number of enterprises to be powered by off-grid electricity was not achieved. Although the target for the reduction in carbon emissions was not achieved, it had achieved 96% of the target.

[93] See Annex 5 for information on these.

***Table 6.1*: Project Achievements**

Components and Sub-Components	Achievement as % of Target
Grid-Connected Power Generation	109.4
Off-grid Community-based Power Generation	103.2
Energy efficiency and DSM strategies	375.0
Public service institutions and rural industrial, commercial enterprises served by renewable energy systems.	82.6
Global environment benefits.	95.6

Although one grid-connected biomass plant, one off-grid community-based biomass plant and one off-grid community-based wind sub-project were approved under the RERED Project only one off-grid community-based wind sub-project was reported by AU as at 30/06/2008. However, the interest created by the Project has led to the establishment of a few biomass power projects without Project support.[94]

6.1.2 Qualitative Achievements

Considering the benefits that electricity has already brought about, it is possible to envisage that electricity will bring far reaching benefits to these communities if there is a reliable supply. This will depend on how well the systems installed perform in the longer term, regardless of whether they are off-grid community-based hydro sub-projects or SHSs. This makes it necessary to ensure that they perform well.

The most common complaints by HHs receiving electricity from off-grid community-based hydro sub-projects were that the lights were dim and there were frequent breakdowns in the power supply. As discussed in Section 3.7, several reasons could cause this situation. The installed capacity being less than the planned capacity in nearly half (42%) of these sub-projects could have contributed to this together with shortcomings in O&M, the use of electrical appliances at night by consumers and the weakness of VECSs in enforcing restrictions on such use and quality of machinery and equipment. HHs with SHSs also complain about the poor quality of lighting but this is not a serious problem as the SHSs are under the control of individual HHs. Over use and lack of proper maintenance of the SHSs are important causes. They also complain about the poor after-sales service by suppliers of SHSs.

6.2 Project Impacts

Communities where these plants are located cannot receive electricity from them. However, these communities have benefited from employment generated by the construction of these plants and their maintenance after they were commissioned. They also benefited from improvements that most Developers made to infrastructure in the villages and sometimes to individual HHs. SHSs and off-grid community-based hydro sub-projects benefited people directly through electricity generated by them.

6.2.1 Impact on Quality of Life

The impact on the lives of beneficiaries of SHSs and off-grid community-based hydro sub-projects has been significantly beneficial. Domestic lighting was the main benefit

[94] This is discussed in Sections 2.1 and 2.2; see Annex 5 for details

for all the 103,225 HHs that received electricity from these sources. This improved the quality of lighting and, more importantly, reduced the amount of smoke inhalation from kerosene burnt for lighting. This would reduce respiratory illnesses and improve the health of the beneficiaries as expected in the PAD. Unfortunately, due to frequent breakdowns and the lights being dim it has become necessary for HHs in some VECS areas to use kerosene lamps as a standby or supplementary lighting. Better lighting has enabled children to study longer and the women to attend to their housework more conveniently. Availability of electricity also eliminated to a large extent the blackening of walls caused by kerosene smoke and encouraged people to improve their housing.

Although many of these HHs watched black and white TV and listened to radio/cassette players powered by batteries even before electricity was received, more HHs were able to do that more conveniently after receiving electricity as they did not have to take their batteries for recharging. In HHs that received electricity from off-grid community-based hydro sub-projects, they could now watch even colour TVs. TV provided them with access to information and entertainment and encouraged the men in these HHs to spend more time with their families in the evening instead of going out with their friends to drink alcohol and gamble. This improved family life.

In the communities receiving electricity from off-grid community-based hydro sub-projects, 68% of the people felt safer now. There is also a stronger sense of unity within the community as they worked together to construct the sub-projects. Some of the VECSs have used this feeling of unity to undertake other development work in their villages.

6.2.2 Economic Benefits[95]

Over 75% of the beneficiaries are farmers who do not have a way of using electricity to increase their incomes in their occupation and there is little opportunity to start enterprises. It is possible to compute the value of the longer hours they are able to work as a result of having electric lighting at home but this is more of a nominal income rather than extra money in their hands because of the lack of opportunities to use this time productively. It has been computed as Rs.2,500 per month per HH for those receiving electricity from off-grid community-based hydro sub-projects. If opportunities were available, this could have generated an additional income of Rs.140.8 million for all the HHs over the duration of the Project. The HHs receiving electricity from SHSs did not get this benefit as they indicated that electricity did not make it possible for them to work longer hours.

The real income accrued was the saving HHs made due to using less kerosene for lighting after receiving electricity. This has been estimated at Rs.250 per month for HHs receiving electricity from off-grid community-based hydro sub-projects and Rs.506 per month for HHs with SHSs. HHs receiving electricity from either of these sources also saved what they had spent on charging batteries that they used to watch TV before electricity was received. These savings were not available immediately for spending as they had to repay the loans they obtained either to construct the off-grid community-based hydro sub-projects, wiring of the HH or to install the SHS.

At appraisal, the Project expected that the availability of electricity would encourage the establishment of enterprises in the villages, generating more employment and income. Considering that there were only 736 enterprises among the 103,225 HHs that received electricity from off-grid systems and that many of them had existed even before electricity was received, their impact on rural economic development was minimal. These enterprises

[95] These conclusions are based on Sections 4.5.3 and 4.7

employed mainly family members and except having the opportunity to work longer hours they did not generate much additional employment.

However, a significant amount of employment was generated by the construction and maintenance of grid-connected and off-grid community-based hydro sub-projects and the installation of SHSs. The value of employment generated by the 41 grid-connected hydro sub-projects in operation as at 30/06/2008 has been estimated at between Rs.44 – 61 million providing an income of Rs.1.1 – 1.5 million per community where these sub-projects were constructed. They also employed 3 – 4 persons regularly for maintenance which is generating Rs.1.1 – 1.5 million monthly to these communities. The communities contributed much labour for the construction of the 118 off-grid community-based hydro sub-projects in operation as at 30/06/2008 but it was beyond the scope of our work to estimate its value. The installation of 98,738 SHSs has generated employment valued at Rs.222 million in direct and indirect employment. They also generate employment for maintenance but this is small and it has not been possible to estimate it due to lack of data. Although about 10% of SHSs were removed due to loan repayment default and other reasons, the resulting employment generation is not quantifiable due to lack of data. On the assumption that the labour required to remove a SHS is two-thirds of what is required to install it, the value of employment on account of SHSs removed would be Rs.14.8 million.

The total value of employment generated by constructing the 41 grid-connected hydro sub-projects and installing 98,783 SHSs and removing 10% (9,784) of them was Rs.281 – 297 million depending on the number of persons employed in constructing grid-connected hydro sub-projects. In addition to this, each grid-connected hydro sub-project employed 3 – 4 persons regularly for maintenance generating a total monthly income of Rs.1.1 – 1.5 million for the 41 sub-projects in operation.

6.2.3 Use of Electricity

The HHs that received electricity from off-grid community-based hydro sub-projects were also able to use electrical appliances. Apart from TVs, electric irons were the most widespread (77% of HHs used them) as parents wanted to iron the school uniforms of their children. They had ironed them with charcoal heated irons before electricity was received. Electric fans were also used but much less widespread (15%) of HHs) probably because the climate in those areas made them unnecessary. Very few (less than 10 % of HHs) used refrigerators, rice cookers and water pumps.

At appraisal, the Project aimed at providing electricity to 1,000 rural small and medium enterprises and public institutions through off-grid systems but succeeded only to reach 826 (83% achievement). Of these 665 were powered by SHSs. 55% of the enterprises using electricity from off-grid community-based hydro sub-projects and 70% using electricity from SHSs were small grocery shops. They used electricity for lighting except in a very few shops powered by off-grid community-based hydro sub-projects it was also used for refrigerators. Only a few carpentry sheds, grinding mills, saloons, computer centres and HHs undertaking tailoring used it to power machinery and equipment and many of these experienced difficulties with the power supply and some of them had closed down as a result.

They reported an increase in income due mainly to saving the cost of using kerosene and some improvement in productivity.

6.2.4 Village Improvements

The main benefit that the communities where grid-connected hydro sub-projects were located received was that Developers improved infrastructure in those villages and

provided some employment that benefited the communities. Road improvements made access to the villages easier and enabled people to get better prices for their produce such as tea green leaf. These communities appreciated the improvements made by Developers and maintained good relations with them.

6.2.5 Innovation Solicitation

Very few of the economic activities started under this sub-component of the RERED Project have been successful. Of the three promoters who started 48 economic activities in 27 villages, two had no prior experience in starting micro-enterprises. Considering the amount of time and effort needed to establish a successful micro-enterprise in a remote village, it is doubtful whether any one of them had the capacity to properly support the 34 economic activities it helped to start in 20 villages.

Several of these economic activities experienced difficulties due mainly to problems connected with the supply of electricity from the off-grid community-based hydro sub-projects leading to the failure of some of them. These enterprises could only be justified on the basis of providing some supplementary income as the income from them was limited by the small market demand in these villages.

The technological innovation introduced by two promoters under this sub-component to add value to what people already produced had variable success. One of them to add value to medicinal herbs that farmers collected during the cultivation off-season by drying them in solar dryers had benefited the farmers significantly. It had been well thought out and implemented effectively and in a manner that made it sustainable. The experience that the promoter had in social mobilisation was an important factor to its success. The outcome of the other sub-project to add value to spices by drying them in solar dryers was less successful due mainly to a lack of understanding of local conditions and weaknesses in social mobilisation.

A sub-project to enable low income HHs to obtain SHSs on a barter arrangement was quite successful according to the promoter who implemented it. The people who obtained SHSs were taught to make paper using local raw materials which the promoter helped them to market. All the 100 HHs had obtained SHSs on barter as planned and they have repaid 40% of their loans.

6.2.6 Capacity Building

Important capacities have been developed in Sri Lanka in the past few years for the sustainable growth of the renewable energy sector. Discussion with SEA confirmed that the RERED Project contributed significantly to this through technical support and finance to underwrite risky initiatives.

Among the capacities the Project has helped to build up, the following can be highlighted:

- Manufacturing and testing of machinery and equipment for off-grid community-based hydro sub-projects.
- Testing of SHS components.
- Knowledge and skills of Developers of grid-connected hydro and off-grid community-based hydro sub-projects.
- Knowledge and skills of VECSs.
- Skills and procedures for design and installation verification.
- Procedures and skills to monitor Government grants to install SHSs.
- Technical skills of village hydro equipment suppliers

- Knowledge and skills of SHS technicians
- Establishment of technology based industry associations (grid connected and off grid); these are listed below.

The staff of PCIs has gained experience in handling applications to finance renewable energy and energy efficiency projects

VECSs had been complaining about the lack of technical skills at the local level to repair village hydros. Because of this they had no way of getting their machinery/ equipment repaired when the equipment suppliers and Developers did not attend to their requests. This shortcoming is being overcome now with a programme to train local level technicians (see Section 5.6).

Projects undertaken with RERED support have demonstrated the technical and economic feasibility of grid-connected hydro sub-projects and ESCOs. Companies supplying SHSs have developed their infrastructure and capacity to install and service SHSs throughout the country. Banks and MFIs have developed their capacity to appraise applications for loans to construct grid-connected and off-grid community-based hydro sub-projects and install SHSs. They have also developed their capacity to appraise applications for loans to improve energy efficiency. SEA is putting in place a variety of financing mechanisms to finance energy efficiency improvement projects [96]

Several associations of stakeholders have been formed to promote the interests of this sector. Among them are:

- Solar Industries Association
- Micro Hydro Developer's Association, Sri Lanka
- Grid-Connected Small Power Developers
- Federation of Electricity Consumer Societies
- Bio Energy Association

Quarterly meetings of stakeholders held by RERED Project AU have brought together various stakeholders including those listed above, PCIs, NERD, relevant Government Ministries and agencies and Consultants to build up consensus on issues relating to this sector and ensure its sustainable growth.

At the village level, the Project has taken steps to train VECS office-bearers by making it a requirement for Developers of off-grid community-based hydro sub-projects. FECS has undertaken follow up training courses. Most Developers of off-grid community-based hydro sub-projects were competent in the technical aspects of village hydro projects but did not have the necessary skills to fulfil their responsibility in social mobilisation and organisational development.[97] Also, although technical aspects of these sub-projects were verified by the Project it had no procedure to verify the performance of Developers in social mobilisation and organisational development. As the office-bearers change from time to time, knowledge and skills that had been developed through training had not been passed on. There was also no procedure to evaluate the effectiveness of capacity building conducted by various organisations. In spite of the training received by the VECSs, they have many shortcomings that affect the performance of off-grid community-based hydro sub-projects negatively

[96] From the unpublished strategy plan of the SLSEA
[97] See Section 3.5.1 for more details.

6.3 Institutional Arrangements

With the exception of some arrangements for off-grid community-based hydro sub-projects, institutional arrangements for the implementation of RERED Project have worked very well.

Both the grid-connected and off-grid community-based hydro sub-projects have been adversely affected by delays in obtaining approvals from various Government agencies. Some of these delays have been due to a lack of understanding by officials dealing with the required approvals. At the national level the Government is committed to developing the renewable energy sector and has translated this commitment by converting the ECF to the SEA with greater responsibility and authority. SEA is expected to act as a one stop shop to coordinate with other state agencies and grant one-step approval for renewable energy projects but this has not seeped through to the levels at which approval is sought and given to various sub-projects in this sector. The fragmentation of governance at that level aggravates the problem and leads to malpractices.

The members in some VECSs were disgruntled as the supply of electricity was unsatisfactory. Less than satisfactory performance of some of the Developers and VECSs has been a stumbling block for the efficient functioning of off-grid community-based hydro sub-projects. This has been compounded by shortcomings of VECSs. Some members complained that these hydro sub-projects are being run by a few powerful individuals in the village who took leadership in constructing them as if they were their private property. There was no transparency in financial matters in several VECSs and many VECSs did not maintain proper records.

Some of the VECSs do not have regular meetings and the members are not aware of their financial transactions. Although the Project expected off-grid community-based hydro sub-projects to be participatory[98], most Developers did not have social mobilisation skills to implement such a process. Several Developers with no proven track record in social mobilisation undertook off-grid community-based hydro sub-projects in the early period of Project implementation but since then the Project has taken remedial action by removing inactive and unsuccessful Developers and by registering others.

More than half the VECSs expressed strong dissatisfaction with the work done by Developers and felt that they had installed poor quality machinery and equipment. The system of verifying the work done by Developers that prevailed did not seem to have detected the shortcomings in machinery and equipment installed in some hydro sub-projects. AU has now made it mandatory for manufacturers and Developers to test machinery and equipment before installing them in any off-grid community-based hydro sub-project and has provided NERD with the necessary capacity to test turbines and ICGs. AU also bears the cost of such testing. However, this does not solve the problem of off-grid community-based hydro sub-projects where the turbines and ICGs already installed are below standard and some of these VECSs do not have sufficient funds to replace them when they breakdown.

After they hand over the sub-projects to VECSs and collect their payment Developers do not help the VECSs to overcome their problems. Where the Developers did their work well and the off-grid community-based hydro sub-projects handed over to the VECSs were in good order, the VECSs had far fewer problems in maintaining them and delivering a good service to their members. These VECSs have become financially viable and built up reserves for any future eventuality. Some of them have started to replace wooden poles in their distribution network with concrete poles.

[98] PAD, Section 6.2, pp.22-23

The problems experienced by VECSs raise the question of whether the present institutional model selected for off-grid community-based hydro sub-projects is suitable. The experience in Sri Lanka as well as in other countries shows that it is quite difficult to develop rural institutions in which people can participate actively and effectively. It requires experienced, skilful and committed social mobilisers and could take 2 year or more. This raises the question whether the model chosen by RERED to implement off-grid community-based hydro sub-projects is appropriate. This model has been adopted because current legislation governing distribution and sale of electricity precludes a more profit-oriented private sector model. However, if the considerable small scale hydro resources available in the country are to be harnessed to provide electricity to remote villages beyond the economic reach of the national grid, it is necessary to search for a more efficient and workable model.

7 LESSONS LEARNT

Implementation of the RERED Project has been a learning experience in many ways for the stakeholders. In this Chapter we will present the lessons that can be learnt that could improve the performance of the on-going Project as well as in planning and implementing Projects of this nature.

7.1 M&E Methodology

1. M&E for Projects like RERED with numerous stakeholders, large geographical coverage and long implementation period need to be resourced more adequately.
2. It is desirable to supplement the present staff of AU with an officer whose tasks could include (i) the maintaining and updating of the RERED Project MIS, (ii) liaise with multiple stakeholders, (iii) follow up on recommendations highlighted in M&E Reports, and (iv) function as an “ombudsman” to address complaints received from the beneficiaries.
3. It is beneficial to retain the same team of interviewers to be fielded during successive rounds of M&E surveys.
4. Unless action is taken to solve the problems respondents highlight when they provide data/information to M&E Team their trust in M&E activities will decline and, sometimes, they might refuse to cooperate with M&E interviews.
5. As monitoring can be done effectively only if there is a time frame to achieve the Project targets, they should be broken down into annual or even bi-annual targets that could be monitored meaningfully.
6. In Projects of this nature, it is sufficient to conduct impact monitoring bi-annually or even annually.
7. There should be provision to undertake special studies to understand the causes and find solutions for important issues surfaced by M&E.

7.2 Grid-Connected Hydro Sub-Projects

1. Construction delays due to approval procedures cause losses to Developers and national economy by delaying power generation.
2. Absorption capacity of CEB sub-stations needs to be increased to absorb power generated by grid-connected hydro sub-projects.
3. The sites for grid-connected hydro sub-projects that Developers select initially are ones with a larger head where cost/kW is lower. As these get developed the sites available would have a lower head where the cost/kW is higher and profitability is less. To encourage Developers to invest in them, it is necessary to find ways to increase their profitability.
4. Developers should help improve village infrastructure in areas where they construct sub-projects to improve relations with the communities.

7.3 Off-Grid Community-Based Hydro Sub-Projects

1. Construction delays due to approval procedures cause losses and disappointment to the community by delaying power generation.
2. Although off-grid community-based hydro sub-projects formed a small part of the RERED Project in terms of the allocation of funds, their impact on the communities has been very beneficial and the communities appreciate these benefits very highly.

3. The skills, expertise, experience, track record and commitment of Developers and the quality of work performed by them are critical for the functioning and sustainability of off-grid community-based hydro sub-projects.
4. The development of social capital (e.g., ability to organise themselves, development of skills to manage their organisation and operate and maintain their hydro sub-projects) was an important respomsibility of Developers who implemented off-grid community-based hydro sub-projects. The failure by some Developers to achieve this has resulted in weak VECSs that affected these sub-projects very adversely.
5. Excessive load, low quality of machinery and weaknesses of VECSs have caused power supply to be unsatisfactory and unreliable.

7.4 SHSs

1. Some HHs had expected more benefits from SHSs such as to watch TV and have lights for a longer time and to use some electrical appliances. This expectation could be due to not receiving proper information about the benefits and limitations of SHSs. When they did not receive these benefits they became disappointed. This was made worse by the malfunctioning of SHSs due to improper use and unsatisfactory maintenance.
2. SHS suppliers have not been able to provide timely after sales service due partly to the shortage of field staff. [99]
3. HHs have defaulted on their SHS loan repayments due to promises by politicians to provide grid electricity to areas not scheduled for electrification as a ploy to get votes during elections.
4. A survey that the Consultants conducted in March 2005 indicated that 88% of HHs had SHS installed before their loan applications were approved. This also contributed to the removal of SHSs as these had been installed before the PCI had appraised the loan applications of the HHs to ascertain their credit worthiness

7.5 Institutional Arrangemen

1. Delays are caused in the construction of grid-connected hydro sub-projects due to delays in obtaining the necessary approvals from relevant Government agencies and local authorities, CEB Grid Interconnection and acquisition of land. An effective mechanism is needed to support Developers to overcome such construction delays.
2. Similar delays are caused in the construction of off-grid community-based hydro sub-projects by delays in obtaining the necessary approvals from relevant Government agencies and local authorities, grants from Provincial Councils, loans from PCIs, machinery and community contributions in some sub-projects..An effective mechanism is needed to support Developers to overcome such construction delays.
3. The manner in which VECSs have been set up has led to many weaknesses in them that have affected the functioning of off-grid community-based hydro sub-projects adversely. It also raises the question whether it is the suitable model for off-grid community-based hydro sub-projects.
4. Alternative funding support is necessary after the end of the RERED Project to enable stakeholders to take initiatives that involve risks.
5. Formation of industry associations brought together stakeholders with common interests to promote their industries.
6. VHWG and Stakeholders meetings showed the importance of interaction among stakeholders to develop the renewable energy sector.

[99] Information gathered by Consultants at AU Stakeholders Meetings.

7.6 Capacity Building

1. Capacity building of different stakeholders has played an important role in the success of the Project.
2. Capacity building is not a one-off event but requires continuous effort because trained personnel move on or lessons learnt in the training are forgotten after some time.
3. Benefits of training cannot be assumed; its effectiveness must be evaluated.
4. It is necessary to identify an agency to play the role that the RERED AU has played in organising capacity building after the Project.

7.7 Energy Efficiency & DSM

1. Although more than the expected number of ESCOs has been established their impact has been limited by the lack of awareness among decision-makers in the private and public sectors of the benefit of improving energy efficiency.
2. Availability of funds is a factor limiting the undertaking of actions necessary to improve energy efficiency partly due to insufficient expertise in banks to appraise loan applications for it. PCIs can overcome their lack of expertise by requesting RERED funds to hire a Consultant to do the technical evaluation

7.8 Innovation Solicitation

1. The lack of success of this component to promote rural economic development is largely due to underestimating the difficulties micro-enterprises face in remote villages.
2. Selection of promoters without experience in establishing micro-enterprises also contributed to their lack of success.

7.9 Best Practices

The following are best practices that would facilitate the successful implementation of projects like RERED. These have been derived from M&E of the RERED Project and literature on successful project implementation.

(i) Creating a favourable environment for public/private business partnerships
(ii) Providing assistance for capacity building
(iii) Providing adequate training in O&M and management
(iv) Arranging easy access to Project financing
(v) Agreement between VECS and members
(vi) Agreement between VECS and supplier
(vii) Strict adherence to specifications/design verification/installation verification
(viii) Strengthening facilities at NERD Centre for quality control
(ix) Providing subsidies on firm output criteria
(x) Ensuring reliable after sales service
(xi) Facilitating formation of stakeholder associations.
(xii) Ensuring that beneficiaries receive correct information
(xiii) Learning from the experience of promoting renewable energy in other countries
(xiv) It is desirable to outsource specialised activities to experts in those fields; this does not apply to project accounting and processing of disbursements

8 RECOMMENDATIONS

8.1 Construction Delays (Grid-Connected Hydro & Off-Grid Community-Based Hydro Sub-Projects)

1. Streamline approval procedures in consultation with concerned agencies.
2. Require Developers to submit an implementation plan with a time frame that the Project Monitoring Unit could use to monitor progress and help overcome problems that delay implementation
3. Provide VECSs a part of the co-financing grant during sub-project construction to overcome funding problems and expedite construction.
4. Negotiate with SEA to take responsibility to help Developers obtain necessary approvals/support from Government agencies and other stakeholders in order that Project activities could be implemented expeditiously;

8.2 Expand Opportunity (Grid-Connected Hydro & Off-Grid Community-Based Hydro Sub-Projects)

1. Seek support for CEB to expand the absorption capacity of sub-stations in areas where there is a good potential for grid-connected hydro development.
2. In consultation with Developers propose investment incentives to develop grid-connected hydro sub-projects.
3. Considering the benefits they bring to village communities, off-grid community-based hydro sub-projects should receive a higher priority than what they receive now from the Government.
4. The decision of the GOSL to extend the grant of Rs.10,000 per family to all forms of renewable energy-which has been temporarily suspended should be implemented.
5. To encourage Developers to prepare proposals to establish off-grid community-based hydro sub-projects after RERED, some arrangement for funding them must be put in place since the village communities cannot absorb this cost.
6. Encourage Developers to undertake infrastructure improvements to generate goodwill in the communities where they construct grid-connected hydro sub-projects. Regulations should be amended to enable Developers to provide electricity to the communities where grid-connected hydro sub-projects are located.
7. A Government agency should mobilise resources to support stakeholders to take new initiatives in developing renewable sources of energy. SEA is already performing this role.

8.3 Improving Performance

a. Off-Grid Community-Based Hydro Sub-Projects

1. Have a system in place to grade Developers on the basis of their skills and track record and exert monitoring according to their grade.
2. Unbundle technical and social aspects of establishing off-grid community-based hydro sub-projects and contract Developers with the required experience and skills to undertake them.
3. Enforce stricter conformity with design standards to minimise installed capacity being less than planned capacity.
5. Larger size conductors could be used to overcome the drop in voltage due to long distribution lines but this option is far too expensive for these communities unless they receive additional financial support.. A practical method of improving the voltage level is to gradually change over from filament type of lamps to CFLs.

6. Evaluate the performance of VECSs from time to time using criteria suggested in Section 3.6 and take remedial action to improve their performance. An agency such as SEA could be responsible for this.
7. Train technicians at regional level to attend to electrical and mechanical repairs of a cluster of VECSs.
8. Involve the DS office from the beginning of VECS activities to ensure sustainability.

b. SHSs

1. Strengthen monitoring of after sales services by solar suppliers.
2. Give HHs proper information on cost and benefits of SHS and ensure that they are not misled by solar suppliers or PCIs.

8.4 Capacity Building

1. An agency such as SEA should formulate a long-term plan in consultation with relevant stakeholders to undertake capacity building on continuing basis.
2. Mobilise resources to support stakeholders who need capacity building at least partially to strengthen their capacities. While RERED-AU has been repeatedly informing stakeholders to make use of the funds available under RERED, sufficient use has not been made of it.
3. Formulate procedures to evaluate the effectiveness of capacity building provided / received by various stakeholders.

8.5 Energy Efficiency

1. An agency such as SEA should develop a long-term plan and strategy in consultation with the relevant stakeholders to create awareness among decision-makers in the private and public sectors of the benefits to be gained from improving energy efficiency.
2. Formulate incentives to encourage private and public sector organisations to adopt measures to improve energy efficiency.
3. Strengthen capacity of PCIs to appraise energy efficiency proposals and provide loans; loan guarantees provided by SEA are a step in the right direction.
4. Strengthen capacity of ESCOs to undertake energy efficiency improvements by studying their needs and providing required facilities.
5. Encourage installing CFL/LEDs for lighting to reduce overloading of off-grid community-based hydro sub-projects.

8.6 Innovation Solicitation

1. Formulate criteria to appraise promoters who propose sub-projects under the Innovation Solicitation component.
2. Formulate procedures for independent on-going M&E of activities undertaken by promoters.

8.7 Institutional Arrangements

1. A more efficient institutional model needs to be found to replace the VECSs that have several weaknesses affecting off-grid community-based hydro sub-projects. This must be done after undertaking a special study

8.8 Monitoring & Evaluation

1. If M&E is outsourced the least cost bid might not be the best selection. Sufficient resources should be provided depending on the complexity of the project, geographical coverage and the difficulty of access.
2. Even when M&E is outsourced, there should be internal arrangements to monitor the project and follow up on issues highlighted by the external M&E. It is especially important to identify and remedy shortcomings that delay project implementation and prevent the achievement of project objectives.
3. Undertake special studies in support of (2) above. Some studies that have been identified are:
   - Identify the causes for shortcomings in the power supply in off-grid community-based hydro sub-projects and measures that should be taken to overcome them.
   - Identify a more efficient and effective institutional model to implement, operate and maintain off-grid community-based power sub-projects. If that is not feasible under existing rules governing power generation and distribution, analyse weaknesses in VECSs and what steps should be taken to make their functioning more efficient and effective.
   - Identify ways and means of motivating members of the community to participate more actively in VECSs.
   - Identify ways to enable people in off-grid community-based hydro sub-projects to use the longer working hours made possible by having electricity more productively.
   - Identify ways in which large energy consumers could be motivated to improve their energy efficiency.
   - Identify the obstacles to developing grid-connected and off-grid wind and biomass powered generation of electricity
   - If Innovation Solicitation is to be continued, undertake a study to understand the factors that contribute to the success or failure of micro-enterprises in remote villages.