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IMPLEMENTATION COMPLETION AND RESULTS REPORT
(IDA-36731 IDA-36730 TF-51248)

ON A

CREDIT
IN THE AMOUNT OF SDR 85.6 MILLION
(US$ 115 MILLION EQUIVALENT)

AND A

GLOBAL ENVIRONMENTAL FACILITY GRANT
IN THE AMOUNT OF US$ 8 MILLION

TO THE

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

FOR THE

RENEWABLE ENERGY FOR RURAL ECONOMIC DEVELOPMENT PROJECT

June 20, 2012

Sustainable Development Department
Sri Lanka Country Management Unit
South Asia Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective May 30, 2012)

Currency Unit = Sri Lankan Rupee
LKR 1.00 = US$ 0.01
US$ 1.00 = LKR 132.40

FISCAL YEAR
July 1 – June 30

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AF	Additional Financing
AU	Administrative Unit
AWDR	Average Weighted Deposit Rate
AWFDR	Average Weighted Fixed Deposit Rate
CAR	Consumer Acceptance Receipt
CAPEX	Capital Expenditure
CAS	Country Assistance Strategy
CEA	Central Environmental Authority
CEB	Ceylon Electricity Board
CER	Certified Emissions Reduction
CO_2	Carbon Dioxide
CPS	Country Partnership Strategy
DFCC	Development Finance Corporation of Ceylon
DSM	Demand Side Management
EIRR	Economic Internal Rate of Return
EnPoGen	Energy, Poverty and Gender
ESCO	Energy Services Company
ESD	Energy Services Delivery
FIRR	Financial Internal Rate of Return
FM	Financial Management
GEF	Global Environmental Facility
GEO	Global Environment Objective
GoSL	Government of Sri Lanka
GW	Gigawatt
GWh	Gigawatt-Hour
ICB	International Competitive Bidding
ICR	Implementation Completion and Results Report
IDA	International Development Association
IEG	Independent Evaluation Group
IFC	International Finance Corporation
IPP	Independent Power Producer
ISR	Implementation Status Report
IVR	Installation Verification Report
JICA	Japan International Cooperation Agency
kW	Kilowatt
kWh	Kilowatt-Hour
kWp	Kilowatt-Peak
LKR	Sri Lanka Rupee
LOLC	Lanka Orix Leasing Company
M&E	Monitoring and Evaluation
MFI	Micro Financing Institution
MTR	Mid Term Review
MW	Megawatt
MWh	Megawatt-Hour
MWp	Megawatt-Peak
NCRE	Non-Conventional Renewable Energy
NGO	Non-governmental Organization
O&M	Operations and Maintenance
PADGO	Portfolio Approach to Distributed Generation Opportunities
PCI	Participating Credit Institution
PDO	Project Development Objective
PUCSL	Public Utilities Commission of Sri Lanka
PV	Photovoltaic
QAG	Quality Assurance Group
QEA	Quality At Entry
QAS	Quality At Supervision
RERED	Renewable Energy for Rural Economic Development
SEA	Sustainable Energy Authority
SFC	Specific Fuel Consumption
SHS	Solar Home System
SME	Small and Medium Enterprise
SPPA	Standardized Power Purchase Agreement
SRMC	Short Run Marginal Cost
TA	Technical Assistance
USD	United States Dollar
VECS	Village Electricity Consumer Society
VHP	Village Hydro Project
Wp	Watt-Peak

	Vice President:	Isabel M. Guerrero
	Country Director:	Diarietou Gaye
	Sector Manager:	Jyoti Shukla
	Project Team Leader:	Abdulaziz Faghi
	ICR Team Leader:	Abdulaziz Faghi

Democratic Socialist Republic of Sri Lanka
Renewable Energy for Rural Economic Development

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A. Basic Information			
Country:	Sri Lanka	Project Name:	Renewable Energy for Rural Economic Development
Project ID:	P076702, P077761	L/C/TF Number(s):	IDA-36730,IDA-36731,TF-51248
ICR Date:	06/19/2012	ICR Type:	Core ICR
Lending Instrument:	SIL, SIL	Borrower:	GOVERNMENT OF SRI LANKA
Original Total Commitment:	XDR 59.30M,USD 8.00M	Disbursed Amount:	XDR 85.59M,USD 7.94M
Environmental Category: B		**Focal Area**: C	
Implementing Agencies: DFCC Bank			
Cofinanciers and Other External Partners: None**.**			

B. Key Dates				
Renewable Energy for Rural Economic Development - P076702				
Process	**Date**	**Process**	**Original Date**	**Revised / Actual Date(s)**
Concept Review:	01/22/2002	Effectiveness:	10/07/2002	10/07/2002
Appraisal:	01/22/2002	Restructuring(s):	-	10/18/2010 06/16/2011
Approval:	06/20/2002	Mid-term Review:	-	09/05/2005
		Closing:	06/30/2008	12/31/2011

Renewable Energy for Rural Economic Development - P077761				
Process	**Date**	**Process**	**Original Date**	**Revised / Actual Date(s)**
Concept Review:	01/22/2002	Effectiveness:	10/07/2002	10/07/2002
Appraisal:	01/22/2002	Restructuring(s):	-	10/18/2010 06/16/2011
Approval:	06/20/2002	Mid-term Review:	-	09/05/2005
		Closing:	06/30/2008	12/31/2011

C. Ratings Summary	
C.1 Performance Rating by ICR	
Outcomes	Satisfactory
GEO Outcomes	Satisfactory
Risk to Development Outcome	Low or Negligible
Risk to GEO Outcome	Low or Negligible
Bank Performance	Satisfactory
Borrower Performance	Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)			
Bank	**Ratings**	**Borrower**	**Ratings**
Quality at Entry	Satisfactory	Government:	Satisfactory
Quality of Supervision:	Satisfactory	Implementing Agency/Agencies:	Highly Satisfactory
Overall Bank Performance	Satisfactory	Overall Borrower Performance	Satisfactory

C.3 Quality at Entry and Implementation Performance Indicators			
Renewable Energy for Rural Economic Development - P076702			
Implementation Performance	**Indicators**	**QAG Assessments (if any)**	**Rating:**
Potential Problem Project at any time (Yes/No):	Yes	Quality at Entry (QEA)	None
Problem Project at any time (Yes/No):	No	Quality of Supervision (QSA)	None
DO rating before Closing/Inactive status	Satisfactory		

Renewable Energy for Rural Economic Development - P077761			
Implementation Performance	**Indicators**	**QAG Assessments (if any)**	**Rating:**
Potential Problem Project at any time (Yes/No):	No	Quality at Entry (QEA)	None
Problem Project at any time (Yes/No):	No	Quality of Supervision (QSA)	None
GEO rating before Closing/Inactive Status	Satisfactory		

D. Sector and Theme Codes

Renewable Energy for Rural Economic Development - P076702		
	Original	**Actual**
Sector Code (as % of total Bank financing)		
Energy efficiency in power sector	1	1
Renewable energy	99	99
Theme Code (as % of total Bank financing)		
Climate change	22	22
Infrastructure services for private sector development	23	23
Other financial and private sector development	11	11
Participation and civic engagement	22	22
Rural services and infrastructure	22	22

Renewable Energy for Rural Economic Development - P077761		
	Original	**Actual**
Sector Code (as % of total Bank financing)		
Renewable energy	100	100
Theme Code (as % of total Bank financing)		
Climate change	25	25
Infrastructure services for private sector development	25	25
Participation and civic engagement	25	25
Rural services and infrastructure	25	25

E. Bank Staff

Renewable Energy for Rural Economic Development - P076702		
Positions	**At ICR**	**At Approval**
Vice President:	Isabel M. Guerrero	Mieko Nishimizu
Country Director:	Diarietou Gaye	Mariana Todorova
Sector Manager:	Jyoti Shukla	Penelope J. Brook
Project Team Leader:	Abdulaziz Faghi	Subramaniam V. Iyer
ICR Team Leader:	Abdulaziz Faghi	-
ICR Primary Author:	Enno Heijndermans	-

Renewable Energy for Rural Economic Development - P077761		
Positions	**At ICR**	**At Approval**
Vice President:	Isabel M. Guerrero	Mieko Nishimizu
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ICR Team Leader:	Abdulaziz Faghi	-
ICR Primary Author:	Enno Heijndermans	-

F. Results Framework Analysis

Project Development Objectives (from Project Appraisal Document)
(1) Improve the quality of rural life by utilizing off-grid renewable energy technologies to provide energy services to remote communities.
(2) Promote private sector power generation from renewable energy resources for the main grid.

Revised Project Development Objectives (as approved by original approving authority)
Not Applicable.

Global Environment Objectives (from Project Appraisal Document)
To reduce atmospheric carbon emission by removing barriers and reducing implementation costs for renewable energy and removing barriers to energy efficiency.

Revised Global Environment Objectives (as approved by original approving authority)
Not Applicable.

(a) PDO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Additional 85 MW of small scale renewable grid connected power generation capacity installed. The additional financing would support another 50 MW of grid-connected power generation capacity			
Value (quantitative or Qualitative)	31.00	116.00	166.00	178.8
Date achieved	10/07/2002	10/07/2002	04/30/2008	12/31/2011
Comments (incl. % achievement)	The Original Target is the sum of the baseline value of 31 MW and the target of 85 MW from the original credit. Formally revised target includes another 50 MW added by the Additional Financing. Percent achievement is 107%. A further 36.5 MW of capacity are under construction.			

Indicator 2 :	Increase in income generating activities in communities that gain access to electricity (measured in number of households, small/medium enterprises and public institutions)			
Value (quantitative or Qualitative)	0.00	1,500.00	-	742 (excludes income increase due to improved education and avoided loss of income due to reduced morbidity)[1]
Date achieved	10/07/2002	10/07/2002	-	12/31/2011
Comments (incl. % achievement)	There was no formal numerical target according to the PAD; however, the Bank team attempted to capture this data during implementation by assuming that the 1,500 households, small/medium enterprises and public institutions targeted for electrification from the original IDA Credit (1,000) and the Additional Financing (500), would experience an increase in income generating activities as a result of access to electricity. As this was reported in several implementation status reports, the decision to keep it in the ICR was to maintain consistency in past reporting. Please refer to the footnote which elaborates on the target value.			

(b) GEO Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Reduction in Greenhouse Gas Emissions			
Value (quantitative or Qualitative)	0.00	1.25	-	2.15
Date achieved	10/07/2002	10/07/2002	-	12/31/2011
Comments (incl. % achievement)	Target values measured in million tons of avoided carbon emissions as a result of Project interventions. Percent achievement is 172%			
Indicator 2 :	Promote adoption of renewable energy by removing market barriers and reducing implementation costs			
Value (quantitative or Qualitative)	See PDO Indicators 1 and 2 above	See PDO Indicators 1 and 2 above	-	See PDO Indicators 1 and 2 above
Date achieved	10/07/2002	10/07/2002	-	12/31/2011
Comments (incl. % achievement)	This indicator was linked to PDO Indicators in so much as the achievement of those was due to GEF support to the promote adoption of renewable energy by removing market barriers and reducing implementation costs.			

[1] World Bank studies in Bangladesh and Philippines found statistically highly significant benefits to electrified households vis-à-vis un-electrified households due to higher educational achievements of children in electrified households and in reduced morbidity due to avoided illnesses by switching from kerosene lamps to electric lamps.

(c) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1 :	Electricity access to households, rural small/medium enterprises and public institutions through off-grid systems			
Value (quantitative or Qualitative)	22,685	183,685	136,185	138,480
Date achieved	10/07/2002	10/07/2002	10/18/2010	12/31/2011
Comments (incl. % achievement)	Original target values include the baseline plus values approved in the PAD and additional targets set by the Additional Finance. The formally revised target represents the values agreed at restructuring (113,500) plus the Baseline Value. Percent Achievement is 103%.			

G. Ratings of Project Performance in ISRs

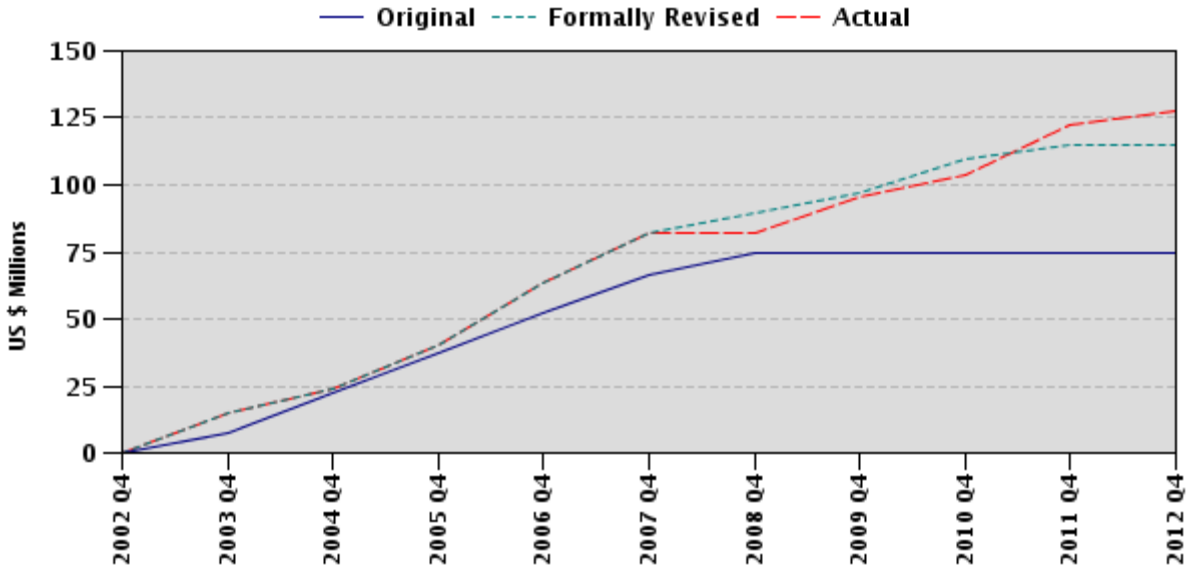
No.	Date ISR Archived	DO	GEO	IP	Actual Disbursements (USD millions)	
					Project 1	Project 2
1	10/23/2002	S	S	S	0.00	0.00
2	05/12/2003	S	S	S	15.00	1.60
3	06/30/2003	S	S	S	15.00	1.60
4	12/29/2003	S	S	S	16.62	2.57
5	06/22/2004	S	S	S	23.55	3.46
6	12/21/2004	S	S	S	30.74	4.38
7	06/14/2005	S	S	S	40.61	5.16
8	12/12/2005	S	S	S	53.25	5.78
9	06/27/2006	S	S	S	63.65	6.16
10	12/22/2006	S	S	S	72.63	6.38
11	06/26/2007	S	S	S	81.81	6.96
12	12/20/2007	S	S	S	82.43	7.15
13	06/19/2008	S	S	S	82.45	7.25
14	12/17/2008	S	S	S	92.02	7.40
15	05/28/2009	S	S	MS	95.22	7.40
16	10/27/2009	S	S	MS	97.81	7.51
17	05/27/2010	S	S	S	103.36	7.72
18	12/01/2010	S	S	S	106.78	7.86
19	06/07/2011	S	S	S	119.38	8.00
20	01/01/2012	S	S	S	127.06	8.00

H. Restructuring (if any)

Restructuring Date(s)	Board Approved		ISR Ratings at Restructuring			Amount Disbursed at Restructuring in USD millions		Reason for Restructuring & Key Changes Made
	PDO Change	GEO Change	DO	GEO	IP	Project1	Project 2	
10/18/2010	N	N	S	S	S	106.78	-	The restructuring was required to revise the end-of-project target for the 'off-grid renewables' component from 161,000 households, small and medium enterprises and public institutions being connected to 113,500 as recommended by the Ministry of Power and Energy. The reduced target is appropriate in light of faster than anticipated grid-based rural electrification which reduces demand for off-grid renewable solutions.
06/16/2011	N	N	S	S	S	122.25	-	The restructuring was required to extend the closing date by 6-months. This was necessary to enable ongoing investments to be completed and ensure satisfactory close-out of the project. The extension is also being considered to make up for the delay in effectiveness of the Additional Financing credit which was beyond the control of the implementing agency.

I. Disbursement Profile

P076702



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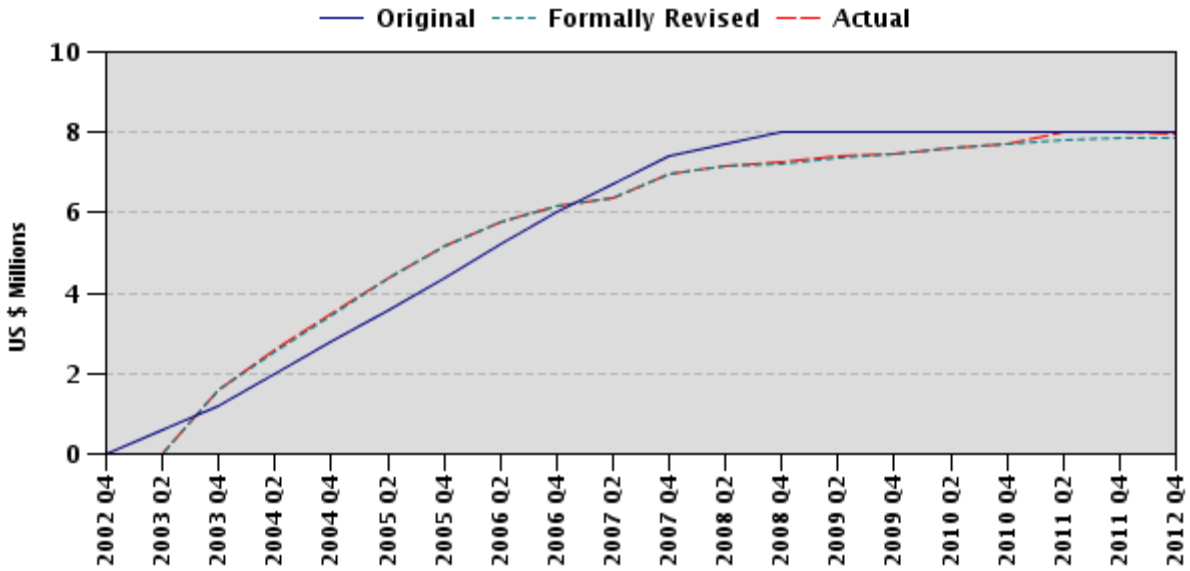

1. Project Context, Development and Global Environment Objectives Design

1.1 Context at Appraisal

At appraisal in 2002, nearly 60 percent of the population of Sri Lanka (about 19 million at that time) had access to electricity; however, the levels of access varied significantly among regions of the country. On one hand, areas such as the Western Province had about 80 percent access to electricity while other Provinces (e.g. Uva) had less than 30 percent. Recognizing the importance of electrification to the expansion of the economy and for the country's overall development agenda, the Government of Sri Lanka (GoSL) set a target to achieve 75 percent electrification island-wide by the year 2007.

The supply of electricity to meet this goal required substantive investment in additional electricity generation capacity. Sri Lanka's largest source of electricity came from hydropower and the task of increasing the supply with limited resources was challenging given that most of the major hydro sites had already been fully developed. The Government would have had to rely purely on conventional thermal power generation as an alternative to hydro in order to serve the unmet demand and achieve its electrification targets. As a result, expansion of the grid through thermal power was the principal vehicle for electrification in the country along with expanding the national grid network.

Meanwhile, the ongoing Energy Services Delivery (ESD) project financed by the World Bank and Global Environment Facility (GEF) had demonstrated that off-grid systems – such as solar home systems (SHS) and community-level independent grids – were a viable option to serve a significant population living in remote rural communities where the grid had not reached. It also demonstrated that mini-hydro and other renewable energy technologies such as wind and biomass had potential to contribute to the energy mix in the grid and could add diversity to electricity generation. As renewable energy technologies use indigenous resources, its use would lead to a reduction in the import of fossil fuels for power generation.

The ESD project had also proven to be a catalyst for engaging the private sector to invest in renewable energy development. As a result of successes achieved under the ESD project, the GoSL sought the Bank's assistance to support a scale-up of its rural 'off-grid' electrification program complemented by a diversification of the energy mix through the development of 'grid-connected' renewable energy investments. Moreover, GoSL was also keen on a continuity of private sector participation in the energy sector and on designing a mechanism, which would enable private developers, commercial banks/financers and entrepreneurs to be key stakeholders in this endeavor. This would improve overall sector development and contribute to a more robust economy. The development of such schemes would have been made possible given the existence of appropriate institutional structures and mechanisms pioneered under ESD.

The request from the Government of Sri Lanka for the development of the Renewable Energy for Rural Economic Development (RERED) project was consistent with the World Bank Country Assistance Strategy (CAS) (May 1996), which included: *promotion of sustainable private-sector led growth; increasing efficiency in delivery of infrastructure, especially in rural areas; preserving the environment; and working closely with communities and non-Governmental*

Organizations (NGOs) to generate development solutions. This was also aligned with the GEF Operational Program 6: *Promoting Renewable Energy by Removing Barriers and Reducing Implementation Costs*. It is also consistent with the subsequent CAS dated July 2008. The latest Country Partnership Strategy (CPS) dated April 2012 came into effect after Project closing; however, in spite of this, the Project remains relevant in the context of this CPS, specifically on Focus Areas 1.A: *Facilitating sustained private and public investment - Improving the investment climate*, and 3.A: *Improving living standards and social inclusion – Increasing quality of services*. Relevant to the first objective, the Project addresses the constraints of access to finance (for renewable energy investments) and electricity rates by moderating the increase of the electricity price through the utilization of indigenous renewable resources of energy. Relevant to Focus Area 3.A, the Project improves rural electricity services which directly improves the quality of life, social inclusion and indirectly enabling the provision or improvement of social services such as health, education and water supply.

1.2 Original Project Development Objectives (PDO) and Key Indicators (as approved)

This project aimed 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 key indicators were:

1. Installation of 135 megawatts (MW) of grid-connected electric power generation capacity from small-scale renewables (original target was 85 MW with an additional 50 MW proposed under RERED Additional Financing).
2. Increase in income generating activities in communities that gain access to electricity.
3. Electricity access to 161,000 households, rural small/medium enterprises (SMEs) and public institutions through off-grid systems (original target was 101,000 with an additional 60,000 proposed under RERED Additional Financing)

1.3 Original Global Environment Objectives (GEO) and Key Indicators (as approved)

The Project's Global Environmental Objective was to reduce atmospheric carbon emissions by removing barriers and reducing implementation costs for renewable energy, and removing barriers to energy efficiency.

The key indicators were:

1. Reduction of atmospheric carbon emissions / Greenhouse Gas Emissions (1.25 million tons of carbon avoided);
2. Promote adoption of renewable energy by removing market barriers and reducing implementation cost.

1.4 Revised PDO (as approved by original approving authority) and Key Indicators, and reasons/justification

A restructuring of the project was approved on October 16, 2010 in order to reduce the target for the off-grid renewables component from 161,000 to 113,500 households, enterprises and institutions. The primary reason was that grid expansion had proceeded more rapidly than

originally expected as the GoSL had made a policy and very significant financial commitment to accelerate grid-based electricity coverage. Therefore, more households, enterprises and institutions were being served by the grid and others anticipating grid electricity to extend to their villages decided not to invest in off-grid electricity sources. This reduced the demand for off-grid schemes.

At Appraisal, the Governments' rural electrification policy envisaged that 20 percent of the population would remain reliant on off-grid electricity supply[2]. At present, the Government expects to achieve 100 percent electrification by end 2012 of which a mere 40,000 households would have to be served by off-grid means (Note: average growth rate in grid-based electricity connections since 2005 was about 6 percent per year and helped household electrification rate to reach 92 percent by March 2012).

1.5 Revised GEO (as approved by original approving authority) and Key Indicators, and reasons/justification

Not applicable.

1.6 Main Beneficiaries

Both the country (as a whole) as well as rural households and enterprises were the principal beneficiaries of this Project. The country benefitted from grid-tied renewables that reduced fuel imports, diversified the power generation mix, reduced generation costs, and built a world-class renewable energy (mainly mini-hydro) industry that is now expanding its services and investments to Africa and other Asian countries. Building on this success, the GoSL has increased its goal of renewable energy generation (excluding large hydro), from 15% of total generation by 2015 to 20% by 2020 (730 Gigawatt-hour (GWh) in 2010 to over 4000 GWh in 2020).

The rural households and enterprises benefitted from increased access to reliable supply of electricity which could expand income generating activities from productive use of electricity; improve their quality of life through the use of (small) appliances; and improving indoor air quality from reduced kerosene smoke.

An indirect benefit to the rural households and enterprises, though limited and difficult to quantify, would be improved services for the electrified public institutions such as health clinics, schools and other education buildings and water supply institutions.

Other beneficiaries include: (i) rural services institutions which can improve their service delivery to the villages and communities; (ii) financial institutions which will be expanding their services with access to long term financing; (iii) entrepreneurs/investors who are able to secure financing for their renewable energy projects; (iv) GoSL leveraging its financial resources for rural electrification; and (v) the global community which is benefitting from reductions of greenhouse gas emissions.

1.7 Original Components (as approved)

[2] Renewable Energy for Rural Economic Development; Project Appraisal Document (PAD)

Component 1: Grid-connected Renewable Energy Power Generation (US$ 77.2 million)
Component 1 is by far the largest component of the project with an allocation of 63% of total Bank financing including from both the original IDA Credit and Additional Financing. Table 1 below provides a breakdown of financing for each component, by source and as a percentage of total financing. This component would dramatically expand the renewable electricity generating capacity and production in Sri Lanka. This would be achieved by supporting private commercial developers to realize grid connected renewable electricity projects. Support would be provided, by facilitating access to sufficiently long-term financing from participating credit institutions (PCIs). Under this component, up to 80% of renewable energy project loans extended by PCI's to private developers can be refinanced by the project. The investments were expected to be mainly in mini-hydro projects; however, it was also available for wind power and biomass generation. Component 1 is directly linked to the PDO *promoting private sector power generation from renewable energy resources for the main grid* and the GEO *reduction in atmospheric carbon emissions.* It also contributes the increased proportion of electricity capacity being derived from renewables.

Component 2: Solar Photovoltaic (PV) Investments (US$ 33.7 million)
Component 2 is the other major component of the project with an allocation of 27% of total Bank financing most of which came from the original IDA Credit supplemented by funds from the Additional Financing. This component would provide electricity to remote rural households that would not be connected to the grid in the foreseeable future. Under this component, output-based credit and grant support would be provided for the supply and installation of solar home systems. The subsidy would depend on system size (smaller systems receive bigger subsidies) and decline over time. The project would also refinance loans given by PCIs to households. Component 2 is directly linked to the PDO *improving the quality of rural life by utilizing off-grid renewable electricity technologies to bring electricity to remote communities* as well the GEO. It also contributes to both the increased proportion of electricity capacity being derived from renewables and number of rural consumers served by renewable energy systems.

Component 3: Independent Grid Systems (US$ 4.1 million)
Component 3 is a relative small component, with an allocation of only about 3% of total Bank financing almost all of which was from original IDA Credit. It supports the development of renewable energy based community mini grid systems which brings electricity services to remote rural communities. Mini grid systems are in particular of interest for villages with good micro hydro resources. The support provided would include: (i) project preparation grants to developers for identifying projects and working with communities to help them realize the projects; (ii) refinancing of loans by PCI's to communities for eligible projects; (ii) investment subsidies to communities to reduce the cost for the communities; and (iv) supervision grants to PCI's to cover the incremental supervision cost. The refinancing would be limited to 80 percent of the loan provided to communities and the subsidy to US$ 400 per kW installed capacity (later increased to US$600) up to US$ 20,000 per system. Component 3 is directly linked to the PDO *improve the quality of rural life by utilizing off-grid renewable electricity technologies to bring electricity to remote communities* and the GEO *reduction in atmospheric carbon emissions.* It also contributes to both the increased proportion of electricity capacity being derived from renewables and number of rural consumers served by renewable energy systems.

Component 4: Energy Efficiency and Demand Side Management (DSM) (US$ 1.1 million)
Component 4 is the smallest component with an allocation of less than 1% of total IDA financing. This component intended to support the development of energy service companies (ESCOs) through awareness creation and training. Support would also be provided for the development of an ESCO business plan and development of legal agreements. Component 4 is directly linked to the GEO and contributes to removal of barriers in energy efficiency.

Component 5: Cross-sectoral Energy Applications (US$ 3.1 million)
Component 5 is also a small component, with an allocation of about 2% of total Bank financing. It was envisaged to promote renewable energy applications in non-energy sectors such as health, education and water supply. This would be achieved through technical assistance (awareness creation, assessment of impact and benefits and specification of standard energy packages) and co-financing of various initiatives. The co-financing would leverage additional funds from ongoing and planned Government and donor-supported projects. Component 5 is linked to the GEO and contributes to the number of electricity use strategies developed and implemented by government and nongovernmental institutions in non-energy sectors for using electricity to improve the delivery of their products and services in rural areas.

Component 6: Technical Assistance (US$ 3.8 million)
The allocation for component 6 was about 3% of total IDA and GEF financing. It was intended to largely support the implementation of the RERED investment components and would comprise a number of technical assistance activities, including:

1. Project administration and promotion
2. Support to the development of sub-projects
3. Market assessment and technology promotion related to renewable energy and energy efficiency capacity building
4. Cross-sectoral energy applications
5. Post-completion sustainability of project
6. Monitoring and evaluation / surveys

Table 1 Component-wise breakdown of financing (all values in US$)

S/N	Component	IDA-1[3]	IDA-2	GEF	Total	% of total
1	Grid-connected RE Power Generation	49.2	28	0	77.2	63%
2	Solar PV Investments	18.8	11	3.9	33.7	27%
3	Independent Grid Systems	3.6	0.5	0	4.1	3%
4	Energy Efficiency and DSM)	0.6	0.5	0	1.1	1%
5	Cross-sectoral Energy Applications	2.3	0	0.8	3.1	3%
6	Technical Assistance	0.5	0	3.3	3.8	3%
Total		**75**	**40**	**8**	**123**	**100%**

[3] IDA-1 means the original IDA Credit and GEF Grant approved in 2002 for an amount of US$ 75 million equivalent and $8 million, respectively. IDA-2 means the Additional Financing approved in 2007 for an amount of US$ 40 million equivalent.

1.8 Revised Components

Not applicable.

1.9 Other significant changes

None. There were a few notable changes namely in the revision of thresholds for using established commercial procurement practices by the private sector; increasing IDA Credit and GEF Grant percentage of expenditure under all TA categories and revising the benchmark of the refinancing rate of interest. Those are discussed in detail in section 2.2.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

2.1.1 Background

The RERED project is a direct follow-up to the ESD Project and was designed to reap the fruits of the groundwork established by that project. ESD was a breakthrough initiative, which created an enabling environment for renewable energy development and energy efficiency. One of the flagship achievements of ESD was the development and adaptation of a Standardized Power Purchase Agreement (SPPA) and piloting the use of relatively large-scale, long-term credit through licensed commercial banks as such credit lines were previously reserved for development banks while commercial banks mainly had access to small-scale SME credit lines. As a result, the capacity of small hydro in Sri Lanka increased from 1 MW in 1997 to 32 MW at the end of 2002. ESD also demonstrated the viability of private sector participation in providing off-grid electricity services with financing coursed through Micro Finance Institutions (MFIs). MFIs extended credit facilities to rural households and by the end of 2002, a total of 20,953 SHS were installed, with sales averaging 850 systems per month. Off-grid electrification was also provisioned through village hydro systems, whereby 35 village hydro schemes had been built with a total capacity of 350 kW, benefitting 1,732 households. An additional 49 village hydro projects were at various stages of development and would immediately benefit from a follow-on financing facility.

Due to these and other factors, the design of RERED was in line with the environment at that time which had become more conducive for growth and scale-up. The number of mini-hydro developers was increasing (11 at the time); 4 major solar companies were in operation and about 12-15 village hydro developers were active. Also at the village level nearly 80 active electricity consumer societies were established.

Wind power development had also been piloted for the first time in Sri Lanka under ESD with the establishment of a 3 MW wind project. There was considerable interest from the private sector to develop additional wind projects on several sites in Sri Lanka. In 2002, the Government had invited expressions of interest from developers for 40 MW of wind capacity. At appraisal, it was envisaged that RERED would be an important facilitator of financing for about 20-25 MW of that targeted capacity.

Tackling energy efficiency was also a key area of engagement as the environment for the implementation of demand side management activities had improved after ESD, including the formation of multiple ESCOs – the first of which came into being during the course of ESD.

While clearly the foundations had been laid for sustainable growth of the renewable energy industry in Sri Lanka, critical barriers still needed to be addressed to maintain momentum; those were:

- The size of the market which was still relatively small;
- Ensuring a level-playing field for private sector participants;
- Access to long term financing was still limited as domestic fund mobilization was mainly short term;
- Integrating renewable energy in the country's overall electrification strategy; and
- Establishing a sustainable and transparent basis for subsidies for rural electrification.

2.1.2 Soundness of the background analysis

During the preparation of RERED it was assumed that technical and financial concerns would limit grid extension and that even with widespread and rapid expansion of the system there would still be nearly 20 percent of the island's population reliant on off-grid systems (nearly 1 million households.) This assumption was based on information from and discussions with the Ceylon Electricity Board (CEB) – the country's largest power utility. CEB had also stated that the existing electricity generating capacity was facing shortages of about 35 percent coupled with an annual electricity demand growth of 8 to 10 percent.

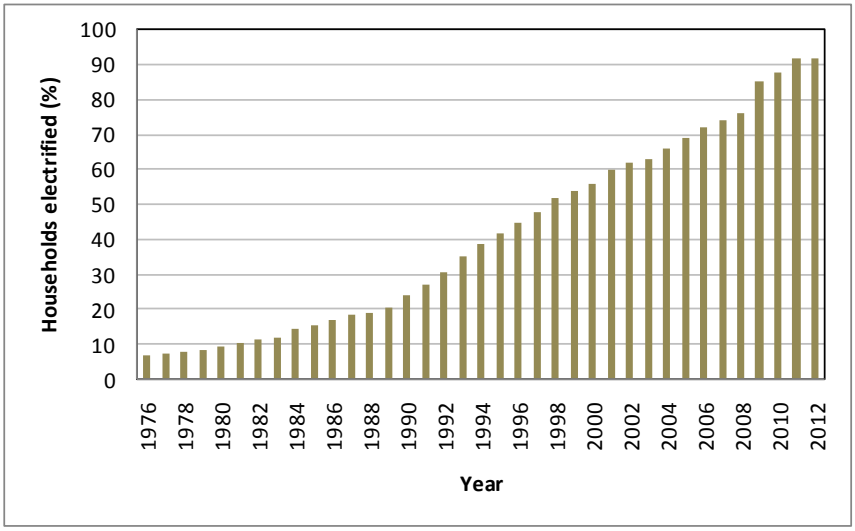

Figure 1 below shows that, in effect, electrification moved faster than anticipated due to GoSL's decision to aggressively invest in grid network expansion, and reached a greater number of households than had been assumed at Appraisal. The current plans by GoSL indicate 100% village electrification by the end of 2012 recognizing that about 40,000 households will need to be electrified through off-grid options.

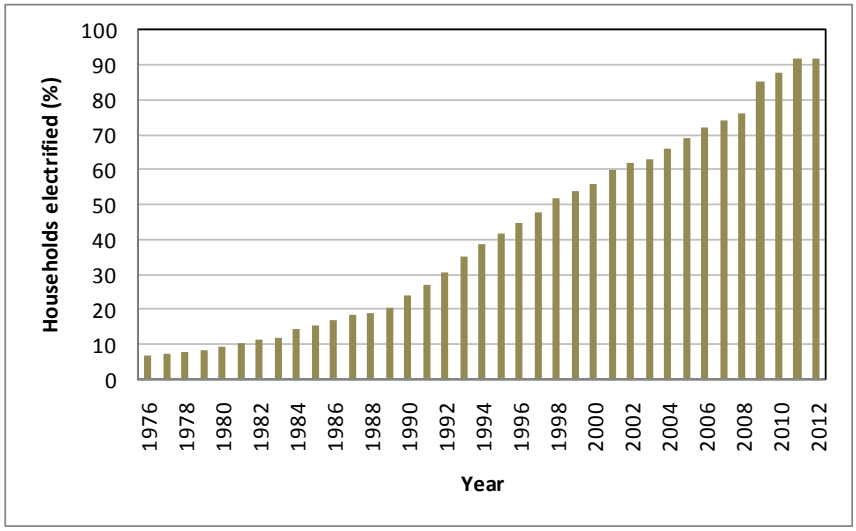

Figure 1 Rate of electrification in Sri Lanka (1976-2012)

One of the sharpest rates of increase in electrification was in the period from 2003-2011 when the generation capacity grew from 2,483 MW to 3,139 MW[4], an increase of 658 MW (or about 26.5% of total installed capacity). As development of major hydro has remained stagnant at 1,207 MW since 2003, the growth came from an increase in thermal power (51%) as well as renewable energy (48%), the latter comprising small hydro, wind and biomass. This was consistent with the analysis at Appraisal.

2.1.3 Lessons taken into consideration during preparation

The preparation of RERED benefitted from a build-up of considerable experience in the implementation of rural and renewable energy projects in the country; however, from the Bank's perspective, this was not only limited to the Sri Lanka experience. RERED also benefitted from experiences in other countries where a number of similar initiatives had been undertaken, including countries in South and East Asia and Sub-Saharan Africa.

The guiding principles for success emerging from the various Bank interventions included: (i) necessity of providing consumer choice; (ii) ensuring pricing which is cost-reflective; (iii) overcoming high start-up cost; (iv) encouraging local participation and tapping into private sector and civil society capabilities and potential; and (v) implementing sound sector policies. The implementation of ESD offered useful lessons, which were built into the design of RERED. Those included:

(i) Flexibility in the implementation and in the effective implementation review missions as an opportunity to address emerging problems and implementation challenges amongst all project stakeholders while considering adjustments to project design, as needed, to help resolve bottlenecks;

[4] Sri Lanka Central Bank Annual Report 2012

(ii) The effectiveness of third-party administration of the credit and grant facility and overall project management;

(iii) Involvement of industry associations and advocacy groups plays an important role in guiding industry growth and directions;

(iv) The adoption of an SPPA, ensuring tariff certainty, a bankable legal framework that assured availability of long term financing was vital to the success in grid connected renewable investments; and

(v) The importance of participation and commitment of the entire community on off-grid village electrification schemes for ensuring long term sustainability of these schemes, as well as a adequate after sales services (especially for SHS) are crucial.

2.1.4 Rationale for Bank involvement

The Bank has been recognized and accepted in Sri Lanka as a key catalyst for grid-connected and off-grid renewable energy and energy efficiency interventions. The key value-added stems from the Bank's experience in supporting countries in Africa and Asia to develop and implement large renewable energy and energy efficiency projects. This knowledge and experience is unique among development institutions. The ESD project validated the adopted approach and laid the foundation for scale-up under RERED. The Bank was best placed to help Sri Lanka achieve that potential, both in terms of knowledge and financing needs.

The Bank's involvement increased the confidence of the PCIs to continue to provide long-term loans to private developers of renewable energy projects. This was of particular importance because increasing the access to energy services from renewable energy was at the heart of the RERED design.

2.1.5 Assessment of project design

The Project has two distinctively different but complementary objectives, one of a social/poverty alleviation nature and another which is geared towards the power sector with an environmental dimension. The element that binds the two objectives is that both will be achieved through renewable energy technologies that are low-carbon and fueled by indigenous resources.

The social and economic benefits of rural access to electricity services are well documented (*IEG. The Welfare Impact of Rural Electrification, 2008* and *Marge: Energy Poverty and Gender (EnPoGen) Sri Lanka Report, 2002*). Rural households prefer grid electricity as it provides them with the highest and most reliable level of services and significantly subsidized tariffs, especially for those consuming less than 60 kWh/month. On the other hand, they would be more inclined to opt for off-grid electricity if the prospects for grid connectivity appeared to be out of reach or would take many years before they are connected. The Project aimed at providing off-grid electricity services to those households. The assumptions made by the Project (i.e. about 20% of households would not be connected to the grid by 2010) meant that the utilities would need to support extending connectivity to 650,000 households between 2004 and 2010. Therefore, the target of electrifying about 160,000 rural households, using off-grid schemes would be approximately 25% of the total forecast of un-electrified households by 2010. This was a

reasonable target and would make a significant impact. In reality, over 1.3 million new grid connections were made between 2004 and 2010, which was double the original target.

The grid-connected renewable energy component would add 135 MW of renewable energy generating capacity to the existing capacity of 32 MW – an increase of over 400%. This would constitute 5.4% of the total installed generation capacity at the time. The grid connected renewable energy component was therefore significant to the power sector in Sri Lanka.

The design of the project also included an engagement on energy efficiency through a small component; however, the limited resources allocated for energy efficiency and DSM (US$ 2 million equivalent or 0.9% of the total financing) made a significant impact unlikely. Moreover, a low interest credit line for energy efficiency extended by Japan International Cooperation Agency (JICA) made demand for RERED funds far less attractive. To reduce complexity and remain focused, it would have been better to limit the project to renewable energy and address energy efficiency in a more significant manner in a different project supported by the Bank or other development institution.

Overall, the project was designed to build on the success of the ESD and it included a number of the same components using proven approaches. In general, the project design was sound and was designed to make a significant contribution to off-grid electrification, increasing the renewable energy generation capacity to diversify the fuel mix relying on indigenous resources, and contribute to an increase in total installed power generation capacity in the country to meet the growing demand for electricity.

2.1.6 Adequacy of Government's commitment

The Government's commitment to the project was unwavering while recognizing the value of implementing such a Project through a commercial entity (i.e. DFCC Bank was the RERED Project Administrative Unit, continuing the role they played in ESD). Due to the nature of the project being driven by commercial lenders and private developers, DFCC was better placed with its experience in commercial banking transactions to work with the PCIs and private developers and administer the refinancing mechanism. The Government facilitated the implementation of the Project by providing the required policy and regulatory support, approving investments by the utility in substation upgrades, as well as considerable grant support for off-grid electrification schemes.

2.1.7 Participatory process

Stakeholder participation during preparation was achieved through a consultative process established under ESD. This included consultation with PCIs, industry associations and individual companies, village electricity consumer societies, CEB and other Government organizations.

2.1.8 Assessment of risk

The overall risk rating at Appraisal was substantial. This is considered appropriate for the type and scale of interventions proposed under the Project. The demand for refinancing of loans for grid-connected renewable energy projects depends on a number of macroeconomic factors that are beyond the control of the Project. For example, when interest rates were substantially higher

at certain periods during the implementation period - most notably at the height of the military conflict - the demand for refinancing loans reduced significantly. Demand grew once more when interest rates dropped again. On the other hand, the risk of an insufficient market for SHS was identified and considered moderate. The impact of a saturated market for SHS or accelerated grid expansion was not analyzed in sufficient detail, which could have addressed some of the challenges faced during implementation. This is an important lesson for other countries that are undertaking or planning aggressive off-grid electrification schemes.

2.1.9 Quality at entry rating by QAG (if any)

Not applicable.

2.2 Implementation

2.2.1 Progress of Implementation

Implementation progress was generally rated 'satisfactory' with a few exceptions in 2009 when the rating was 'marginally satisfactory' mainly attributed to slow disbursements. This eventually picked up and the Credit was fully disbursed[5]. The major implementation issues by component are discussed below:

Component 1: Grid-connected Renewable Energy Generation

There were no major issues during the implementation of Component 1. Minor issues were the benchmarking of refinance interest rate and limitation of refinancing approvals to the available budget. The AU approved refinancing until the total budget was committed. This led to non-disbursing commitments and did not provide an incentive to submit refinancing applications quickly. This approach would have caused a significant amount of undisbursed refinancing approvals at the end of the project. Both issues were resolved (refer to the section below on *Actions Taken in Response to Problems*). As component 1 was by far the largest component of the project the AU rightfully devoted most attention to this component.

Component 2: Solar PV Investments

Sales of SHS fell from 2,000 per month in 2005 to 800 per month in 2008. The shrinking of the market was caused by rapid expansion of the grid and by a reduction or cessation of SHS loans from financial institutions as the rate of defaults on loans began to rise sharply. This in turn, was caused by, among others, SHS vendors not honoring their after sales services and warrantee obligations. Due to some of these unanticipated market conditions, actual number of households to be electrified fell short of the original target. However, overall, the component was successful in providing opportunities for rural households to gain access to much-needed electricity services far sooner than they would have, had they waited for a grid electricity connection. As component 2 was a major component the AU made significant efforts to get this component back on track. When the AU realized that this was not possible, a proposal was made to restructure the project to revise the realistic target expected to be achieved under this component.

Component 3: Independent Grid Systems

[5] Fully disbursed does not mean zero balance. At the end of the Disbursement Grace Period, US$ 12,052 of IDA funds were refunded by GoSL as unutilized.

There were no major issues implementing this component. One minor issue was in the quality and technical capacity of some of the village hydro developers and equipment suppliers. That issue was addressed through the introduction of a pre-qualification process for all village hydro developers and suppliers, mandatory testing of equipment and stricter supervision.

Component 4: Energy Efficiency and DSM

There was little demand for support from the Project under this small component. The main reason for this was that the Environmental Friendly Solutions Fund (E-Friends), supported by JICA, offered similar support at better terms (70-100% refinancing, 10 year loan with 2 year grace period and a fixed Rupee interest rate of 8.5% per annum.)[6] The initiatives that were supported under this component included refinancing of loans for energy efficiency sub-projects and awareness campaigns. Because there was no demand on these funds (and component was very small) the AU correctly decided to focus its attention on the more significant components with larger impacts on the achievement of the PDO and GEO.

Component 5: Cross-sectoral Energy Applications

This component also had limited demand. The grid was expanding rapidly and most rural public institutions such as schools and hospital were gaining access to grid electricity and, as such, a long term renewable energy-based solution was not a priority. AU also did not push this component and devoted its attention to the main (larger) components, namely 1 and 2.

Component 6: Technical Assistance

There were no issues with the implementation of component 6.

2.2.2 Success Factors

RERED is a successful project in a number of dimensions. It supported the development of 185.3 MW of renewable energy capacity (or about 65% of total renewable electricity generating capacity in Sri Lanka as of March 2012. It also provided off-grid electricity to over 116,000 remote rural households (or about 0.5 million people.) Key factors that contributed to the successful implementation of RERED are given below:

(i) Building on the success and lessons learned from ESD and use of proven concepts. Many of the activities designed for RERED were previously piloted under ESD. All of the support mechanisms were developed and required minimal fine-tuning. The adoption of an SPPA developed under ESD coupled with an established tariff regime and securing long-term financing was critical to the continued success of renewable energy investments in the sector. Consultation with major stakeholder groups had been institutionalized and the implementation agency had acquired the necessary skills, knowledge and experience to handle these transactions. Stakeholders were familiar with the requirements and support provided, resulting in a seamless transition from ESD to RERED.

(ii) Private sector leadership. The project development and global environmental targets could only be achieved through the implementation of a significant number (ultimately 71) grid-connected renewable energy sub-projects. This required substantial implementation

[6] An external evaluation of the E-Friends Fund can be obtained from the following link: http://www.jica.go.jp/english/operations/evaluation/oda_loan/post/2006/pdf/project27_full.pdf

and financial capacity that could only be provided by the private sector. The project was set to achieve those targets by creating an enabling environment for private sector participation. Entrepreneurs would identify economic and financially viable projects, investing time, effort and equity in the preparation of those projects, and seeking financing from PCIs. Having a line of credit facility through RERED incentivized the PCIs to extend sub-loans as they were able to refinance these loans through the IDA Credit at favorable terms.

(iii) Implementation arrangements. One of the key success factors lay in the project management by the DFCC Bank which functioned as the RERED Administrative Unit (AU). The AU was, by design, a separate entity from DFCC Bank's main lending function to avoid a possible conflict of interest and provide transparency to PCIs whom were competing with DFCC Bank on the refinancing of sub-loans. The AU was staffed with professionals (including engineers), many of whom had gained considerable experience from the implementation of ESD. As the implementation progressed, the AU retained much of this knowledge and became well in tune with energy sector issues. The AU was also taking up an important role as facilitator and intermediary between the direct beneficiaries (PCIs, developers, SHS vendors, village hydro developers and end-users), the various Government branches (Ministry of Finance, Ministry of Power and Energy, etc.) and the World Bank. The AU maintained a good consultation process with all stakeholders throughout the implementation of RERED and convened regular workshops and meetings to help resolve impediments and address emerging problems. This established good faith and a great deal of trust in the AU among the various stakeholders.

(iv) Enabling macro-economic environment. Re-financing of loans for renewable energy sub-project only works in a suitable macro-economic environment which is usually outside of the control of the Project. In this case, GoSL supported an excellent market enabling environment and its commitment to getting the private sector engaged in developing the sector was crucially important to RERED's success. Significant duty and tax concessions were also available for most sub-projects. During the implementation of RERED the macro-economic environment was generally conducive. Interest rates were reasonable (other than for a period during heightened military conflict in the country), the exchange rate fluctuated relatively modestly and there were no restrictions on lending for renewable energy investments. With the tariffs offered by the CEB, projects were financially viable and encouraged developers to actively develop and implement renewable energy projects. Under different macro-economic conditions, and without government cooperation, the Project might not have been successful.

2.2.3 Actions Taken in Response to Problems

During implementation several actions were taken in response to emerging problems. The most important actions are discussed below.

(i) Change of Interest Rate of Refinancing Loans. The original RERED IDA Credit and GEF grant agreement stipulated that interest rates to PCIs are calculated based on a six-month average of the Average Weighted Deposit Rate (AWDR). At the time the Additional Finance was approved, the rate was to a blend of AWDR and Average Weighted Fixed Deposit Rate (AWFDR). This was done to improve financial sustainability by bringing the

interest rates closer to market terms. Subsequently, interest rates had begun to rise sharply and that led to a significant increase in the financing terms for renewable energy project loans and resulted in a considerable decline in loan applications. While lending rates began to decline rapidly in the second half of 2009, the cost of RERED remained high as it was influenced by fixed deposit rates set every 6-months. The interest rates for RERED funds remained high for a longer period of time, causing its sub-loans to be out-priced by other loans available in the market. Therefore, in response to these issues, the Bank agreed with GoSL to use the AWDR - revised every 3 months. As a result, more sub-projects were picked-up and the pace of loan applications and financing of sub-projects increased.

(ii) Change of disbursement condition to first-come first-serve basis. For the most part during the life of the project, the AU did not approve new refinancing requests when the RERED un-committed balance was insufficient. As per the participation agreements with the PCIs, the AU could cancel a refinance commitment only if no disbursements had taken place in 12 months. This resulted in non-disbursing commitments with a risk of large undisbursed balance towards the latter stage of the project. In 2008, the AU in consultation with the Bank and PCIs, changed their approach and overcommitted the available funds by approving refinancing requests with the clear understanding that disbursements would take place on a first-come first-serve basis until the available funds are exhausted. This provided an incentive for project developers and PCIs to submit disbursement requests as soon as possible or otherwise run the risk of not being able to draw on the full amount of approved refinancing. This modified approach resulted in an increase in disbursements and ensured that the IDA Credit would be fully disbursed by the closing date of the project or during the grace period.

(iii) Prequalification of village hydro developers and suppliers. Developers received a project preparation grant to develop village hydro projects. This grant was paid in installments after a set of milestones were reached. The support was considered attractive and resulted in an increase in the number of village hydro developers during the latter stages of ESD, not all of whom had the required knowledge and skills. To avoid this issue, including potential misuse of resources, the AU introduced a prequalification process for village hydro developers and equipment suppliers whereby only those with a minimum level of knowledge and experience were pre-qualified under the Project. This led to fewer number of incomplete projects and potentially unsatisfied end-users, and overall, a more efficient implementation of the village hydro component. The introduction of mandatory testing of turbines prior to installation led to better quality equipment and less conflicts with suppliers.

(iv) Modification of SHS vendors' business model. In late 2006, problems with the solar PV component began to surface. By 2009, it became clear that sales targets might not be achieved. To address this problem, the AU organized a participatory problem analysis workshop in December 2009 to analyze the issues in detail and identify remedial actions (details on problems encountered are provided in section 6 on lessons learned). The workshop provided recommendations for possible actions, including the modification of the SHS vendor business model. This included import of cheaper but good quality systems, shift to cash sales and modification of the sales services networks. SHS vendors started to

implement the recommendations, but it was not sufficient to increase SHS sales. In October 2010, the project was restructured to reduce the target for the off-grid renewables component from 161,000 households, enterprises and institutions to 113,500. With a saturated market, the number of solar vendors active at the peak of SHS sales fell from 14 to 2. The current vendors are supplying SHS systems on a cash basis or on credit provided by the vendors themselves.

(v) Increasing the thresholds for using established commercial procurement practices by the private sector. The established thresholds were set in 1997 under the ESD project and were carried over into the RERED project without revision. Data from RERED-financed sub-projects showed that costs had gone up substantially over the period (2004-2010). This meant that more sub-projects would need to follow International Competitive Bidding (ICB) procedures since the costs would go beyond the established thresholds under ESD. This was also more critical for smaller projects where the cost of going through an ICB procedure outweighed the benefit of using commercially accepted procurement practices. As such, an increase in the thresholds for investment projects was agreed with GoSL. For the procurement of Goods, the threshold increased from US$ 2 million to US$ 6 million, while the Works category increased from US$ 3 million to US$ 9 million and Turnkey contracts from US$ 5 million to US$ 15 million. These increases were in line with the percentage increase in Prior Review in the Bank's South Asia Region for the Borrower's Procurement Transactions approved in May 2009.

(vi) Increasing IDA Credit and GEF Grant percentage of expenditure under all TA categories. The Government requested to increase the percentage of expenditures financed for the technical assistance categories of the IDA Credit and GEF Grant to 100%. Due to the difficult fiscal situation further aggravated by the global economic crisis, GoSL had not been able to allocate co-financing for technical assistance funded by IDA or GEF in a timely manner. At the height of the military conflict, the solar subsidy payments were also delayed by GoSL, resulting in severe cash flow problems to SHS vendors. This has often resulted in payment delays to suppliers and reputational risks for the Bank. The increase facilitated the implementation of a critical technical assessment of the power grid absorption capacity as well as capacity building activities and other TA geared towards scaling-up investments in new renewable energy technologies such as wind and biomass. The increase in expenditures was covered by a reallocation of non-utilized funds from other categories.

2.2.4 Mid Term Review

The Mid Term Review (MTR) was carried out in September 2005. At that time it was concluded that the original targets for off-grid electrification could be achieved (101,000). The grid connected renewable energy project component was behind schedule. Delays were caused by problems with connections that needed to be made by CEB as result of sub-stations reaching their maximum capacities, delays in obtaining required approvals from the Central Environmental Authority (CEA) and other agencies, and from delays in obtaining land. The MTR provided the following recommendations: (i) streamlining approval procedures; (ii) address with CEB problems related to connection of renewable energy projects to the grid (grid failure and absorption capacity of sub-stations); (iii) pre-qualification and training of village hydro

developers and equipment suppliers; (iv) closer monitoring of performance of village hydro projects; and (v) require village hydro developers to involve village mobilization experts. The AU implemented the recommendations to the extent possible. To address sub-station capacity, CEB took on a number of grid strengthening projects financed by the Asian Development Bank (ADB) and others.

Approximately two years following the MTR, an Additional Financing was approved by IDA in 2007. This was largely in response to the increased demand for RERED refinancing. Since the majority of the funds would be geared towards new sub-projects, and with an average gestation period of about 2 years from inception to commissioning, a 3-year extension to the closing date was approved to allow sufficient time for the additional financing credit to be committed and disbursed. By that time, most of the funds available under the IDA Credit and GEF Grant were disbursed; however, since there were some amounts that still remained uncommitted (mainly allocated for TA), the parent project was also extended to allow GoSL to utilize all remaining sources of funds. Ultimately, all but a few thousand dollars from the entire allocation of IDA and GEF was exhausted by the end of the disbursement grace period.

2.2.5 Performance ratings by the Quality Assurance Group (QAG) for Supervision or Projects at Risk

Not applicable.

2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization

2.3.1 M&E Design

The first objective of the Project is to improve the quality of rural life by utilizing off-grid renewable energy technologies to bring electricity to remote communities. The M&E framework includes two indicators for the first objective: (i) increase in income generating activities in communities that gain access to electricity; and (ii) electricity access to 161,000 households, rural small/medium enterprises and public institutions through off-grid systems. Studies show that quality of life improves when access to electricity is provided. This does not necessarily require an increase in income. Non-financial benefits include reduction of "time poverty," the feeling of social inclusion, improved cleanliness of the home and a greater improvement in studying opportunities for children. Increased income generating activities would be an additional benefit and further improve the quality of life. The number of households, small and medium enterprises and public institutions electrified can simply be obtained from project statistics. The increase in income generating activities would be accessed through surveys. Where increased income generation activities are found, attribution may be difficult.

The second objective is to promote private sector power generation from renewable energy resources for the main grid. This will increase the electricity generation capacity of Sri Lanka using environmentally friendly indigenous renewable resources, avoiding carbon emissions and conserving foreign currency which is otherwise spent on the import of fossil fuels. The indicators for the second objective are: (i) additional 135 MW of small-scale renewable grid-connected power generation capacity installed (85 MW under RERED and 50 MW under the Additional Finance); (ii) reduction of greenhouse gas emissions (1.25 million tons of CO_2 avoided); and (iii) promote adoption of renewable energy by removing market barriers and reducing implementation

cost. The indicators are adequate to assess achievement of this objective. The installed capacity is obtained from project statistics, as this information must be provided for all re-financed projects, whereas the avoided green house gas emissions can be calculated from total electricity generated, which can be obtained from CEB. The removal of market barriers will be evident from achieving the first indicator. In the discussion of this indicator additional details on barrier removal can be provided.

2.3.2 M&E Implementation and Utilization

The AU contracted a consultant to monitor progress towards achieving objectives and meeting indicators. M&E reports were submitted initially every quarter and bi-annually from 2006 onwards. Where the information had to come from project statistics, very accurate and reliable information was obtained. The AU collected the required information as part of its routine administration work and progress was monitored throughout the sub-project lifecycle. Based on this process, corrective action was taken where needed.

2.4 Safeguards and Fiduciary Compliance

2.4.1 Safeguards

There were no major issues on either social or environmental safeguards and overall safeguards compliance is rated satisfactory. The project relied on GoSL environmental clearance processes. In addition, the AU contracted consultants to conduct environmental and social assessments of every grid connected sub-project before approval, and on a sample basis after commissioning, which also included site visits. Based on these assessments, two projects were denied its application for refinancing because of non-compliance with environmental safeguards. After commissioning, no significant problems were found. According to the RERED Operating Guidelines which were strictly adhered to, IDA had required prior review of: (i) all biomass projects; (ii) mini-hydro projects with a capacity of more than 5 MW; (iii) wind projects with a capacity of more than 10 MW; (iv) all projects involving land acquisition and/or resettlement; and (v) the first two environmental assessments of each PCI for mini hydro, biomass and wind power projects. The AU followed these procedures diligently.

2.4.2 Fiduciary

Fiduciary compliance was satisfactory. The AU had well-established procedures for approval of disbursements of loan and grant resources and adequate financial management (FM) staff with sufficient capacity to undertake those responsibilities. PCIs were required to submit refinancing application packages comprising a complete set of documents. Refinance disbursements were made only after providing proof that PCIs had already disbursed their loans to developers and such funds were utilized for the stated purpose. Co-financing grants were disbursed on submission of proof of installation. Other grant payments were generally based on reaching specified verifiable milestones. Verification of installation of SHS was carried out on a sample basis. These verifications did not find any indication of unjustified payment requests. The AU kept detailed records on all payments made. Financial audits carried out during implementation did not find any issues. To ensure adequate fiduciary controls, IDA reviewed: (i) the first two refinancing requests, irrespective of size, submitted by each PCI; (ii) refinancing applications

above the free limit (US$ 3.5 million); (iii) each PCIs' first solar home system refinancing request; (iv) each PCIs' first grid-connected hydro, wind and biomass refinancing request; and (v) each PCIs' first village based hydro, wind and biomass refinancing request.

2.5 Post-completion Operation/Next Phase

Until 2007 there was no single Government organization in Sri Lanka responsible for the promotion of renewable energy. To implement ESD and later RERED, an implementing unit had to be established and GoSL decided to facilitate this through an independent unit within a private development bank, namely DFCC Bank. On October 1, 2007 the Sri Lanka Sustainable Energy Authority (SEA) was established through the enactment of the Sri Lanka Sustainable Energy Authority Act No. 35 of 2007. SEA was established as an apex institution responsible for reaching a new level of sustainability in energy generation and use through increasing the use of indigenous renewable energy resources and improving energy efficiency.

The RERED AU is expected to be handing over Project files to the SEA who will continue to take on some of these roles of facilitating investments in the sector. They will also likely continue to maintain the documentation, data, and studies undertaken under RERED which was disclosed on the Project website. This includes a wealth of analysis, data and information on the subject of renewable energy and related initiatives in the developing country context. Throughout the project, this had been very valuable resource for many researchers, practitioners and those who are keen on replicating some of Sri Lanka's experiences. Although the transfer arrangements are clear it could have been benefitted from better coordination with SEA and more pro-activity. Sub-projects refinanced by RERED shall continue to comply with GoSL environmental requirements, including the required monitoring. This is expected to continue after Project closure.

ESD and RERED addressed one of the most important barriers to renewable energy development, namely the availability and access to sufficient long-term credit. This barrier was addressed by encouraging commercial banks to lend to renewable energy projects in order to demonstrate that the risks are manageable and that lending would also be profitable. Once commercial banks recognized this, they were expected to continue lending for these projects, even without support from RERED. The true criterion of success of RERED is in the continued lending for renewable energy projects by commercial banks and the initial findings post Project completion are very encouraging. SPPAs have been signed for an additional 95 renewable energy projects with a total capacity of 281 MW, commercial banks are willing to continue lending in the sector, and some banks have even taken their financing abroad on other renewable energy projects outside of Sri Lanka. In addition, the credibility created by RERED and ESD have led to other investors financing grid-tied renewable projects. These include, fund mobilization through Initial Public Offerings (IPOs) by several local firms, entry of foreign funds, and a risk sharing facility from the International Finance Corporation (IFC) namely, Portfolio Approach to Distributed Generation Opportunities (PADGO) Project. It would be of interest for the SEA to continue monitoring these trends and other relevant ones.

The SHS component of the Project (Component 2) was largely of similar design to the one financed under ESD given the success achieved under the latter. The outcome of the SHS sub-

component of ESD was rated satisfactory, and while the design did not vary much between the two projects, the SHS component of RERED faced substantial difficulties. This illustrated that sometimes the most important lessons can be learned years after project completion and not always immediately following completion of a project. It is worth noting that the difficulties were not necessarily due to component design or product failures, but rather because the market reached saturation leading to fewer business opportunities for vendors. As a result, the cost of doing business went up and led to a higher transaction cost and smaller volumes. A number of solar companies closed down and their customers were left without support prompting many to stop repaying their loans. These issues led to a somewhat negative reputation for solar PV.

It is therefore important for SEA to continue monitoring the impact of the activities implemented under RERED as it will help also in supporting the Government's continued effort of off-grid electrification of remaining households to achieve island-wide electrification.

A possible follow-up to the RERED Project could be support for the development of wind energy as well as power generation from biomass and grid-connected solar PV (where installed cost is dropping rapidly). The distribution utilities and the regulator (PUCSL) introduced net metering regulations that allow individual customers to install solar PV systems where the electricity generated from PV offsets their electricity payments at the retail tariffs. Few investments of these schemes (limited to 42 kWp per facility) are happening as residential tariffs were recently increased to as much as Rs 50.4/kWh (currently about US$0.38/kWh). Small hydro development is now considered a commercial practice with sufficient expertise in the country which may not require additional support. Biomass generation, and to a lesser extent wind power and solar PV, are still facing a number of barriers and support to overcome these barriers would be useful. These barriers include some of a technical nature, as well as regulatory and financing barriers. There are at present no renewable energy projects in the World Bank lending pipeline for Sri Lanka.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

RERED is still highly relevant to Sri Lanka, the Bank and global energy and climate initiatives. Grid-connected renewables supplies electricity to consumers from indigenous resources. At the national level, this contributes to reduced expenditures on imported fossil fuels as well as greenhouse gas emissions from fossil fuel based electricity generation.

The grid-connected renewable energy sub-project development under RERED is in line with the October 2006 GoSL National Energy Policy and Strategies of Sri Lanka as it addressed 3 of the 9 main elements of that policy, namely: (i) provide basic energy needs; (ii) improve energy security; and (iii) use indigenous resources. This is also consistent with President Mahinda Rajapaksa's 'Mahinda Chinthanaya – Vision for the Future' which commits to increasing generation from renewable energy (excluding large hydro) to 20% of total generation by 2020 corresponding to about 4,000 GWh/year (or ~1300 MW in installed capacity). The development of grid-connected renewables responds to the 2009 CAS outcome 2.1 *Improving Infrastructure Provision.* As a result of these sub-projects, a vibrant sustainable world-class SME-based

renewable energy industrial sector has developed with good domestic and foreign business prospects. This also contributes to achieving CAS outcome 2.2 *Improving the Business Environment for Stronger Entrepreneurship and Knowledge-based Economy*.

As the Project ended prior to the completion of the latest CPS dated April 2012, there are no direct indicators to which the Project contributes to in this CPS; however, it is believed that as a result of RERED interventions, outcomes such as '*Improved access to finance'* (under 1.1 Improving investment climate) as well as *Improved quality and sustainability of infrastructure* (under 3.1 Increasing the quality of service delivery). This attribution is mainly due to the emergence of a sustainable industry which is engaged in developing, financing and operations and maintenance of energy delivery systems. Moreover, commercial banks are continuing to lend to private developers whereas in the past the latter faced significant challenges securing financing (or obtaining it at much higher costs) due to perceived risks of small-scale privately-developed infrastructure projects in the county and/or the usually high capital cost of these investments.

To date, climate change is still one of most important global priorities. Its' impact not only on the environment, but on food security, water resources, etc. is critical, and the grid-connected renewable energy sub-projects reduce the carbon intensity of the power supply in Sri Lanka. In addition, lessons learned and experience gained from the implementation of the RERED project has been shared with a number of countries many of whom have adopted similar models in the development of their renewable energy initiatives.

Electrification has been a high priority for GoSL. The 2006 Energy Policy calls for 85% electrification by 2015. In 2010, GoSL announced its intention to have island-wide electrification by the end of 2012[7]. To achieve the 100 percent electrification goal, GoSL is investing significantly in network expansion, using off-grid means to electrify roughly 40,000 customers who are "beyond the last mile," and adding new generation capacity. If the subsidy required for grid connection exceeds LKR 200,000 per household (approximately US$ 2,000), those households will be provided with an alternative subsidy to obtain a robust renewable energy-based off-grid solution.

Therefore, the off-grid schemes developed under RERED remain highly relevant to GoSL's priorities. From the Bank's perspective, these are also relevant to the 2009 CAS outcome 1.1 *Supporting Integrated Rural Development* and outcome 2.1 *Improving Infrastructure Provision* by providing electricity services which in turn improves market connectivity. The village hydro sub-projects also contribute to village organization through the establishment of electricity consumer societies. The off-grid activities contribute to CAS outcome 1.2 *Improve Economic Opportunities in North and East* as 15% of the SHS supported by RERED were sold to households in those areas. This is also relevant to the 2012 CPS as off-grid electricity significantly improves households' quality of life and social inclusion.

3.2 Achievement of Project Development Objectives and Global Environment Objectives

Achievement of the following objectives is discussed:

[7] Electrification data shows that at the end of the first quarter of 2012 the electrification ratio had reached about 92 percent.

1. Improve the quality of rural life by utilizing off-grid renewable energy technologies to bring electricity to remote communities;
2. Promote private sector power generation from renewable energy resources for the main grid;
3. Reduce atmospheric carbon emissions by removing barriers and reducing implementation costs for renewable energy, and removing barriers to energy efficiency.

The first objective corresponds in particular with component 2 (Solar PV Investments) and component 3 (Independent Grid System). The two components cover about 18% of the actual total expenditures for the Project. The second and third objectives relate in particular to component 1 (Grid-Connected Renewable Energy Power Generation), which incurred about 80% of actual total expenditures of Project funds.

Objective 1: Improve the quality of rural life by utilizing off-grid renewable energy technologies to bring electricity to remote communities.

RERED aimed to provide 161,000 households, rural small and medium enterprises and public institutions access to electricity services through off-grid renewable energy schemes. In 2010, the target was reduced to 113,500 based on the forecast demand for off-grid electrification. The final accounting for off-grid electrification showed that RERED had provided access to electricity to 110,575 households through the sales of SHS while 6,220 households were electrified through independent grid systems, mainly village hydro. In total RERED provided 116,795 households access to electricity, which exceeded the revised target by a small margin.

It is also important to realize that for many families, first time access to electricity was a life-changing event. Electricity from SHS and off-grid community-based hydro sub-projects has made a lasting impact on the lives of the beneficiaries. Although there has been only a limited improvement in their income, they have gained significant benefits in quality of life through better lighting, enabling children to study longer in the evening hours, facilitating the work of women and improving family and community relationships. Of these benefits, improved domestic lighting has played the most significant role in improving the quality of life. Many villagers described the improved lighting as "a reawakening of their lives," believing that they would have never realized this dream in their lifetime.

Electric lighting when compared to alternatives such as kerosene lanterns – which had long been used by the village communities – offers distinct advantages: (a) it is far safer as it dramatically reduces kerosene-related accidents including fire and burns; (b) it is cleaner as soot build up from burning kerosene oil in homes is avoided; (c) it improves safety by allowing more light points, especially for outdoor use; and (d) provides overall greater quality of lighting.

Off-grid electricity is also extensively used for watching television, leading to more awareness of the outside world, in addition to the entertainment aspect. Surveys[8] carried out during Project

[8] Resources Development Consultants (Pvt) Ltd.: *Monitoring and Evaluation of the Renewable Energy for Rural Development Project. September 2004 - September 2008. Completion Report submitted to RERED AU*.

implementation showed that husbands devoted more time to the family (80% of the respondents in surveys) and reduced time spent outside of the house including alcohol consumption in the evening (20% of respondents). Villagers feel safer (60 – 87 % of the respondents of different surveys) and reported that there is more unity among villagers and an increase in socio-cultural activities resulting from electricity at religious places in the villages (80% of the respondents). The use of computers was also observed in a few houses electrified by village hydro schemes.

Contrary to expectation, the availability of electricity did not stimulate the development of enterprises. It did, however, improve operation of existing enterprises. According to reports from PCIs and consultants, access to electricity improved economic activities of 742 (household) enterprises or 0.6% of total number of electrified households. Economic activities that benefited from access to electricity include grocery shops, bakeries, battery-charging stations, communication centers, computer training centers, grinding/rice milling and cinnamon processing. Although there was no formal target according to the PAD, the Bank team tried to capture this data during implementation by assuming that the 1,500 households, small/medium enterprises and public institutions targeted for electrification from the original IDA Credit (1,000) and the Additional Financing (500), would experience an increase in income generating activities as a result of the provision of electricity. However, as indicated above, that implicit target was not achieved.

Although the revised targets have been achieved, and the impact on those receiving access to electricity is evident from surveys, there are a few issues to be noted. Of the 110,575 SHS sold to rural households an estimated 20,000 had to be repossessed because households defaulted on their loans. In general, the PCIs only repossessed the modules which were deemed as their only collateral. The value of the repossessed modules was insufficient to recover the outstanding balance. Further, a small number of SHS and village hydro systems are no longer used because the households have since been connected to the electricity grid. On the other hand, many rural households – in spite of being connected to the grid - continue to use their SHS as a back-up system and some villagers continue to use their village hydro system. By doing so, they are able to reduce their electricity bills.

On the other hand, while several village systems have now been connected to the grid, another important development occurred. Under a scheme similar to an SPPA but for smaller systems, the off-grid village systems connected to the grid can now sell power to the utility at an agreed tariff. This is a win-win situation for the villages communities who have invested money and sweat equity into their off-grid systems as they can now benefit from the reliability of the national grid, while continuing to earn revenues from the sale of electricity generated by their village hydro schemes back to the utility at an agreed tariff (see Annex 2 for more details.)

It should be noted that not all rural households using off-grid schemes have benefitted from the expansion of the national, grid approximately 40,000 households are expected to still remain without access to the national grid (including some who are on small islands.) This is in addition to thousands who are still using off-grid schemes or other means such as kerosene for lighting today. However, for those who have benefitted from faster than anticipated grid expansion this was a positive development as it provides a higher level of services and is more affordable for households. Off-grid electricity supply provided years of access to electricity before the arrival

of the grid to their communities, and for those households who have yet to receive grid power, the off-grid schemes are still very much valued.

The number of grid connected domestic customers were 2.82 million in 2004. By 2010, that number had increased to 3.96 million - an increase of 1.14 million. Grid electrification now serves 92 percent of households making off-grid less relevant than originally anticipated at Project Appraisal. However, off-grid schemes have demonstrated that SHS and/or independent mini grids are a viable option for rural areas where the cost of grid extension would be prohibitive for the utility.

Overall, achieving this objective is rated satisfactory as benefits to electrified households outweigh the difficulties and challenges encountered.

Objective 2: Promote private sector power generation from renewable energy resources for the main grid

The indicator for achieving objective 2 was the installation of an additional 135 MW of small-scale renewable grid-connected power generation capacity installed (85 MW under RERED and 50 MW under the Additional Financing). In reality, RERED supported the installation of about 185.3 MW grid-connected renewable energy sub-projects. This included 2 wind projects (19.8 MW total capacity), 1 biomass project (1 MW capacity) and 68 mini hydro projects (164.5 MW total capacity.) Only the biomass project stopped operating[9]. Private sector developers developed all projects, using loans provided by commercial banks participating in RERED. The PCIs extended loans totaling US$ 122 million (LKR 12.84 billion), which is on average 59.5% of total project cost. The total investment was about US$ 205 million (LKR 21.55 billion).
As of March 2012, there were 102 NCRE projects connected to the grid. The total installed capacity from those was 243.1 MW of which almost 65% was a result of RERED support. The total energy generated during 2011 from NCRE was 722 GWh[10] of which RERED-funded sub-projects contributed 422.5 GWh (58%).

There are good indications that development of grid-connected renewables will continue after the close of the RERED project. About 26 other plants commissioned to date have not been financed by RERED or ESD, most of which were commissioned during the last few years of RERED implementation. In addition, there is a pipeline of about 95 projects for which an SPPA has been signed between private developers and CEB. Developers have shown a continued desire to undertake private investment in renewable energy generation even without support from RERED, and commercial banks continue to finance these investments. Sources of funds include private equity, funds raised through stock markets, foreign equity investors and support from a small IFC loan guarantee facility. This demonstrates that the expected outputs and outcomes have been achieved.

[9] The 1 MW Walapane biomass power plant at Nuwara Eliya was Sri Lanka's first grid-connected biomass plant commissioned in November 2004. It stopped operation due to a variety of reasons, including fuel supply issues, frequent grid failure and remoteness of the plant site. The failure of this project made PCIs more reluctant to lend for biomass power projects.
[10] Source: CEB Statistical Digest 2011. Small IPPs (604) + IPP NCRE (118) =722 GWh

Whilst the above discussion highlights the significant achievements associated with this objective, they do not capture the full picture. In achieving this objective, the Project contributed to the creation of a world-class renewable energy industry in Sri Lanka (in particular for small hydropower) comprising investors, private developers, financiers, engineers/designers, planners, operators, equipment manufacturers, etc. In addition, rural communities benefitted from both temporary and long-term employment opportunities from construction and operations of the sub-projects and overall improved infrastructure as GoSL had undertaken construction of new roads and/or repair of existing ones to facilitate the construction activities for some of these sub-projects. A number of villages benefitted from piped water supply, construction of houses, school facilities, community centers and improved facilities at places of worship. Developers carried out these improvements mainly to create goodwill among the villagers, while some were done as compensation payments to the villagers.

Overall achieving this objective is rated highly satisfactory.

Objective 3: reduce atmospheric carbon emissions by removing barriers and reducing implementation costs for renewable energy, and removing barriers to energy efficiency

The indicators for achieving the global environmental objective were: (i) avoiding emissions of 1.25 million tons of CO_2); and (ii) promotion of the adoption of renewable energy by removing market barriers and reducing implementation cost. The quantifiable indicator was not increased with the additional financing.

The avoided emissions are calculated from the actual renewable electricity production. As given above, total electricity generation from RERED-financed sub-projects in 2011 was 422.5 GWh. Total generation supplied will fluctuate, mainly depending on rainfall (for the hydro plants.) When considering that not all plants commissioned in 2011 are operating at full capacity or were in operation for a full year, and those commissioned in 2012 or yet to be commissioned did not generate any electricity as of yet, the electricity generation figure used is considered a conservative estimate for the total annual electricity generation over the lifetime of the sub-projects.

Assuming an average carbon emission coefficient for Sri Lanka of 0.8 kgCO_2/kWh, the resulting avoided emissions of sub-projects commissioned to date is 1.84 million tons CO_2) surpassing the target by 47%. By estimating the total expected generation from all plants commissioned in 2012 or those expected to be commissioned by year's end, the volume of avoided CO_2 emissions would be 2.15 million.

The removal of market barriers is evident from the additional installed capacity of grid-connected renewable energy from all investments in the sector. The main market barriers first addressed by the ESD project at a smaller scale were more substantially addressed through RERED. Those were: (i) commercial banks not willing to lend for grid-connected renewable energy projects because they are not familiar with these until then untried projects and consider lending in this sector too risky; (ii) developers cannot obtain lending (or lending with longer tenures) for these projects; (iii) un-electrified households had little access to clean electricity services on affordable

terms; (iv) investors considered renewable energy investments to be risky; and (v) CEB is reluctant to purchase electricity from grid-connected renewable energy plants.

The resulting reduction in carbon emissions can also be attributed to the off-grid schemes as well, though these are far smaller in volume than emissions avoided from the grid-connected sub-projects.

Achieving this objective is rated highly satisfactory.

3.3 Results Framework

The objectives of RERED were all within the direct control of the Project. Higher-level objectives could have been: (i) create strong support and commitment among Government agencies and CEB for the development of grid-connected renewable energy sub-projects; and (ii) create recognition that renewable energy-based off-grid electrification schemes are a viable and preferred option for areas where the cost of grid extension is prohibitive. These higher-level objectives also have been achieved with RERED playing a crucial role.

The CEB has changed from a reluctant acceptor of grid-connected renewable energy to a strong supporter of those. CEB stated that power purchased from small renewable energy plants, had saved the utility LKR 2 billion in electricity generation cost in 2010, resulting from reduced expenditure on imported heavy fuel oil and other fossil fuels based power generation.

The Mahinda Chinthanaya calls for generation from renewable energy to reach 20% of total electricity generation or about 4,000 GWh/year by 2020 and the 2012 National Energy Policy currently under preparation calls for increasing the renewable energy generation capacity from 234 MW at the end of 2012 to 928 MW by 2020. Mahinda Chinthanaya also commits to 100 percent access to grid electricity for all households.

3.4 Efficiency

3.4.1 Economic

Grid-connected mini hydros were the dominant investment in the "grid-tied" component. A mini hydro sub-project was used as a representative project for the economic and financial analyses. Post completion, the Economic Internal Rate of Return (EIRR) was 46 percent for a representative 2.5 MW mini hydro plant with an investment cost of US$1,445/kW, a plant factor of 38 percent and an avoided cost of US$0.252/kWh based on Short-Run Marginal Cost (SRMC) of highest cost thermal plants offset by the mini hydro generation. The economic analysis at Appraisal for a 1,500 kW mini hydro plant showed an EIRR of 24 percent. The higher EIRR is attributed to the higher avoided cost even though plant factor was lower and investment cost higher than at Appraisal.

Solar Home Systems. Households using a SHS will save on kerosene for lighting and batteries as well as receiving far superior and safer lighting services from electric lighting compared to kerosene lighting. A 40 Wp SHS is used for the representative analysis. The EIRR is 88 percent

when consumer surplus (attributed to the far superior electric lighting) is considered. If consumer surplus is disregarded, the EIRR is 13 percent. There was no EIRR calculated at Appraisal for this component.

Village hydro. The village hydro plant saves kerosene for lighting and batteries as well as providing far superior and safer electric lighting services compared to kerosene lighting. Beyond meeting households' basic electricity needs, they have the potential to meet other electricity needs in the community such as ironing, water pumping, and power for small enterprises. The EIRR of a representative sub-project was calculated taking into account only savings due to avoided kerosene and battery use as well as consumer surplus gained from using superior electric lighting. The EIRR for a representative sub-project with a capacity of 8 kW and serving 30 households is 54 percent when consumer surplus was considered and 9 percent if consumer surplus was not considered. The EIRR of a typical village hydro sub-project was reported as 12 percent at Appraisal.

3.4.2 Financial

Grid connected mini hydro. The financial analysis of the representative 2.5 MW mini hydro plant shows a Financial Internal Rate of Return (FIRR) of 17 percent against an FIRR of 21 percent calculated at Appraisal. The FIRR varies substantially from sub-project to sub-project depending on site characteristics, which determine investment cost and plant factor. The financial analysis used the flat rate 20-year tariff approved by the regulator, PUCSL, which was applicable in 2010.

Solar Home Systems. The FIRR for the representative 40 Wp SHS was 12 percent compared to 7 percent estimated at Appraisal. While the 12 percent is comparable to interest that is paid on a fixed deposit savings account, it would be considered a low return on an investment that a poor household with few savings would expect. However given the poorer quality of services from kerosene lighting, the expenses and difficulties of transporting batteries for recharging, a household would expect to give the SHS services a higher value than merely its financial returns.

Village hydro. The FIRR for the 7.5 kW representative sub-project is 50 percent. The high FIRR is due to the significant reduction in investment costs due to grants provided, which reduce the investment cost to US$704/kW (compared to a SHS of over US$9,000/kW after grant). Without investment subsidies, the FIRR would drop to 13 percent. Even more so than in the case of an SHS, the level of services provided by the village hydro plant is much greater than that of the alternative (kerosene lighting, dry cell batteries, battery charging, etc.) For example, in the representative sub-project evaluated, a household could potentially use nearly 60 kWh per month given the generation potential of the village hydro scheme (compared to 5.5 kWh per month from a 40 Wp SHS.)

3.5 Justification of Overall Outcome and Global Environment Outcome Rating

Rating: Satisfactory

The RERED PDOs and GEOs have been achieved. The indicator for grid-connected renewable energy capacity and avoided emissions has been exceeded by a substantial margin, while the indicator for rural households connected through off-grid renewable electricity options was less

than planned, bearing in mind that the number of households electrified by the grid far exceeded expectations at Appraisal. The objectives of project are still highly relevant to the Government of Sri Lanka and within the World Bank CAS. The sub-projects supported by RERED are economically and financially sound.

Based on actual expenditure, it can be argued that the grid-connected component was the most dominant component of the Project (nearly 80% of expenditures against 18% for off-grid component). Therefore, the shortcomings in the smaller element of the project must be weighed against achievements above expectation by the larger component and the one contributing to the major development of the PDOs and GEOs. Giving an overall rating for this Project only as 'satisfactory' would not do the project justice in conveying the truly transformational and breakthrough achievements of this Project and the significant benefits it has brought to Sri Lanka. On the other hand, rating this project as 'highly satisfactory' would downplay some of the shortcomings, especially on the smaller components. In order to maintain a high standard and remain critical it is considered appropriate to maintain an overall rating of 'satisfactory.'

3.6 Overarching Themes, Other Outcomes and Impacts

3.6.1 Poverty Impacts, Gender Aspects, and Social Development

The off-grid electrification elements of the project (i.e. components 2 and 3) had achieved the intended rural development impact envisioned at Appraisal. In both off-grid electrification options, household lighting has improved considerably. Electrification offers the possibility of increased lighting points in homes and for outdoor lights. Village communities have felt the difference and clearly expressed preference in the cleanliness aspect of electric lighting compared to kerosene lanterns. This has also prompted some to invest in home improvements. Village hydro also offers the opportunity of using equipment with a higher power rating such as television sets, grinders, power tools, heaters and irons.

The World Bank IEG 2008 impact evaluation of rural electrification (which includes off-grid electrification) concluded that the economic case for investment in rural electrification is proven, provided that technical problems in service provision are adequately addressed. It further concludes: (i) electricity represents cost savings compared with kerosene; (ii) electricity can spur growth of home businesses; (iii) electricity extends waking hours; and (iv) electrification benefits the quality of health services. The positive effect of electrification on woman has been extensively described in the EnPoGen series of reports (2002).

The study found that even in minimal quantities, electricity brings about profound *lifestyle changes* in families, mainly by making home life more convenient and housework easier. Electricity results in *time savings* in the daily lives of both men and women. Men use these mainly for recreation and leisure, whereas women redirect it to other household chores. On the whole, time savings from electricity do not reduce the overall work load of women, although they make work easier. The social development impact comes from *Alleviation of isolation*, through television and radio. This is considered the next highest benefit of electricity as it serves to bring remote rural communities closer to the outside world. Further, the level of *social interaction* within households and communities increase with electricity, which contributes in numerous ways to social capital development. The above is confirmed in the project surveys summarized in

the "Completion Report" which reports on achievements in the period September 2004 to September 2008[11].

3.6.2 Institutional Change/Strengthening

RERED was instrumental in developing a vibrant renewable energy industry in Sri Lanka. A large number of renewable energy sub-projects and schemes were initiated as a result of availability of RERED financing. Consequently, a demand for supporting services developed, including project development, technical/advisory, construction, equipment manufacturing, financing, etc. Given the long-term support extended by the Bank in the sector over a period of 15 years (including ESD), these services were able to thrive. Moreover, the Project contributed to the formation of several associations, including solar, village hydro developers and small power. These continue to be active today and play an important role in representing their industry in government, regulatory and other consultations. As a result, Sri Lanka now has a world-class renewable energy industry with developers, manufacturers, and financiers venturing abroad to undertake investments in renewable energy projects in other countries in Asia and Africa. A few examples include:

- Five Sri Lankan mini hydro developers are now active in East Asia;
- Lanka Ventures, an equity financier, is investing in mini hydro projects in East Africa;
- VS Hydro is an established consultancy in the hydropower industry, and undertakes its own contracting and manufacturing of turbines in Sri Lanka and has investments in Uganda, Tanzania and Kenya.
- An 18 MW plant in Uganda uses three 6 MW turbines manufactured in Sri Lanka.

3.6.3 Other Unintended Outcomes and Impacts (positive or negative)

To enlarge the SHS market and speed up sales, MFIs were brought in under ESD and continued to have a role under RERED. The MFIs were providing loans to households for the purchase of SHSs. The MFIs were frequently under pressure from vendors to process loans faster in order to maintain the sales levels of SHSs. At the same time, extending loans for SHSs was profitable and, thus, the MFIs also had an incentive to increase the number of loans. The process was moving well until about 2006 when defaults began to increase and some PV modules had to be repossessed (with MFIs unable to resell those at prices high enough to cover the unpaid balance of the loans.) This led to substantial losses for the MFIs who eventually ceased to provide loans for SHS altogether. This was an unintended negative impact.

At the same time, Lanka Orix Leasing Company (LOLC) entered the micro financing business only in 2003 to provide SHS loans under RERED. LOLC provided about 12,000 loans for SHS, of which about 4,000 defaulted. The repossessed modules could not be sold and were finally combined into a grid-connected PV array at LOLCs headquarters in Colombo. LOLC incurred substantial losses from providing SHS loans, yet still considers its' participation in RERED of great value. As a consequence of its participation in the Project, an LOLC subsidiary is now the largest MFI in Sri Lanka. It also ventured overseas (Cambodia) providing micro credits, interestingly for SHS. This is an unintended positive impact.

[11] Resources Development Consultants (Pvt) Ltd.: *Monitoring and Evaluation of the Renewable Energy for Rural Development Project. September 2004 - September 2008. Completion Report submitted to RERED AU*.

3.7 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops

The AU carried out a beneficiary survey among the participating PCIs, which was administered and analyzed by an independent third party. The most interesting results of the survey were that PCIs had entered the business of lending for grid-connected renewable energy because of ESD and RERED, but they are now confident enough to continue lending for those projects provided they are viable at commercial interest rates. The work of the AU was also highly praised. Details are provided in Annex 5.

4. Assessment of Risk to Development Outcome and Global Environment Outcome Rating: Negligible to Low

The risks to the following outcomes are assessed:

1. Improved quality of rural life by utilizing off-grid renewable energy technologies to bring electricity to remote communities
2. Promoted private sector power generation from renewable energy resources for the main grid
3. Reduced atmospheric carbon emissions by removing barriers and reducing implementation costs for renewable energy, and removing barriers to energy efficiency

The risk to the improved quality of life by utilizing off-grid renewable energy technologies to bring electricity to remote communities is considered low. The risk of communities no longer using the off-grid renewable energy technologies for another reason than the arrival of the grid is low. Once they have experienced the benefits of electrification they will make considerable efforts to maintain this service. If communities are connected to the grid, the level of services improves and therewith the quality of life. In many cases, the off-grid options may be maintained as back-up or to reduce the grid electricity bill.

RERED contributed to the development of an off-grid renewable energy industry. A substantial part of the capacity built and infrastructure established has not been sustained. Of the 14 SHS vendors at the peak of sales, only 2 vendors are still active in the off-grid sector. Those two vendors are, however, expected to continue the SHS business because there still is a market with little or no competition. Several of the 14 SHS vendors are now offering grid-connected solar PV systems (typically 1-2 kWp each), under net metering rules. Some of the technicians trained under ESD/RERED are providing independent after sales services in their area and SHS vendors depend on their services to fulfill their obligations. Development of village hydro without RERED support is unlikely while the need is also declining due to rapid grid expansion. Developers active in village hydro have moved to other areas and some are now providing consultancy services in India and Africa.

While there is a risk that some of the grid-connected renewable energy sub-projects would stop operating (mainly for projects where PPAs will be expiring and the tariff offered for those would be too low to sustain operations), it is highly unlikely that this would occur in any considerable numbers as these projects are very profitable, especially after debt is paid off (between 5 to 10 years.) The risk that the private sector ceases to develop and seek new projects is considered low unless tariffs decline substantially to the point where the economics become unviable. The Government has indicated its commitment to the participation of the private sector in electricity

generation, especially from renewable resources. These projects are financially viable and commercial banks are continuing to lend, even without RERED refinancing. In addition, RERED contributed to the establishment of a sustainable renewable energy industry which is now catering to more than just the local demand.

Project developers and the CEB both have a shared interest in maximizing renewable energy production. As the alternative will remain imported fossil fuel based electricity generation, the risk to the conservation in greenhouse gas emissions is considered low.

The overall risks to achieving the PDO and GEO are considered Negligible to Low.

5. Assessment of Bank and Borrower Performance

5.1 Bank Performance

5.1.1 Bank Performance in Ensuring Quality at Entry

Rating: Satisfactory

The quality at entry was satisfactory. RERED was for the most part a continuation of the successful ESD project. Successful approaches piloted under ESD were incorporated in RERED and the proven management structure was maintained. Lessons learned from the implementation of ESD were applied in the design of RERED. Conversely, and in retrospect, the benchmarking of loans to AWFDR in the Additional Financing (from AWDR in the first RERED IDA Credit) should have been carefully studied as this shift constrained the Projects' ability to commit and disburse funds until the decision was made to revert back to AWDR. Also, in retrospect, the removal of the GEF grant for larger systems was probably done pre-maturely. The only shortcoming was the inclusion of two relative small components (energy efficiency/DSM and cross-sectoral energy applications) which did not yield the anticipated results and diverted the focus from the main components. Overall the Bank performance in ensuring quality at entry is rated satisfactory.

5.1.2 Quality of Supervision

Rating: Satisfactory

Bank supervision was made easy by the high quality of the implementing agency. This enabled the Bank supervision team to maintain a more strategic management role rather than day to day handholding of all activities. This also tremendously improved the sense of ownership by the implementing agency and GoSL, and facilitated the AU to propose solutions to arising problems. The Bank responded adequately and timely on requests for clearances and No Objections and participated regularly in meetings with all Project stakeholders. The role of the Bank was highly valued in the feedback survey conducted at the end of RERED.

The quality of supervision could have been improved through deeper involvement by the Bank in areas where the AU was weak. The AU was not as proactive in administering the technical assistance component, and less TA had taken place than envisaged. Many TA activities were intended to be demand driven, and the AU on its own did initiate many capacity building programs unless requests were made by the industry, Project stakeholders or beneficiaries. The proper analysis of the problems faced by the SHS which took place could have been done sooner.

When the analysis was finally completed it was too late for recommendations to be implemented. Finally, the Bank should have insisted on better transition arrangements including digitalizing the archives and transfer of files.

The benefits of creating ownership (highly satisfactory) balance the disadvantage of a hands-off approach (moderately satisfactory). Overall, the quality of supervision is rated satisfactory.

5.1.3 Justification of Rating for Overall Bank Performance

Rating: Satisfactory

Given the satisfactory rating for both 'ensuring quality at entry' and 'quality of supervision,' the overall rating of the Bank performance is satisfactory.

5.2 Borrower Performance

5.2.1 Government Performance

Rating: Satisfactory

The Government took a hands-off approach on day-to-day implementation while playing an essential market enabling role. The Project was designed to support the private sector in developing grid-connected and off-grid renewable energy projects, and implemented by a commercial entity, namely the RERED AU of DFCC Bank. The Government limited its role to creating an enabling environment and providing counterpart funding for these sub-projects to flourish. The AU was being funded by the Government based on the level of disbursements of the refinanced loans. In turn, the Government was very responsive to requests for assistance from the AU and helped address problems arising during implementation. The Government also provided considerable grant support for SHS (directly) and village hydro schemes (through provincial councils) and, through CEB, established attractive tariffs for selling renewable electricity to the national grid and ensured that the SPPA terms and conditions were adhered to by all parties. Based on the above, the Government performance is rated as satisfactory.

5.2.2 Implementing Agency or Agencies Performance

Rating: Highly Satisfactory

The performance of the AU is rated highly satisfactory. The AU was highly committed to achieving the objectives of the Project. They established very good relationships with all major stakeholder groups, including PCIs, MFIs, developers, SHS vendors, village hydro developers, industry associations, and village electricity societies. The AU avoided a possible conflict of interest by separating itself from the lending arm of DFCC Bank. This aspect was highly appreciated by the other PCIs who were competing against DFCC on refinancing loans. The AU had full ownership of the Project and proactively coming up with solutions to arising problems, with input and support from the World Bank and the Government, where needed. The AU established well-documented procedures, kept good and complete files on all sub-projects and maintained detailed records. The areas where the AU could have done better include: (i) being more creative in identifying opportunities for TA activities to support the various components; (ii) devoting adequate attention to all components; and (iii) planning for a smoother transition at Project close.

Although there were minor shortcomings, the performance of the implementation agency was exceptional and is rated highly satisfactory.

5.2.3 Justification of Rating for Overall Borrower Performance

Rating: Satisfactory

As Government performance was rated satisfactory and implementing agency performance rated highly satisfactory, the overall Borrowers' performance is rated satisfactory.

6. Lessons Learned

A number of valuable lessons can be taken away from the implementation of RERED. These lessons are in particular important for the design and implementation of possible follow-up initiatives to RERED, and for the Sri Lanka Sustainable Energy Authority to take into account in future sustainability of the sector. These lessons are also relevant for future renewable energy projects in other countries.

The most important lessons include:

- Lesson 1: Long term involvement is very important;
- Lesson 2: A quality implementation body is vital;
- Lesson 3: Private sector market growth should be carefully managed where possible;
- Lesson 4: Stakeholder consultation throughout the project cycle is necessary;
- Lesson 5: Risk analysis should be carried out also during implementation;
- Lesson 6: Performance-based incentives to selected developers is key in enabling communities to get expert support;
- Lesson 7: Prepare well for project closure;
- Lesson 8: World Bank involvement added credibility.

Lesson 1. Long-term involvement is very important

As mentioned elsewhere in the document, RERED (and the Additional Finance) were a follow-up to the ESD project and this string of continuity in engagement with the country covers a period of more than 14 years. Implementation of ESD started slowly largely because different stakeholders had to grow into their respective roles and start-up problems had to be resolved. These start-up problems did not happen in RERED. The procedures and systems set-up during ESD were, with minor modifications, also used for RERED. The long project period enabled building trust and good relationships between the AU and the various stakeholders. It also provided sufficient time to convince PCIs that the risk of lending for grid- connected renewable energy sub-projects was manageable. Policies established under ESD could be monitored under RERED and emerging problems could be addressed. A much shorter duration of the project would have substantially increased the risk to the sustainability of the results.

Long-term involvement also enables the identification of problems that usually occur much later, sometimes after several years. The off-grid PV component was considered a success at the end of ESD, and so with minor modifications, this component was continued under RERED. It took almost four years after the start of RERED for problems to surface. A number of factors

contributed to the problems encountered, these were: (a) there was no mechanism to address vendors not honoring after sales and warrantee obligations as they stopped providing after sales and warrantee services because of bankruptcy or because business was becoming non-profitable in a small and dispersed market; (b) dissatisfied end-users stopped repayment of SHS loans to PCIs who in turn began repossessing the PV modules, and the re-sales of these would not cover the outstanding balance because the price of new modules was reducing significantly over time; (d) a shrinking market due to expansion of the grid at a faster pace than assumed; (e) PCIs were providing fewer loans with, as a consequence, further shrinking of the market.

These developments show that design issues may become apparent years after project closure and it was because of RERED that these could at the least be monitored and salvage efforts be made. In projects with shorter durations, such problems would only be identified after an evaluation is carried out several years from completion. More importantly, in a rapidly saturating market, businesses must be agile to adopt and be responsive to new market conditions – what worked where electrification rate is low will not be viable in areas where electricity coverage is high.

Lesson 2: A quality implementing body is vital

The quality of the implementing agency is vital to the success of any project. The implementing body needs to have ownership, authority and the responsibility to be flexible in addressing arising problems. The implementing agency should be able to function independently and solve issues on its own, while knowing when to involve the Government and the World Bank where appropriate. Another key aspect was in building trust among key beneficiaries and stakeholders. The implementing body must have adequate staffing and the right skill mix to carry out the various tasks. It must also be able to devote sufficient time to the project.

Lesson 3: Private sector market growth should be carefully managed where possible

The provision of off-grid electricity using SHS depended on private vendors, and the village hydro component depended on private village hydro developers. These private sector parties enter into this business only when profit is to be made. In some isolated cases, this has led to participation of unqualified and/or undesirable private entities, which were drawn by the grants on offer. However, many of the unqualified/undesirable entities were not strictly private sector, but small non-governmental organizations (NGOs) or community-based organizations (CBOs). The private sector 'businesses' that engaged in village hydro to expressly earn a profit were, on the whole, fine. The real problems arose towards the end of ESD when a large number of new developers were trained (in hindsight inadequately) in order to scale up village hydro development. Some village hydro developers lacked the required technical and community development skills, causing frustration among Village Electricity Consumer Societies (VECS), PCIs and the AU. The AU addressed this problem by introducing a pre-qualification process for all village hydro developers and also equipment suppliers. This may have reduced the number of developers but it substantially improved the quality and reduce conflicts otherwise.

When SHS sales grew steeply (2003 to 2005) a large number of SHS vendors entered the market as entry barriers were low, which later became overcrowded and resulted in declining margins for each vendor. As the growth rate slowed down, the market was less profitable, causing vendors to go bankrupt or cease operations. In both cases, after sales services and warrantee obligations were often not honored. In hindsight, it would have been better to manage the growth phase more

carefully to assure sustainability of after sales and warrantee services. On the other hand, there are factors beyond the control of Project as managing such growth can often be complex and difficult to control. Where possible, the implementation would have been easier with a smaller number of pre-qualified SHS vendors. One disadvantage is that prices and services would need to be regulated by an appropriate body in the country as having fewer vendors might lead to monopolizing power in some areas. Introducing more stringent entry requirements such as the provision of guarantees and/or performance bonds may have also helped address this problem.

Lesson 4: Stakeholder consultation throughout the project cycle
Implementation of RERED confirmed the importance of maintaining an ongoing dialogue with the main stakeholders and beneficiaries. The AU maintained this dialogue through regular meetings and visits and actively supported the strengthening of stakeholder groups such as the Federation of Electricity Consumer Societies and other technology associations. Consultations strengthened trust and understanding of problems and constraints amongst the various stakeholder groups.

Lesson 5: Risk analysis should be carried out also during implementation
An analysis of the risk to achieving the PDO and GEO should be carried out also during implementation and not only during preparation. External experts, not involved in the implementation of the Project, should preferable carry out this assessment. That way, it is possible to identify new risks, assess the risks of emerging problems, and take appropriate action.

Lesson 6: Performance based incentives works well
The project provided performance-based incentives to selected village hydro developers. This provided an incentive to developers to help communities develop village hydro schemes. The developers would identify the village, mobilize the community and establish contacts with appropriate financing institutions, many of whom were not participating in RERED. Payment of developers by the Project was based on achieving clearly defined milestones. This minimized the risk to the Project and reduced the workload of the implementing agency. The Development of grid-connected renewable energy sub-projects was based on a similar principle where the Project did not need to identify the opportunities but rather only evaluate those proposed by the developers. Subsidies to SHS vendors were also performance-based depending on proven sales of SHS. On the other hand, no grants were given to grid-connected project developers.

Lesson 7: Prepare well for project closure
A project like RERED generates valuable information for similar projects, not only in Sri Lanka, but also in other countries. However, the wealth of information is only of limited accessibility. The paper files are currently stored in boxes. It is unlikely that any of the information in these boxes can be accessed in one or two years. A project like RERED should digitalize its files for easy reference. The way this was done for the China Renewable Energy Scale-up Program is a best-practice example. Digitizing the files should be planned well before project closure and financial resources must be reserved for this. It is further important to discuss project closure with key stakeholders and beneficiaries to make sure they understand that the project will close and that there will be no direct follow-up. This will help them to prepare for project closure.

Lesson 8: World Bank involvement added credibility

The World Bank not only brings financial resources, knowledge and staff expertise, but through its' participation in the Project, it also boosts the credibility of the project and builds confidence among stakeholders and beneficiaries. This was of particular importance for the participating commercial banks involved in RERED as it made them more willing to consider lending for renewable energy initiatives.

7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners

7.1 Borrower/implementing agencies

Comments received from the Borrower were mainly editorial and were incorporated in the ICR where appropriate. In addition, the Borrower's Completion Report is attached as Annex 7.

7.2 Co-financiers

Not applicable.

(c) Other partners and stakeholders

(e.g. NGOs/private sector/civil society)

Not applicable.

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in USD Million equivalent)

Renewable Energy for Rural Economic Development – Fully Blended Project P076702 and P077761			
Components	**Appraisal Estimate (USD millions)**	**Actual/Latest Estimate (USD millions)**	**Percentage of Appraisal**
Grid Connected Hydro, Wind and Biomass	150.3	204.92	136.34
Solar PV Investments	63.7	43.70	68.60
Community Based Hydro and Biomass Energy	5.3	2.62	49.43
Energy Efficiency and Conservation	2.0	0.33	16.50
Cross Sectoral Links	4.9	0.04	0.82
Technical Assistance	5.7	2.30	40.35
Total Baseline Cost	**231.9**	**253.91**	**109.49**
Physical Contingencies	0.00	0.00	-
Price Contingencies	0.00	0.00	-
Total Project Costs			
PPF	0.00	0.00	-
Front-end fee IBRD	0.00	0.00	-
Total Financing Required	**231.9**	**253.91**	**109.49**

(b) Financing

Renewable Energy for Rural Economic Development – Fully Blended Project P076702 and P077761				
Source of Funds	**Type of Financing**	**Appraisal Estimate (USD millions)**	**Actual/Latest Estimate (USD millions)**	**Percentage of Appraisal**
International Development Association (IDA)	Lending	115.00	120.73[(12)]	104.98
GEF	Grant	8.00	7.94	99.25
Borrower (GoSL)	Grant	6.30	7.81	123.97
Sub-borrower	Equity	61.50	87.28	141.92
PCI	Lending	41.10	30.15	73.36
Total		**231.9**	**253.91**	**109.49**

[12] Note: US$ 7 million was re-allocated to the tsunami emergency relief.

Annex 2. Outputs by Component

An indication of the relative importance of the RERED components is what was envisaged in the PAD and the actual as per the ICR, in terms of share of the total expenditure (see Table 2.)

Table 2 Share of envisaged and actual expenditure by component

S/N	Component	PAD	ICR
1	Grid-Connected Renewable Energy Power Generation	64.8%	80.7%
2	Solar PV Investments	27.5%	17.2%
3	Independent Grid Systems	2.3%	1.0%
4	Energy Efficiency and Demand Side Management	0.9%	0.1%
5	Cross-sectoral Energy Applications	2.1%	0.0%
6	Technical Assistance	2.5%	0.9%

The outputs and outcomes of each component are discussed below:

Component 1. Grid-Connected Renewable Energy Power Generation

This component is by far the largest in the Project amounting to about 80% of total expenditures. Refinancing was made to 63 grid-connected renewable energy sub-projects by private sector developers and investors. This included 68 mini hydro projects, 2 wind projects and 1 biomass project. Details on these projects are provided in Table 3.

The main barrier was the reluctance of commercial banks to offer long-term lending to the sector. This was primarily true for technologies other than hydro (such as biomass and wind) as the hydro has been tested under ESD. Lending to wind sub-projects commenced once tariffs were revised and RERED provided additional TA to support the PCIs and developers. RERED extended a line of credit through IDA to a group of commercial banks, development banks and leasing companies (collectively known as PCIs) to re-finance a portion (up to 80%) of the loans that they would extend for renewable energy sub-projects. The terms of the refinancing loan were an interest rate of AWDR with repayment over 10 years starting from 5.5 years after the first withdrawal. The terms of the loan to developers was negotiated between the developer and the PCI with a maximum duration of 10 years, including a two-year grace period.

Table 3 Grid connected renewable electricity sub-projects refinanced under RERED

Technology	**Sub-Projects (Nos.)**	**Total Capacity (MW)**	**Electricity Production (GWh)**	**Number of PCIs**	**Status**
Mini-hydro	68	164.5	401.3	6	62 plants commissioned as of March 2012; the remaining by end-2012.
Wind	2	19.8	27.3	4	One project was commissioned in 2010, the second is expected in 2012.
Biomass	1	1.0	0.0	1	Stopped operation because of fuel supply problems
Total	**71**	**185.3**	**428.6**	**6**	**-**

The total volume of investments for all sub-projects was about US$ 205 million (LKR 21.55 billion). The PCIs had extended loans totaling US$ 122 million (LKR 12.84 billion), which on average represents 59.5% of total sub-project cost. The amount of re-financing provided by RERED for these investments was US$ 88.38 million (LKR 9.35 billion).

The expected outputs for this component have been surpassed, as measured by the key performance indicators. The overarching outcomes were also achieved as PCIs have all indicated a continued interest and actual lending to the sector, specifically for grid-connected renewable energy projects beyond the close of RERED. Similarly, developers were confident of securing finances for their projects as enough capacity has been built that developers are now able to attract financing by listing projects on the Colombo Stock Exchange. To date, five companies have become publically traded in Sri Lanka. The first company to do so was Vallibel Power Erathna PLC, which was listed on May 17, 2006. The company has 3 mini hydro projects with a total capacity of 21.9 MW, all of which have been refinanced by RERED.

This component also made the largest contribution to positive environmental impact through the avoidance of about 2.15 million tons of CO_2.

Component 2. Solar PV Investments

This component was the second largest to be supported by the Project with 17.2% of actual expenditures. It facilitated the sale of 110,575 SHS to rural households by private vendors as well as support to investment subsidies (or co-financing grant) from RERED[13] and refinancing of loans provided by PCIs for SHS.

The total refinancing provided by RERED for this component was US$ 21.78 million. The Project provided an investment subsidy of US$ 40 per SHS which was paid to the developer for systems with module sizes ranging between 10-30 Wp. About 76,000 systems received a Government subsidy with the majority receiving LKR 10,000 (approximately US$ 95 per system. A total of 77,408 systems bought through loans were refinanced by RERED (including re-flows of refinancing funds). The balance (33,167) were sold on cash basis, through vendor credits or financed by institutions not participating in RERED ("Non-PCIs"). The average SHS loan from PCIs to households was about US$ 400 with a 3-year repayment period at an interest rate above 15 percent per annum.

Requests for payment of the SHS investment subsidies submitted by the vendors were reviewed by Project auditors checking for all appropriate documents, invoices, consumer acceptance receipts (CAR) and packing lists. The project auditors then prepared an assessment report for the AU, upon which the AU would disburse against eligible payments. Field verification was carried out on a sample basis. The total investment subsidies paid to 14 SHS vendors was US$ 11.9 million (US$ 4.5 million from GEF, US$ 0.2 million from IDA and US$7.2 million from GoSL). With an average capacity of 25 Wp per the system, the total capacity of RERED-financed SHS is 2.8 MWp.

[13] Depending on the locality, many systems received supplemental subsidies directly from the local government.

The revised target for number of households to be served by off-grid means was achieved; however, of the 110,575 SHS sold, an estimated 20,000 were repossessed by the PCIs due to defaults by households on their loans. The implicit expected outcomes were: (i) SHS demonstrated as a viable option for areas not being served by the grid; (ii) micro credits for SHS are routine business for PCIs; and (iii) ensuring a sustainable SHS industry. These outcomes have been partially achieved. The Government, CEB and SEA consider SHS a viable option for areas that are unlikely to receive grid in the near future. However, PCIs have ceased lending for SHS and only two SHS vendors are still active in Sri Lanka. On the other hand, those vendors still see SHS as a profitable market in Sri Lanka. One vendor offers households the option to pay for the system in installments, which in itself is a form of micro credit to households.

Component 3. Independent Grid Systems

With 1.0% of actual total expenditure, this was also considered a small component in volume, though its impacts outweighed the volume of financing. Under this component, RERED supported the installation of 173 community-based micro hydro systems and 2 community-based biomass electricity systems. The average capacity of the village systems was 10 kW. While, the project refinanced 53 systems, the balance 120 (69%) were re-financed by 'non-PCIs.' The Project provided development and co-financing grants for basically all systems and supervision grants for 73 PCIs and non-PCIs.

The independent mini-grid systems component provided access to electricity for 6,181 households. A survey conducted among VECS in 2011 showed that 66% of the villages have now access to the grid. This does, however, not mean that all households in a given village are connected to the grid. Villages, in general, continue operating the mini grids independent from the CEB connection. Villages not only benefitted from the electricity provided, they also benefitted from the establishment of VECS.

Another important development related to village schemes that have been connected to the grid is the availability of an option to sell electricity to the utility at the mini-hydro tariff (similar to an SPPA but for much smaller systems.) This means that a village which is purchasing electricity from the national grid can also sell back to that grid the energy which has been produced by its village hydro scheme. The first pilot scheme to adopt this was the Athuraliya village hydro at in Ratnapura with a capacity of 21 kW. The grid connection and upgrade costs were borne by donors (including a consultancy cost borne by the RERED Project) and village residents were issued shares to the value of their investment in the assets of a new power company, allowing them to benefit from dividend income once payments are received from CEB from the power bought by the utility.

Component 4. Energy Efficiency and Demand Side Management

This component was intended to be complementary to the renewable energy investments but was too small to make any significant impact. In the original design, 0.9% of the total financing was allocated to this component. In reality, only 0.1% of total actual expenditure was incurred. Under component 4, six energy efficiency projects were refinanced for a total of US$ 154,000 which leveraged a total investment of US$ 330,000. The number of sub-projects was small because

there was very limited demand for the support provided under this component. The availability of similar support with better financial terms from the Environmental Friendly Solutions Fund (E-Friends) supported by JICA made it difficult for the component to take off.

Component 5. Cross-sectoral Energy Applications

This component was designed to be a small but significant activity using 2.1% of the total financing envelope. Final accounting shows that less than 0.05% of funds were used to finance activities under this component. Two consultancy services were contracted and carried out to assess electricity needs of public institutions in the North and East of Sri Lanka. In addition, two other pilot projects to electrify a government school and a hospital in the Eastern and Northern provinces did not proceed due to the escalation of the military conflict at the time.

Component 6. Technical Assistance

The TA component funded a number of important activities such as environmental audits, physical verification of assets, and overall support to the RERED AU. Several studies were also carried out under this component, including:

- Technical assessment of Sri Lanka's renewable energy resource based energy generation for the connection and management of embedded generation;
- Wind integration study to assess the absorption capacity of the grid to an increase in wind power;
- Support for due diligence of two proposed wind farms to be refinanced by RERED;
- Evaluation of capital market constraints to finance renewable power projects;
- Feasibility and mechanism for connecting off-grid hydro schemes to the grid;
- Solar industry growth analysis.

TA activities were of tremendous value to many Project stakeholders and contributed to a greater understanding of sector and project-related issues for developers/investors, commercial banks/MFIs, industry associations, the CEB, other government agencies and stakeholders. These knowledge products focused on the important elements of successful sector development (e.g. techno-economic appraisal of projects, environmental and social considerations, and financial aspects of the energy sector.) The provision of TA activities including both studies as well as human resource capacity building through hands-on training and workshops that has lead to the creation of a more robust and mature sector.

Annex 3. Economic and Financial Analysis

This annex summarizes ex-post economic and financial analysis of three of the dominant areas financed under this project and compares them to expectations at Project Appraisal. These are: (i) grid connected renewable energy projects using a 2.5 MW mini-hydro project as a representative project, (ii) solar home systems using a 40 Wp SHS as a representative project, and (iii) community-based village hydro projects using an 7.5 kW project serving 30 households as a representative project. The analysis is conducted for a typical project in 2010. The analysis is undertaken for a representative investment in each investment category. The LKR to US$ exchange rate at Appraisal was 92 LKR per US$ and in 2010 it was 112 LKR per US$.

Mini-Hydro Sub-projects

Mini hydro, biomass power and wind power projects feed power to the national grid at a substation with adequate capacity that is nearest to the power plant. All mini-hydro projects are on streams/rivers in the hill country except for two projects in Polonnaruwa District where one mini-hydro project is at the dam toe on Maduru Oya Reservoir and another at a canal drop. The wind projects are in Puttalum district in the North Central Province (See Figure 2). The one (1) MW biomass power plant is no longer operating.

An economic and financial analysis was conducted for one representative mini hydro project as mini hydro projects were the dominant class of grid tied projects financed by RERED. The economic analysis shows that the project economics is robust and the economic returns are better than estimated during Appraisal.

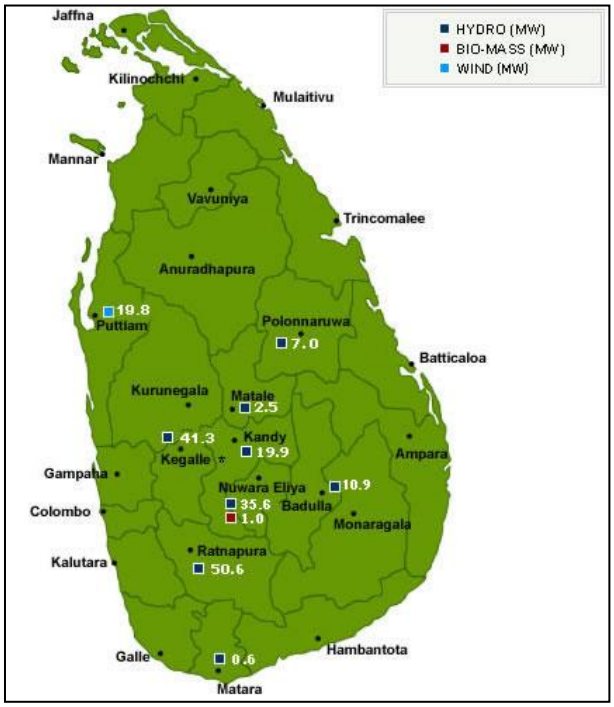

Figure 2 Grid-tied Sub-Project Locations

The EIRR for the representative project is 45.8 percent compared to 24 percent at appraisal. The higher EIRR is principally due to higher economic SRMC of generation of thermal plants offset by operating the mini hydro plants. The FIRR for the project is 17.3 percent compared to 21 percent at Appraisal. The lower FIRR is due to higher investment cost and lower plant capacity factor.

The 2010 analysis values economic benefits from avoiding CO_2 emissions. The increase in EIRR due to emissions avoided is 1.8 percent. Economic avoided cost is based on the SRMC of generation of the most expensive generators. The sources of data and assumptions used to estimate the avoided cost is given in Box 1.

Key data and results and comparison with estimates at Project Appraisal are given in Table 4.

Table 4 Mini-hydro Project Assumptions and Results

Representative Mini hydro Project	Units	At Appraisal	At Project Close
Representative Project Capacity	MW	1.5	2.5
Unit Economic Cost	2010 USD/kW	1,177	1,445
Unit Financial Cost	2010 USD/kW	1,766	1,786
Capacity Factor	Percent	46%	38%
O&M Cost	Percent of Capex	5%	2.5%
Project construction time	Months	10 to 15	Up to 24
Economic avoided cost (See text box)	2010 USD/kWh	0.077	0.252
Tariff	2010 USD/kWh	0.077	0.116
Carbon Emissions Factor	tons/MWh	-	0.80
Economic Value of Carbon Avoided	USD/ton CO2	-	15.00
Financial CER Credit	USD/ton CO2	-	4.68
Results			
Economic Internal rate of return	Percent	24.0%	45.8%
Financial Internal Rate of Return	Percent	21.0%	17.3%

Box 1 Assumptions in Calculating Avoided Cost

Economic short run marginal cost at 33 kV	0.252	US$/kWh
Financial short run marginal cost at 33 kV	0.118	US$/kWh
Flat rate tariff for mini hydro	0.116	US$/kWh

- Calculations are based on mini hydro power offsetting CEB and Independent Power Producer (IPP) diesel-fired plants (CAES and GT16) and Naphtha combined cycle plant (CCKP), the highest cost generators in CEB system according to CEB 2011 tariff application.
- The SRMCs are based on diesel at 0.63 US$/liter and Naphtha at 0.75 US$/kg.
- Variable Operations and Maintenance (O&M) cost is 4.5 US$/MWh for diesels and 3.5 US$/MWh for combined cycle plant.
- Transmission loss is 1.89% as per CEB tariff application.
- Diesel Specific Fuel Consumption (SFC) is 0.25 liters/kWh and Naphtha SFC is 0.34 kg/kWh. Flat rate tariff for mini-hydro from PUCSL.

Data on CEB marginal plant operation used for SRMC calculation

Owner	Thermal Gen Unit	Fuel	Financial Fuel Cost (LKR/kWh)	GWh for 6 months (Jan-Jun '11)	Capacity Factor with 270 GWh of NCRE
CEB	GT16	Auto diesel	36.89	1.71	0.5%
IPP	CAES	Auto diesel	18.98	24.76	3.5%
CEB	CCKP	Naphtha	12.63	249.52	34.8%

Source: CEB Tariff Application (2011)

The economic and financial analyses are given in Table 5 and Table 6.

Table 5 Economic Analysis of Mini Hydro Sub-Project

Mini-Hydro Project Economic Analysis (In 2010 US$)

Year	Capex	O&M	Total Cost	kWh supplied	Economic Output	CO2 Avoided	Total Value	Net Value
1	2,168,036		2,168,036	-	-	-	-	(2,168,036)
2	1,445,357		1,445,357	-	-	-	-	(1,445,357)
3		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
4		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
5		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
6		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
7		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
8		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
9		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
10		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
11		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
12		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
13		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
14		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
15		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
16		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
17		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
18		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
19		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
20		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
21		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
22		90,335	90,335	8,322,000	2,099,699	99,864	2,199,563	2,109,228
EIRR								45.8%

Table 6 Mini Hydro Financial Analysis

Mini-Hydro Project Financial Analysis (In 2010 US$)

Year	Capex	O&M	Total Cost	kWh	Elec. Sales Revenue	CER Revenue	Total Revenue	Net Value
1	2,678,571		2,678,571	-	-	-	-	(2,678,571)
2	1,785,714		1,785,714	-	-	-	-	(1,785,714)
3		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
4		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
5		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
6		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
7		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
8		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
9		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
10		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
11		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
12		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
13		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
14		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
15		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
16		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
17		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
18		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
19		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
20		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
21		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
22		111,607	111,607	8,322,000	968,919	31,158	1,000,076	888,469
FIRR								17.3%

Off Grid Systems

Off grid systems supported by RERED were principally SHS and village hydro schemes and two biomass powered mini-grids. The distribution of installations is shown in Figure 3. As expected the off-grid systems are predominantly in districts that have lower electrification coverage. Presently, GoSL considers consumers where a grid connection cost is more than LKR 200,000 (approximately US$1,785 in 2010 US$) to be candidates for off-grid solutions and they estimate there are about 40,000 such consumers. In contrast, in 2002 when grid coverage was much less, the marginal cost of grid connection was US$300 (about US$450 per connection in 2010 US$).

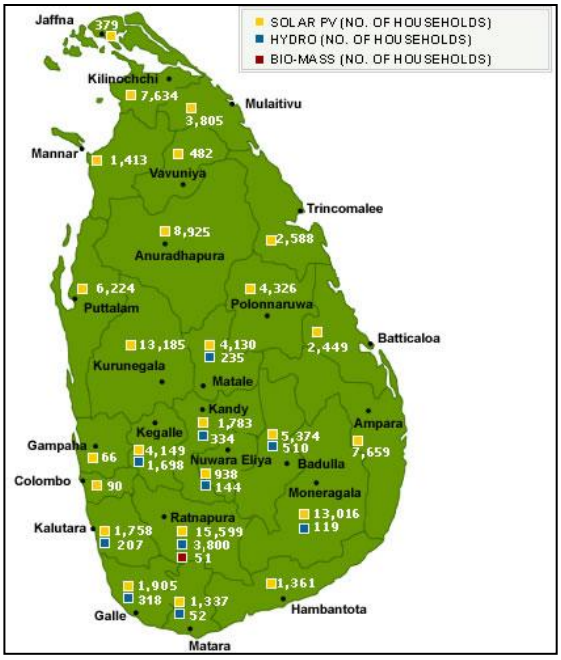

Figure 3 Distribution of Off-grid Systems

Solar Home Systems

SHS are purchased by households and enterprises that either do not want to wait a long time to receive

grid connection or by those in located in areas where grid connection is not cost effective or is impossible.

The SHS offers basic electricity services to those switching from kerosene for lighting and using rechargeable batteries to operate small appliances such as television or radio. A 40 Wp SHS[14] will provide about 5.5 kWh a month and for the purpose of analysis, 2.3 kWh/month is assumed to be used for lighting and the balance for other purposes such as operating a TV and other appliances. At this scale of electricity use it is not a substitute for grid electricity that has the potential to offer "unlimited" electricity at low cost (households consuming small amounts of electricity, for example 30 kWh/month or less, the tariff is highly subsidized).

The economic and financial analysis considers the benefits to derive from (a) kerosene fuel and kerosene lanterns displaced, and (b) rechargeable batteries and battery charging costs avoided. The economic analysis additionally considers the economic value of carbon emissions avoided and the consumer surplus due to superior lighting provided by electric lamps compared to kerosene lamps[15]. Consumer surplus assumptions and results are shown later in Table 16.

The EIRR for the 40 Wp SHS providing electric lighting and electricity for television, radio or other small appliance was 95 percent when Consumer Surplus was taken into account. If Consumer Surplus was not considered, then EIRR was 16 percent. EIRR was not reported at appraisal. The FIRR was 12 percent. At appraisal FIRR was estimated at 7 percent. Comparative data for 40 Wp SHS at Appraisal, ICR and summary of results is given in Table 7.

Table 7 Assumptions and Results for 40 Wp SHS

Representative 40 Wp SHS	Units	At Appraisal	At Project Close
Size	Wp	40	40
Economic SHS Cost	2010 USD	N/A	447
Financial SHS Cost	2010 USD	518	500
RERED Grant	2010 USD	103	40
Other Grants	2010 USD	-	91
Total Grant	2010 USD	103	131
Financial Cost after grant	2010 USD	415	369
Module Life	Years	15	15
Battery Life	Years	3	3
Financial Battery Cost	2010 USD	72	71
Controller Life	Years	7	7
Financial Controller Cost	2010 USD	47	32
Economic Cost of Kerosene	LKR/Liter	N/A	83
Financial Cost of Kerosene	LKR/Liter	N/A	51
Results			
EIRR w/ consumer surplus		N/A	95%
EIRR w/o consumer surplus		N/A	16%
FIRR		7%	12%

[14] The average size of a SHS supported by RERED was 43 Wp and 97 percent of SHS were in 20-60 Wp range. See http://www.energyservices.lk. It should be noted that the GEF grant was being phased out and from Jan 1, 2007, a 40Wp system was no longer entitled to a GEF grant. A US$40 grant was available only for SHS below 20Wp while the GoSL subsidy continued. From January 2010, the US$40 GEF grant was made available for systems up to 30Wp.

[15] Consumer Surplus is calculated using the approach detailed in Meier, Peter, "An Economic Analysis of Solar Home Systems: A Case Study for the Philippines", February 3, 2003, The World Bank and available at http://www.worldbank.org/retoolkit.

The cost, usage patterns and output from kerosene lighting and rechargeable batteries used in the economic and financial analyses are given in Table 8.

Table 8 Costs Avoided with SHS

Displaced when using SHS		Financial	Economic
Kerosene savings	Liter/month	5.7	5.7
Cost of kerosene	LKR/Liter	51	83
Cost Savings Kerosene	USD/month	2.60	4.22
Number of lamps		2	
Lamp Life (Years)	Year	5	
Lamps Cost	USD/month	3	2.4
Recharged Batteries/HH		1	1
TV use	hours/day	3	3
TV wattage	watts	14	14
Energy/day	Wh	42	42
Recharge interval	days	14	14
Battery capacity	Ah	61	61
Usable capacity	Ah	70	70
Charging cost	LKR/charge	100	88
Annual Charging Cost	USD	23	20
Battery cost	LKR	71	47
Battery Life	years	5	5

The EIRR and FIRR calculations are given in Table 9 and Table 10.

Table 9 SHS Economic Analysis

SHS Economic Analysis (In 2010 US$) for 40 Wp SHS

Year	Capex	Lamp Replace-ments	Battery Replace-ment	Controller Replace-ment	Total Cost	Economic Avoided kerosene	Batteries Displaced	CO2 Avoided	Consumer Surplus	Total Value	Net Value	Useful kWh/Year
1	447	0			446.89	48.18	67.27	2.77	124.53	242.76	-204.13	65.7
2		5.50			5.50	43.47	20.48	2.77	124.53	191.26	185.76	65.7
3		5.50			5.50	43.47	20.48	2.77	124.53	191.26	185.76	65.7
4		5.50	46.51		52.00	43.47	20.48	2.77	124.53	191.26	139.25	65.7
5		5.50			5.50	43.47	20.48	2.77	124.53	191.26	185.76	65.7
6		5.50			5.50	48.18	67.27	2.77	124.53	242.76	237.26	65.7
7		5.50	46.51		52.00	43.47	20.48	2.77	124.53	191.26	139.25	65.7
8		5.50		28.93	34.43	43.47	20.48	2.77	124.53	191.26	156.83	65.7
9		5.50			5.50	43.47	20.48	2.77	124.53	191.26	185.76	65.7
10		5.50	46.51		52.00	43.47	20.48	2.77	124.53	191.26	139.25	65.7
11		5.50			5.50	48.18	67.27	2.77	124.53	242.76	237.26	65.7
12		5.50			5.50	43.47	20.48	2.77	124.53	191.26	185.76	65.7
13		5.50	46.51		52.00	43.47	20.48	2.77	124.53	191.26	139.25	65.7
14		5.50			5.50	43.47	20.48	2.77	124.53	191.26	185.76	65.7
15		5.50		28.93	34.43	43.47	20.48	2.77	124.53	191.26	156.83	65.7
NPV @ Discount Rate		10%			551	339	241	21	947	1,549	998	500
Levelized Economic Electricity Cost					1.10	USD/kWh						
EIRR		88% with Consumer Surplus				13% w/o Consumer Surplus						

Table 10 SHS Financial Analysis

SHS Financial Analysis (In 2010 US$) for 40 Wp SHS

Year	Capex net of grants	Lamp Replace-ments	Battery Replace-ment	Controller Replace-ment	Total Cost	Kerosene Cost Avoided	Battery Use Displaced	Total "Revenue"	Net Revenue	Useful kWh/Year
1	369.00	-			369.00	36.50	94.71	131.21	(237.79)	65.7
2		6.00			6.00	31.15	23.28	54.42	48.42	65.7
3		6.00			6.00	31.15	23.28	54.42	48.42	65.7
4		6.00	71.00		77.00	31.15	23.28	54.42	(22.58)	65.7
5		6.00			6.00	31.15	23.28	54.42	48.42	65.7
6		6.00			6.00	36.50	94.71	131.21	125.21	65.7
7		6.00	71.00		77.00	31.15	23.28	54.42	(22.58)	65.7
8		6.00		32.00	38.00	31.15	23.28	54.42	16.42	65.7
9		6.00			6.00	31.15	23.28	54.42	48.42	65.7
10		6.00	71.00		77.00	31.15	23.28	54.42	(22.58)	65.7
11		6.00			6.00	36.50	94.71	131.21	125.21	65.7
12		6.00			6.00	31.15	23.28	54.42	48.42	65.7
13		6.00	71.00		77.00	31.15	23.28	54.42	(22.58)	65.7
14		6.00			6.00	31.15	23.28	54.42	48.42	65.7
15		6.00		32.00	38.00	31.15	23.28	54.42	16.42	65.7
NPV @ Discount Rate:			10%		531.09	246.67	307.34	554.02	22.93	500
Levelized Cost					1.06	USD/kWh				
FIRR					12%					

Village Hydro

Under RERED, 174 Village Hydro Projects (VHP) were refinanced and have all been commissioned; 14 VHPs remain to be completed as of December 31, 2011. The median VHP project had 7.5 kW serving 27 customers. The largest project had a capacity of 48 kW serving 102 customers and the smallest, 3 kW serving 2 customers. The economic and financial analysis was done for a representative project, Andawala in Udagama with 7.5 kW serving 30 customers. The project potentially could supply 22 MWh/year at a load factor of 33 percent (~8 hours/day at peak capacity). However, only a small portion may be needed for household lighting and appliances (5 MWh/year), thus leaving 17 MWh/year for other purposes, including productive uses.

The economic and financial analysis results and the characteristics of the project and comparison to the VHP scheme analyzed at Appraisal are given in Table 11. The EIRR with Consumer Surplus was 54 percent and without it was 10 percent. The EIRR at appraisal was 12 percent. The FIRR was 50 percent compared to the estimate of 10 percent at appraisal. The higher FIRR is due to lower cost of the project to the community (after RERED and government grants) of US$700/kW compared to US$940/kW at appraisal. The VHP project analysis at appraisal assumed revenues from electricity sales to community of US$2600, compared to US$3,000 for the representative project analyzed.

Table 11 Economic and Financial Analysis of VHP

Representative VHP Project	Units	At Appraisal	At Project Close
VHP Capacity	kW	11.0	7.5
Customers	Number	50-60	30
Investment Financial Cost	2010 USD	21,630	14,005
Project Dev. Financial Cost	2010 USD	10,300	7,000
Total Project Financial Cost	2010 USD	31,930	21,005
Total Project Economic Cost	2010 USD	N/A	17,854
Unit Cost	2010 USD/kW	2,903	2,801
Grant	2010 USD	16,774	15,728
Net Financial Cost	2010 USD	15,156	5,277
Net Unit Financial Cost	2010 USD/kW	1,378	704
O&M Cost	% of investment	8%	7%
Project Life	Years	20	15
Results			
EIRR with consumer surplus		N/A	55%
EIRR without consumer surplus		N/A	10%
EIRR (unknown method or assumptions)		12%	-
FIRR		10%	50%

The savings to village from avoided kerosene and battery use is summarized in Table 12.

Table 12 VHP Avoided Cost

Kerosene savings per household	liter/month	5.7	5.7
Cost of kerosene	LKR/liter	51.0	83.0
Kerosene Savings per household	LKR/month	291	473
CO2 emissions factor	kg/liter	2.7	2.7
CER Credit Value	USD/ton CO2	0	15
Lights per Household		4	4
Cost per lamp	USD	3	2.7
Other electricity uses after hydro	kWh/month/HH	10	10
Recharged Batteries/HH		1	1
TV use	hours/day	6	6
TV wattage	watts	20	20
Energy/day	Wh	120	120
Recharge interval	days	7	7
Battery capacity	Ah	88	88
Use capacity	Ah	100	100
Charging cost	LKR/charge	100	88
Annual Charging Cost	Million LKR	0.156	0.138
Battery cost	Rs	11,500	7533
Battery Life	years	5	5
Total cost of batteries	Million LKR	0.345	0.226

The economic and financial analyses are given in Table 13 and Table 14.

Table 13 VHP Economic Analysis

Village Hydro Project Economic Analysis (In 2010 US$)

Year	Capex	O&M	Total Cost	Economic Avoided kerosene	Batteries Displaced	CO2 Avoided	Consumer Surplus	Total Value	Net Value	Useful kWh/Year
1	17,854		17,854	-	-	-		-	(17,854)	0
2		980	980	1,545	3,247	83	7,118	11,993	11,013	5,133
3		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
4		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
5		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
6		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
7		980	980	1,545	3,247	83	7,118	11,993	11,013	5,133
8		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
9		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
10		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
11		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
12		980	980	1,545	3,247	83	7,118	11,993	11,013	5,133
13		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
14		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
15		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
16		980	980	1,304	1,229	83	7,118	9,734	8,754	5,133
	NPV		23,010	9,417	11,844	575	54,140	71,054	48,044	35,493
	Levelized Cost		0.648	USD/kWh						
	EIRR		54%	w/ Consumer Surplus and			8.6%	w/o Consumer Surplus		

Table 14 VHP Financial Analysis

Village Hydro Project Financial Analysis (In 2010 US$)

Year	Capex net of grants	O&M	Total Cost	Kerosene Cost Avoided	Batteries Displaced	Total Value	Net Value	kWh/Year
1	5,277		5,277	-	-	-	(5,277)	-
2		980	980	1,175	4,477	5,653	4,672	5,133
3		980	980	934	1,397	2,331	1,351	5,133
4		980	980	934	1,397	2,331	1,351	5,133
5		980	980	934	1,397	2,331	1,351	5,133
6		980	980	934	1,397	2,331	1,351	5,133
7		980	980	1,175	4,477	5,653	4,672	5,133
8		980	980	934	1,397	2,331	1,351	5,133
9		980	980	934	1,397	2,331	1,351	5,133
10		980	980	934	1,397	2,331	1,351	5,133
11		980	980	934	4,477	5,411	4,431	5,133
12		980	980	1,175	1,397	2,572	1,592	5,133
13		980	980	934	1,397	2,331	1,351	5,133
14		980	980	934	1,397	2,331	1,351	5,133
15		980	980	934	1,397	2,331	1,351	5,133
16		980	980	934	1,397	2,331	1,351	5,133
	NPV		11,576	6,861	14,864	21,724	10,148	35,493
	Levelized Cost		0.326	USD/kWh				
	FIRR		50%					

Other Assumptions and Consumer Surplus Calculation

The other assumptions used in the economic and financial analyses are given in Table 15.

Table 15 Assumptions Used in Economic and Financial Analysis

Conversion from 2002 to Constant 2010 USD (mid-year)	1.47	multiplier
Exchange Rate 2010	112	LKR/USD
Discount rate	10%	
CER Credit Value	4.68	$/ton CO2
Economic Value of CO2 avoided	15	$/ton CO2
Kerosene emissions factor	2.7	kg/liter
Kerosene Economic Price	83.00	Rs/Liter
Kerosene Subsidy	32.00	Rs/Liter
Source: Ceylon Petroleum Corporation		

Duties & Taxes	**Percent**
Assumes most imports from India	
Mini hydro	
E&M equipment (assumes BOI project - duty & VAT free imports, but pays PAL, NBT)	8.5%
Civil Works (Steel, Concrete etc.)	34.9%
Weighted average duties and taxes	19.1%
Solar Home Systems	
Solar Module	9.6%
Battery	34.5%
Controller	9.6%
Lights	8.4%
BOS	12.0%
Installation	12.0%
Dealer margins	0.0%
Weighted average	10.6%
Village Hydro	
SHP & Distribution Network (VAT, NBT, PAL)	22.5%

Consumer surplus is calculated for SHS and VHP using the methodology described in Peter Meier, "An Economic Analysis of Solar Home Systems: A Case Study for the Philippines", February 3, 2003, The World Bank[16]. The calculation and results are given in Table 16.

Table 16 SHS and VHP Consumer Surplus Calculation and Results

Consumer Surplus for SHS and Village Hydro		
	40 Wp SHS	Village Hydro
Kerosene Fin. Cost (LKR/Liter)	51.0	51.0
Kerosene (Liters/month)	5.7	5.7
Number of lamps	2	3
Lamp Life (Years)	5	5
Lamps Cost LKR	300	300
Kerosene (Liters/Year)	68.4	68.4
Battery Cost (LKR)	11,500	11,500
Battery Life (years)	5	5
Recharging Cost/Year (LKR)	4,589	4,589
Kerosene Lumens/lamp	20	20
Liters/hour	0.025	0.025
Lumen hours/liter	800	800
Kerosene light output (lumen-hours/year)	54,720	54,720
Lighting Cost (USD/lumen-hour)	0.0006	0.0006
Kerosene lighting annual cost (LKR)	32	33
Solar lamp rating (W)	5	7
Solar Lamps (lumens/watt)	30	30
Hours/day of Lighting	4	4
No. of lamps	3	4
Lumen Hours/Year	657,000	1,226,400
Watt hours/Year (20% losses)	27,375	51,100
USD/kWh	1.0628	0.3262
Annual Lighting Cost (USD)	29.09	16.67
Lighting Cost USD/lumen-hour	0.000044	0.0000136
Economic Lighting Consumer Surplus USD/HH/Year	125	237

Note Consumer Surplus uses 2/3 of rectangular area under demand curve to reflect its concave shape

[16] http://siteresources.worldbank.org/EXTRENENERGYTK/Resources/5138246-1237906527727/Economic_Analysis_of_Solar_Home_Systems.pdf

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending			
Supervision/ICR			
Abdulaziz Faghi	Energy Specialist	SASDE	-
Amali Rajapaksa	Senior Infrastructure Specialist	SASDT	-
Boonsri Prasertwaree Kim	Program Assistant	SASDO	-
Darshani De Silva	Environmental Specialist	SASDI	-
Deepal Fernando	Senior Procurement Specialist	ECSO2	-
Donna Thompson	Sr Financial Management Specialist	OPCFM	-
Gevorg Sargsyan	Program Coordinator	SEGEN	-
Hiran Heart	Consultant	SASDI	-
Jiwanka B. Wickramasinghe	Sr Financial Management Specialist	SARFM	-
Lashantha Handapangoda Jayawardhana	Consultant	SASDI	-
Luis Alejandro Lara Lopez	Program Assistant	SASDO	-
Md. Iqbal	Senior Energy Specialist	SASDE	-
Mikul Bhatia	Senior Energy Specialist	SEGEN	-
Miriam Witana	Procurement Specialist	EAPPR	-
Peter Johansen	Senior Energy Specialist	ECSS2	-
Raihan Elahi	Senior Energy Specialist	AFTEG	-
Ravindra Anil Cabraal	Consultant	AFTEG	-
Seenithamby Manoharan	Senior Rural Development Specialist	SASDA	-
Shane Andrew Ferdinandus	Program Assistant	SASDO	-
Shaukat Javed	Program Assistant	SASDO	-
Sriyani De Alwis	Team Assistant	SACSL	-
Sriyani M. Hulugalle	Senior Economist	SASFP	-
Sumith Pilapitiya	Lead Environmental Specialist	SASDI	-
Supul Chamikara Wijesinghe	Financial Management Specialist	SARFM	-

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD Thousands (including travel and consultant costs)
Lending		
FY02	22.63	70,966
FY03	0.00	0
Total:	**22.63**	**70,966**
Supervision/ICR		
FY03	25.37	80,118
FY04	22.77	64,358
FY05	18.98	47,457
FY06	19.63	67,250
FY07	16.03	43,334
FY08	26.47	85,307
FY09	27.65	113,345
FY10	19.16	85,112
FY11	20.28	88,388
FY12	16.01	100,271
Total:	**212.35**	**845,906**

Annex 5. Results of Beneficiary Surveys

To obtain feedback from beneficiaries, a survey of PCIs lending to grid-connected sub-projects and SHS was undertaken. The AU undertook a number of surveys. Different questionnaires were prepared for each of the two sectors.

PCIs lending to grid-connected sub-projects

The questionnaire was sent to four PCIs actively involved in lending to grid-connected sub-projects and responses were received from three (3) of them. The questionnaire was not sent to DFCC Bank. The most salient points were:

1. All respondents stated that they have started financing grid-connected renewable energy investments because of ESD/RERED, as it offered long-term financing, the PCIs could extend the tenures of their loans to developers. Overall, RERED was critical for the development of the portfolio of sub-projects financed by the PCIs.

2. The refinancing credit line improved the liquidity position of the PCIs and accelerated credit growth. Further, the conditions of refinancing were attractive with a long repayment period, concessionary interest rates and low volatility because the interest rate was linked to the AWDR which was an acceptable benchmark to the banks, which in turn allowed the banks to offer lower interest rates to the developers. The rates typically charged by commercial banks in the absence of RERED refinancing would have been too costly and some of sub-project may have become unfeasible.

3. In addition to the refinancing, the PCIs valued the technical assistance provided. In particular, the training extended to their staff in order to build in-house capacity, and on financing of low head hydro and wind projects. Also the hydro and wind related overseas study tours, workshops and seminars were appreciated.

4. When asked what the PCIs did not like about the support given by RERED, one PCI mentioned the lengthy procurement procedures and another would have preferred if 100% refinancing was extended for the sub-loan instead of the ceiling of 80%.

5. The PCIs were also asked to rate the support provided by RERED on a 10-point scale with 10 being perfect. The average rating was 8.3. One PCI remarked that: "in an interest rate falling scenario in the country the refinancing scheme proved to be more expensive than the commercial lending possible by the banks. During this time, some projects were financed by commercial loans. However, subsequently this rate was amended."

6. The performance of the AU was rated very highly. On all aspects (guidance and help provided, responsiveness and timeliness of actions and quality of work) the average score was 9.3. The PCIs expressed their great appreciation for the AU who had worked diligently to provide direct and valuable assistance to them. This was done independent from GoSL and the World Bank and the PCIs did not need to resort to them to resolve most of their issues.

7. All PCIs indicated that they will continue lending for grid-connected renewable energy projects after RERED closure; however, the interest rate will be based on commercial rates and thus projects which are marginally viable, will likely not be able to obtain financing.

8. One of the PCIs, Hatton National Bank, received a runner-up award in the Development Project Financing category at the Asian Banking Award 2004 for their involvement in financing off-grid village hydro schemes.

PCIs financing SHS

The questionnaire was sent to three (3) PCIs involved in SHS financing. The following is a summary of the main issues emerging from their responses:

1. The reasons for households not repaying their SHS loans were: (i) poor after sales service by suppliers; (ii) grid connection; (iii) financial problems; (iv) willful defaulters; and (v) problems with quality of the product.

2. About 40% of the SHS loans were non-performing (small loans in particular) and of the total loan value, 19% was non-performing. PCIs repossessed 23% of the modules for systems they financed and only 41% of the repossessed modules could be sold.

3. The PCIs were asked to rate different aspects of the vendors on a 10-point scale. The results were: system quality: 5, user manual/operation training: 1, honoring warrantee: 1 and provision of after sales services: 0. The low scores reflected the dissatisfaction of the PCIs with the industry.

4. In terms of their support to the Project, the AU received an average score of 6.7.

Annex 6. Stakeholder Workshop Report and Results

The off-grid electrification target of RERED was 101,000 households, rural small and medium enterprises and public institutions. The Additional Finance increased this target to 161,000. Sales of SHS, was the main vehicle to reach this target. In 2009 the RERED Solar PV Investment component was facing serious challenges. While the component reached 66 percent of its target, it was witnessing a steady year-to-year decline in annual installations. If the decline could not be stopped, it would be difficult to reach the target.

To analyze the problems and to identify solutions, the AU organized a participatory PV Component Trouble Shooting Workshop. The two-day workshop was held in Colombo on November 17-18, 2009. Seventeen participants attended the workshop, representing PV companies, MFIs, leasing companies, the AU and the World Bank. The participants conducted a problem analysis and proposed possible solutions.

From the problem analysis it was clear that the RERED solar PV investments component was in a downward cyclical trend and represented in Figure 4 below:

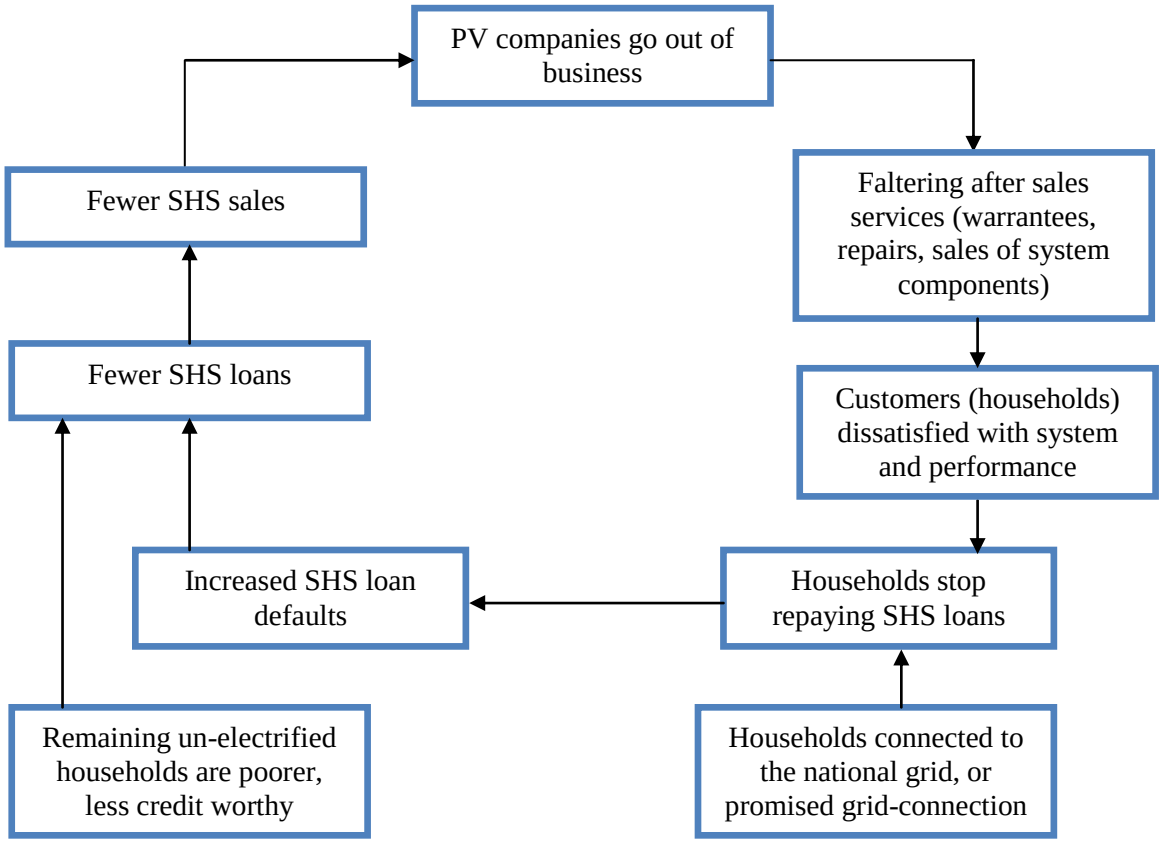

Figure 4 SHS Problem Analysis

The following actions were proposed by the workshop:

1. PV companies should diversify their business and not only rely on SHS sales;

2. RERED will commission a study to come-up with a solution for warrantee problems;

3. PV companies will prepare a plan for Coordinated System Service by PV Companies to reduce both risks and costs;

4. The AU will prepare a PV Component Wind-Down Plan in case the PV component stops;

5. PV companies will specify products they will offer for cash sales which meet RERED specs;

6. RERED will extend the same GEF subsidy from 20 Wp systems to < 40 Wp systems;

7. AU and PV companies agreed on an awareness creation plan;

8. PV companies, in consultation with MFI's will prepare information for end-users (i.e. households) on their rights and obligations for their PV system should they be connected to the grid. This will also include information on what is included in the lease including what is covered in the lease agreement (i.e. commissioning and repairs during the warrantee period) and what needs to be paid by households beyond the warrantee period;

9. RERED will commission a study to improve the PV loan payment collection.

Although all stakeholders supported the recommendations, it was concluded that it was too late to implement these and revive the solar PV investments component. In 2010, the Project was restructured to reduce the target from 161,000 households, small and medium enterprises and public institutions to 113,500.

Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR

Renewable Energy for Rural Economic Development Project:
Borrowers Report

1. Introduction

The Government of Sri Lanka (GOSL), with the assistance of the World Bank and the Global Environment Facility (GEF) established the Renewable Energy for Rural Economic Development (RERED) Project as a credit line along with a co-financing grant and technical assistance component, with the development objective of (a) improving the quality of rural life by utilising off-grid renewable energy (RE) technologies to bring electricity to remote communities and (b) promoting private sector power generation from renewable energy resources for the main grid. The Global objective was to reduce atmospheric carbon emissions by removing barriers and reducing implementation costs for RE and by promoting energy efficiency.

RERED was a follow-on project to the previous Energy Services Delivery (ESD) project implemented during 1997-2002. The RERED design was based substantially on the ESD experience.

RERED was implemented from 2002 with an International Development Association (IDA) Credit of US$ 75 million (Credit NO. 36750 CE) and a GEF Grant of US$ 8 million (Trust Fund Grant No.TF-51248). Consequent to the success of the Project and the strong demand, RERED was extended by three years with Additional Financing (AF) of US$ 40 million provided by IDA (Credit No. 36731 CE). The Project was implemented until closure on 31 December 2011, after a six month extension.

The Project had six components, namely, (i) Grid-connected renewable energy power generation, (ii) Solar photovoltaic investments, (iii) Independent grid systems, (iv)Energy efficiency and demand-side management (v) Cross-sectoral energy applications and (vi) Technical assistance.

The Project was implemented by an Administrative Unit (AU) set up within DFCC Bank – a private sector development bank. Credit funds were channelled in the form of refinance for loans for subprojects (individual investments) from participating credit institutions (PCIs). The PCIs made independent project assessments and took on the credit risk. The PCIs and the AU ensured that the subprojects complied with the RERED Environmental and Social Assessment and Management Framework and complied with World Bank procurement guidelines. The AU was responsible for promoting the Project and achieving its targets; administering the technical assistance and co-financing components, the GOSL solar subsidy scheme[1] ; ensuring technical and safety standards and consumer protection; and for fostering new renewable energy technologies.

2. Assessment of the project objectives, design, implementation experience and outcomes

The Project's development objectives were highly relevant at the time and still continue to be relevant. The currently stated goals of GOSL are that (i) 100% of Sri Lanka's households will have access to electricity by end 2012 and (ii) 10% of Sri Lanka's electricity generation will be from non-conventional renewable energy (NCRE)[2] sources by end 2015 and 20% by 2020. While these are ambitious targets, RERED has played a crucial role towards the achievement of these objectives.

Achievements of the Project's Key Performance Indicators are indicated in the following table:

RERED Key Performance Indicators:

Indicator	Units	Target	As of 31 Dec 2011
Grid connected RE capacity commissioned	MW	135	147.8
Off-grid households electrified	Nos.	113,500	116,795
Off-grid enterprises	Nos.	1,500	742
Carbon emissions avoided	CO_2 Million Tons	1.25	2.15

[1] The GOSL subsidy scheme for solar was not in the original design of the RERED Project.

[2] NCRE refers to all renewable energy based generating sources such as small scale run-of-the-river hydro (upto 10MW), wind, bio-mass and solar PV etc and does not include large reservoir based hydro electric schemes.

The project disbursed essentially the entire amount of funds allocated to it, save for US$61,913 under GEF Grant funds and US$12,052 under IDA Credit 3673 CE. The following is a summary of disbursements:

RERED Disbursement Position

Category	Plan US$ million	Disbursed[3] US$ million
IDA 3673-CE	75.0	79.74
IDA 3673-1-CE	40.0	40.99
GEF TF 51248	8.0	7.94
GoSL Counterpart funds c.	0.8	0.50
GoSL Solar Subsidy c.	-	7.23
Total	**123.8**	**136.40**

Grid-connected Renewable Energy Power Generation: The grid-connected generation capacity significantly exceeded project targets and reached **147.8MW** by project closing date. In addition, a further 12 grid connected projects with a planned capacity of **36.5MW** were under construction at project close.

Grid-connected projects funded by RERED[4] as of 30th April 2012

Project Type	Commissioned		Under Construction		Total	
	Projects	Capacity (MW)	Projects	Capacity (MW)	Projects	Capacity (MW)
Hydro	57	137.8	11	26.7	68	**164.5**
Wind	1	10.0	1	9.8	2	**19.8**
	58	**147.8**	**12**	**36.5**	**70**	**184.3**

The final capacity available after completion of all RERED projects will be **184.3MW**. If 15 ESD projects are also included, the final capacity addition will be **215.3MW**.

As of 15 March 2012, three mini-hydro projects with an aggregate capacity of 9.6MW (of the 11 under construction) had been commissioned. By that date, total NCRE capacity connected to the Ceylon Electricity Board (CEB) grid was 243.1 MW from 102 projects as shown below:

Grid Connected NCRE Projects as at 15th March 2012:

Type	Number of Projects				Capacity			
	ALL	ESD	RERED	ESD & RERED	ALL	ESD	RERED	ESD & RERED
Hydro	92	15	60	75	200.2	31.0	147.4	178.4
Wind	3	-	1	1	30.0	-	10.0	10.0
Bio-mass	3	-	-	-	11.5	-	-	-
Solar[5]	4	-	-	-	1.4	-	-	-
	102	**15**	**61**	**76**	**243.1**	**31.0**	**157.4**	**188.4**

The table demonstrates the significant role played by RERED towards the achievement of Sri Lanka's NCRE goals[6]. Out of the 102 projects presently connected to the grid, RERED had funded 61 with a capacity of 157.4MW, constituting 64.7% of NCRE capacity. NCRE projects generated 702 GWh of

[3] Original IDA Credit and AF amounted to SDR 59,300,000 and SDR 26,300,000 respectively. Of this, SDR 4,600,000 was re-allocated for emergency Tsunami relief. The USD depreciated against the SDR by 16.8% over the life of the Project. Hence the US$ amounts disbursed are greater than the planned amounts.

[4] A 1MW bio-mass project funded by RERED in 2004 is no longer in operation and has not been counted. A 1.4MW hydro project funded by both ESD and RERED credit lines has also not been counted as it had already been counted under ESD.

[5] Of the four solar projects, two are grant funded projects of 0.737MW and 0.5MW operated by the Sri Lanka Sustainable Energy Authority. The other two are for a 'Green' hotel and a small TV station.

[6] The aggregate contribution from ESD and RERED to the NCRE capacity as of 15 March 2012 was 77.5% overall and 89.1% for Hydro only.

energy in 2011 constituting over 6.1% of the total grid connected electricity generation.[7] Considering the high cost incurred for petroleum based power generation, RERED's contribution to fuel savings is considerable.

The small-hydro industry in Sri Lanka has developed since 1996 to such an extent that it could be termed as 'World Class'. Sri Lankan developers and contractors have developed and constructed small hydro projects in Africa while competing internationally with reputed firms with long experience. A Sri Lankan turbine manufacturing company, with capacity to fabricate turbines of 1-8 MW capacity, is exporting turbines for small-hydro projects overseas and also competing successfully with European machinery in Sri Lanka.

Wind project development picked-up after the introduction of cost based technology specific tariffs in the later stages of RERED. The Project funded Sri Lanka's first privately owned grid connected wind project. Local banks were initially hesitant to fund wind projects as the country had no significant experience in the operation of such projects, other than CEB's pilot 3MW wind farm funded under ESD where the plant factors were relatively low. The availability of long term RERED funding on a relatively large scale (upto the equivalent of US$8 million in refinance), sharing the cost of independent technical evaluations by international consulting firms and capacity building programmes in the form of training and study tours were factors that provided comfort to local banks. Considering the attractive tariffs offered and the demonstrated success of commissioned projects, there is considerable interest in wind projects and multiple sources of funding through bank and non-bank sources are now available. There are presently nine wind projects under construction with a capacity of 65MW - only one of which is funded by RERED. Two other wind projects which applied for RERED funding could not be served due to lack of funds.

While small hydro and wind, with RERED assistance, are now clearly successful technologies in Sri Lanka, dedicated bio-mass generating projects are yet to establish a track record. The only bio-mass project funded by RERED (in 2004), ceased operations due to a variety reasons including fuel supply issues and frequent grid failures. This was also Sri Lanka's first ever grid connected bio-mass project. The fact that there were more opportunities to be exploited in hydro and wind meant that there was less enthusiasm for comparatively complicated bio-mass based generation projects. Most PCIs have been reluctant to fund bio-mass projects due to uncertain fuel supply. The GOSL has increased the feed-in tariffs in order to make such projects attractive. There are at present three commissioned projects with a capacity of 11.5 MW.

In addition to the 102 commissioned NCRE projects, the CEB had signed 96 standardised power purchase agreements (SPPAs) showing the strong pipeline for RE projects:

SPPAs signed by CEB as of 15 March 2012:

Project Type	Number of Projects	Capacity
Small Hydro	74	142.643
Wind	9	64.950
Bio-Mass	13	65.770
	96	**273.363**

Sri Lankan banks have expressed their willingness to continue to funding grid-connected RE projects. Such projects are also attracting other sources of funds such as from the capital market – there are six companies currently listed on the Colombo Stock Exchange, while certain foreign and local dedicated Energy Funds have invested substantially in Sri Lanka.

Solar photovoltaic investments and Independent Grid Systems: At the time of design, the Government's target was for 75% of the population to have access to grid electricity by 2007. Due to technical and financial constraints, it was envisaged at the time that nearly 20% of the population would eventually be served from off-grid systems. However, as per current plans, 95% of Sri Lankan

[7] In 2010 (a year with higher rainfall), the total energy generation from NCRE (from a lower capacity) was 724 GWh, constituting 6.8% of total generation.

households will have grid access, leaving only around 40,000 households to be served from non-grid sources.

RERED initially targeted electrification of 100,000 rural households by 2007. RERED AF extended it to 160,000 households. This was eventually revised downward to 113,500 in the context of the rapid expansion of the national grid which resulted in reduced demand for off-grid solutions. By Project close, RERED had electrified 116,795 households through Solar Home Systems (SHS) and independent community owned mini-grid systems (village hydro and bio-mass) as shown below:

Solar Home Systems & Independent Grid Systems Installed

	Projects	Capacity (kW)	Households
Solar Home Systems	n/a	4,805.3	110,575
Independent Grid Systems			
Hydro	173	1,747.7	6,181
Bio-Mass	2	22.0	39
Sub-Total	175	1,769.7	6,220
Total		**6,575.0**	**116,795**[8]

A significant impetus for the growth of SHS was the GOSL subsidy scheme of Rs.10,000 per household (initially in 3 provinces and later island wide) which complemented the GEF co-financing grant scheme which was designed to be phased out over the life of the Project. The total outlay in terms of the GOSL subsidy was Rs.757.4 million (approx. US$7.24 million) which was significantly more than the Rs.471.6 million expended as GEF/IDA co-financing grants for solar. While the co-financing grant was finally available only for smaller systems targeting poorer households, these systems were not very popular. The ability to watch television appeared to be a key requirement. LED based systems appeared in the later stages of RERED and were not popularized.

The Solar programme enabled 110,575 households to obtain electricity for lighting and viewing television. While this displaced the use of kerosene for lighting, it meant that school children could study with better lighting; indoor air pollution was reduced or eliminated; serious or even fatal accidents from use of unsafe bottle lamps were reduced; householders had access to a new world of news and entertainment through television; mobile phones could be charged at home and on the whole, quality of life was improved substantially. According to the RERED Monitoring & Evaluation Report, the monthly kerosene consumption for households with an SHS reduced from 11 litres (2005 baseline) to 0.7 litres. The monthly expenditure of Rs.168 on charging batteries was eliminated in 93% of the households.

The above benefits of electricity were also available to 6,220 householders in 175 remote villages with village hydro (VH) or bio-mass schemes. The benefits were more so, as they had access to a continuous supply of AC electricity (SHS provided only DC). This meant that appliances such as irons, kettles, emersion heaters, blenders could be used. In larger capacity projects, even refrigerators were allowed.

These community owned independent schemes also received subsidies from Provincial Councils (PCs), again supplementing the RERED co-financing grant scheme. However, such subsidy schemes were not centrally co-ordinated and were entirely upto the respective PCs, which recognized the social, economic and political benefits of fostering such schemes.

Energy efficiency and Conservation: The Project funded six energy efficiency projects. Progress under this component of RERED was slow due to the existence of the parallel 'E-Friends' credit line which provided funds at more attractive rates. GOSL and the utilities, with RERED support made efforts to popularize the concept of grid tied systems with 'Net Metering' for larger urban homes and offices. The concept is now catching on and some RERED solar vendors are actively engaged in the business. .

[8] Previously under ESD, 20,953 SHS had been installed and 1,732 households were electrified through 35 VH projects. As such, a total of 139,480 households benefited from both ESD and RERED Projects.

(v) Cross-sectoral Energy Applications: The Project funded two surveys to assess energy needs in the Education and Health sectors with a focus on providing RE based electricity solutions for schools and hospitals in off-grid areas and energy efficiency methods for large installations such as base hospitals/teaching hospitals in areas served by the grid. The Project also planned to fund two pilot demonstration projects – a solar powered 'Peripheral Unit' (rural hospital) and a rural school in the Northern and Eastern Provinces. However, the escalation of hostilities at the time prevented their implementation. Eventually, the rapid expansion of the national grid reduced or even negated the need for such off-grid renewable energy based solutions in public sector institutions.

Off-Grid Sub-Project based Enterprises: While RERED initially targeted 1,000 enterprises and RERED AF targeted an additional 500 enterprises, only 742 enterprises were eventually counted, while there could more enterprises which remained uncounted. The 742 enterprises consisted of 665 SHS customers and 77 entrepreneurs using electricity in VH schemes. Most of the entrepreneurs in VH projects were provided technical assistance by RERED consultants through Innovation Solicitation contracts – where consultants encouraged householders to use day-time electricity for income generating activities. The enterprises included grocery shops (use of a refrigerator), battery charging, tailoring and dress making, small scale grinding mills, food preparation, communication facilities and computer training centres.

Most of the 742 entrepreneurs were already engaged in the respective business and used the newly available electricity to expand operations or to extend working hours. It was relatively difficult to encourage villagers to embark on new ventures. The Project did not provide any loan or grant support for such ventures and the entrepreneur had to take on the entire risk. If they needed credit, they had to obtain it from a rural bank or MFI, without RERED support. In the case of innovation solicitation contracts in VH schemes, it was found that many of the villagers were comfortable with the income they received from agricultural pursuits. The majority of VHs were in tea growing areas, and many of the inhabitants were getting a good income from tea small-holdings in an environment of rising tea prices. The opportunity cost and risk of diversifying from tea growing to other ventures were considerable. The market for a village entrepreneur was mostly the village itself. There was limited opportunity to expand and gain through economies of scale. On the whole, this component cannot be termed as successful.

Technical Assistance: The Project spent approximately US$2.05 million on a variety of technical assistance (TA) programmes. Some of the largest TA contracts were in respect of grid strengthening and stability studies for the CEB, including a 'Technical Assessment of Sri Lanka's Renewable Resource Based Electricity Generation' and a 'Wind Integration Study'. The Project supported two independent technical due diligence studies for PCIs in respect of two wind projects and one for a bio-mass project[9].

A 'Low-head Hydro' workshop and a training course for bank credit officers in appraising wind projects (in association with USAID) were well received. A PCI was afforded an opportunity to send a participant to a foreign micro-finance (MF) training course. That PCI is now one of the largest providers of MF. Their initial entry to MF sector was through RERED.

The Project supported the solar industry through training for solar technicians and also commissioned a number of studies/conducted workshops to identify problems and to find solutions/strategies for industry sustainability. A television advertising campaign was funded.

The Project provided training for office bearers of village Electricity Consumer Societies (ECS) and also office equipment for the Federation of Electricity Consumer Societies (FECS) - the umbrella body. VH developers and equipment manufacturers were also provided with training. The Project

[9] As a result of the study, the developer decided to not use the originally proposed equipment

supported the solar equipment testing laboratory and the micro-hydro turbine testing facility at the NERD centre with procurement of certain equipment.

In 2007, RERED funded a study on capital market constraints for RE project financing which considered the introduction of a dedicated RE bond scheme.

TA funds were also used for environmental verification studies, physical verification of assets, project audits and for support provided by the AU. Approximately of US$ 3.77 million of unutilized IDA funds set aside for TA, was eventually used for investment purposes.

3. Factors Affecting Implementation

There were many positive as well as negative factors that effected implementation.

The principal success factors were:

a) Grid Connected Projects

- Grid-connected projects were entirely private sector driven with the project developer spending considerable time and resources and taking on significant risk.
- The availability of a SPPA together with the certainty of the feed-in-tariff regime (initially-using the 'avoided cost' mechanism with a minimum floor price and later - technology specific).
- A positive policy framework wherein the GOSL actively encouraged the development of RE technologies. Towards achieving its objectives, the GOSL came up with attractive technology specific tariffs to encourage private investors. The initial tariffs scheme offered for wind power projects were a significant draw for developers and banks funding them.
- Tax and import duty concessions were made available through the Board of Investment
- The end of the civil conflict in May 2009 which resulted in a post-war economic boom in a relatively low-interest and low-inflation environment
- Sri Lanka already had competent engineers, who had gained experience in the country's extensive hydro power and irrigation sectors. The existence of hydrological data and survey maps etc also helped to save time in project implementation. Likewise, the 2003 national wind resource map and local wind measurements were helpful for the rapid development of the wind sector.
- RERED's support in terms of the provision of significant long term funding at stable rates, technical assistance, encouragement for banks to fund new technologies (low head hydro, wind etc) and the 'champion' role played by it.

b) Off-Grid Sector

- The solar home system (SHS) programme was very successful in the early years of RERED with a rapid growth in the systems installed. However, in later years the programme encountered problems. The initial success could be attributed to:
  - The momentum created under ESD
  - Low penetration of the national grid at the time
  - The solar home scheme being a private sector led demand driven programme
  - The availability of loans schemes through PCIs and micro-finance providers
  - The availability of the GOSL subsidy scheme to supplement/replace the GEF co-finance grant scheme which was being phased out.
  - The adherence to technical standards and the availability of a consumer protection scheme
- For community based VH projects, the availability of Project funds to pay for the cost of the Project Developer and the Verification Consultant were decisive factors. The availability of a project supervision grant was also an attraction to lenders. While initially limited to PCIs, this was subsequently extended to Central Bank regulated 'non-PCI' financial institutions.
- The existence of 'non-PCI' rural financial institutions willing to fund VH projects was also an important factor, as only a few PCIs funded such schemes.
- The AU was able to resolve the problems encountered in VH projects during the early stages of RERED by establishing a 'Village Hydro Working Group' consisting of representatives of

developers, equipment suppliers, verification consultants, lenders and FECS who met periodically to discuss and resolve problems. Some of its decisions were to:

- Accredit village hydro developers and local equipment suppliers
- Test all village hydro turbines at the NERD centre testing laboratory prior to installation at the project site. The Project part funded some of the equipment at the testing lab.
- Pay the preparation grant to the VH developer on a staggered basis with final payment made only 6 months after successful operation of the project

From an overall sense, the fact that the Project was private sector led and demand driven and managed by a private development bank (DFCC Bank) were significant contributory factors for success. The RERED Administrative Unit performed its functions with considerable autonomy. The GOSL's involvement was mainly for policy interventions or to remove impediments where possible. The required policy interventions and impediments were highlighted by articulate industry associations.

Negative factors that affected implementation included:

a) Grid Connected Projects:

- The benchmark interest for refinance to the PCI under RERED AF was a simple average of the AWDR[10] and AWFDR[11]. When banks included their usual margin during a high interest rate environment, the cost of funds were simply too high for many projects to be viable, and approvals and disbursements reduced considerably. During the latter half of 2009, general lending rates reduced rapidly while the RERED AF refinance rate, which was tied to a 6 month average of the deposit rate, was slow to reduce. This led to non-RERED funds being cheaper. The GOSL and IDA agreed to change the benchmark interest rate to the 3 month average of the AWDR (only), and the approval rate increased substantially thereafter.
- Due to rising project costs over time, the initial approval/procurement thresholds were found to be too low, leading to delays due to 'prior reviews' and ICB requirements. The thresholds were subsequently increased.
- According to the hydro/wind project developers and PCIs consulted, the negative factors that affected or delayed the implementation of sub-projects included delays in obtaining approvals from government agencies and delays in obtaining leases for the use of government owned land. Some conditions for the leases of government land are such that they cannot be mortgaged. The Sri Lanka Sustainable Energy Authority has been attempting to resolve these issues through stakeholder discussions and workshops, some of which were assisted by RERED. A Presidential Task Force has also been appointed to examine these issues.
- For bio-mass projects, banks are still hesitant to lend mainly due to uncertainty related to fuel supply. Many project developers do not have access to the large extents of land needed for captive plantations and hence have to depend substantially on external suppliers and markets.

b) Off-Grid:

After a rapid growth, Off-grid electrification efforts of the Project slowed down around 2006. The main reasons include:

- the rapid growth of the national grid following GOSLs accelerated rural electrification programme. At the macro-level, the situation was desirable as SHS or community owned independent grids (as specified under RERED) were essentially interim solutions until the eventual arrival of the grid. At the micro-level however, the grid extension programme caused some customers to default loans. While buy-back scheme existed for SHS, they were ineffective at the later stages. The CEB was hesitant to divulge grid extension plans and even when divulged, they were frequently changed for political reasons. A more transparent and co-ordinated approach to grid extension would have prevented situations where SHS were installed in areas which were immediately served by the grid thereafter. One of the reasons for the curtailment of the government's solar subsidy programme in May 2011 was for this reason.

[10] AWDR – Average Weighted Deposit Rate published by the Central Bank of Sri Lanka
[11] AWFDR – Average Weighted Fixed Deposit Rate

- Some solar vendors 'moved out' of the business due to declining returns and some even 'went out' of business, leaving customers stranded. When demand was saturated in some areas, some companies shut down area offices/services centre and moved to other areas. These factors led to many customers receiving poor or no after-sales service, which in turn led to loan defaults and negative publicity for solar.
- Lenders financing SHS had high transaction costs as remote customers were conditioned to expect the lender to visit them at their doorstep for the monthly payments. Some lenders tried alternative collection mechanisms such as payments at fuel stations, banks and cooperatives etc. The RERED Project also intervened to find new collection methods. However, by then the problems were such that, all lenders had withdrawn from the business.
- The phasing out of the GEF grant along with mis-selling by solar salesmen led to customers purchasing smaller than required PV module systems leading to over-use and under-charging.
- The batteries used in a majority of SHS were modified automotive batteries manufactured in Sri Lanka - the aim was to reduce the high initial start-up cost. Maintenance free deep cycle batteries would have been a better solution in terms of durability and long life.
- Due to budgetary constraints and cash problems faced by the GOSL during a heightened period of the conflict, there were delays in the releasing of subsidy funds, which in turn led to cash flow problems for solar companies.
- Initially there were no state banks as PCIs under Project. The Regional Development Bank and its province based predecessors however, used their own resources and funded a considerable number of village hydro projects as 'Non-PCIs'. In 2010 and 2011 (i.e. almost at the end of the Project), two large state banks namely the Bank of Ceylon and People's Bank became PCIs. If the state banks had been involved with the Project at the early stages, there would possibly have been more options available for solar financing.

While SHS and community owned mini-grids were envisaged to be interim measures until the consumer had access to grid electricity, the fact is that thanks to RERED, 116,795 households (or around half a million citizens of Sri Lanka) got access to electricity and all its attendant benefits over poorer alternatives such a kerosene oil lamps.

4. Transition Arrangements for Sustainability of Project Achievements

The Government established the Sri Lanka Sustainable Energy Authority in 2007 to function as the apex institution to "...drive Sri Lanka towards a new level of sustainability in energy generation and usage through increasing indigenous energy and improving energy efficiency within the country". Hence, the work carried out by the RERED Project in promoting the use of renewable energy technologies will be continued by the SEA.

In terms of Grid Connected projects, no significant sustainability issues are foreseen as there is a steady demand as denoted by the number of new power purchase agreements signed with the CEB and the expressed willingness of banks to continue lending to the sector.

Current policy is that if the subsidy required for grid connectivity exceeds Rs.200,000/- per household, such households will be provided with an alternative subsidy to obtain a robust RE based off-grid solution. The Government is currently working on the mechanics of the programme named "Gramashakthi".

To address the problem of stranded VH assets due to the arrival of the national grid, the Project funded a consultant to study and implement a mechanism for connecting such VH projects to the grid. USAID provided financial assistance in the form of capital outlays for two pilot projects. As a result, two VHs of 12kW and 21 kW capacities will now soon be grid connected. The village ECSs were converted to companies under the Companies Act of 2007 with the ECS members as shareholders. The CEB signed SPPAs with the village companies which will be paid the standard small hydro tariff.

In 2012, the Government made a strategic decision to drastically reduce fuel and electricity subsidies in order to achieve more cost reflective consumer tariffs. This should greatly encourage energy

efficiency and demand-side management measures. Greater demand for bio-mass based energy sources to replace petroleum based boilers and co-generation plants etc may encourage and strengthen existing and create new fuel supply chains, which in turn will help bio-mass based generation projects. High electricity tariffs for offices and large houses and the decline in solar PV prices has increased demand for Solar based individual grid-tied systems.

In the 2010 budget, the Government introduced a scheme for Banks and Financial Institutions to set aside certain tax savings to create dedicated Investment Fund Accounts for long term project lending. These funds may be used for financing RE generation projects in the post-RERED environment.

5. Risks for Sustainability

Factors that may inhibit the future progress of grid connected projects are the dearth of long term funding and limitations in the absorption capacity of the grid.

RERED provided long term project funds of a significant quantum at a relatively stable rate, although pegged to a variable benchmark (AWDR). Post-RERED interest rates will be far more volatile as lending will be based on the prime lending rate - AWPLR[12], which is heavily dependent on prevailing short term liquidity levels in system. Sri Lankan Commercial banks lack significant sources of long term funds as their deposit base is mainly comprised of short term maturities of up to one year. While the above mentioned dedicated Investment Fund can fund RE projects, the quantum of available funds will be limited due to competing demands from other sectors. While RE projects have successfully accessed the equity capital market, the private bond market in Sri Lanka is still at a nascent stage, and long term funds come at high cost due to limited supply.

Taking in account comparatively small size and isolated nature of the grid in Sri Lanka, capacity limitations will restrict future development of the RE technologies such a hydro and wind considering their non-dispatchable nature. GOSL is exploring the option of interconnecting the grid with India and also at various energy storage options.

6. Lessons Learnt

Grid Connected:
As the RERED Project continued with the successful model created under ESD, there are relatively few additional lessons to be leant. For the introduction of new technologies such as wind and bio-mass, the importance of TA for awareness and capacity building, for provision of expert knowledge and for providing comfort to lenders should be emphasised. It may be re-iterated that creating a favourable policy environment, having certainty through standardised power purchase agreements and a reliable and attractive tariff regime are critical success factors.

Off-Grid Systems:

- For off-grid projects such as SHS and community based projects - with unsophisticated consumers, the maintenance of standards, adherence to specifications and ensuring consumer protection is very important. In the case of SHS components, the AU checked for compliance with specifications only at initial acceptance. A continuous testing programme may be desirable in large scale SHS deployments.
- It must be understood that, in a rapid growth situation such as that experienced in Solar, there can be hidden problems. Stakeholders must be watchful for early warning signs and take timely corrective action. Frequent scrutiny of financial statements of solar companies and lenders may be advisable to detect problems.
- An adequate vetting process has to be conducted to prevent fly-by-night operators leaving stranded customers and spoiling the market. Some sort of performance bond in the form of a bank guarantee at entry or a retention payment (part of the grant is paid after a year etc) may be necessary. In the case of RERED, the AU withheld grant/government subsidy payment to solar

[12] AWPLR- Average Weighted Prime Lending Rate

vendors when problems such as non-settlement of customer complaints etc arose. However, when the company exited from the solar business, the AU no longer had a hold.

- In the case of SHS sales, the lenders suffered some losses due to high default rates. In hindsight, more stringent appraisal standards as well as higher customer down payments (to increase commitment to repay) would possibly have been appropriate. The interests of the vendor and the lender should also be aligned to the extent possible. Under RERED, vendors recovered their cost and profit up-front through the loan, grant and subsidy payments. The lender took on most of the risk. In an environment of growing sales and healthy competition, the vendor would ensure good after sales service in order to maintain a good reputation through word of mouth and also to encourage the lender to keep on lending. In a declining market with limited competition, this motivation may to be absent. In this regard, one PCI obtained guarantees in the form of 'buy-back' agreements from the vendor in the case of customer default. While this was very onerous for the vendor, the interests of the lender and the vendor were aligned. Even after the vendor stopped selling new systems, customer complaints from this particular vendor were minimal.
- Capacity building for human resources, risk management and information systems etc in MFIs should also be given emphasis. The reward scheme for credit officers to grow the portfolio while maintaining a good collection ratio is very important. A good risk management and internal audit system to maintain appraisal quality and to be alert for early warning signs are also important.

Overall

- As in ESD, flexibility in implementation was an overall success factor. The design was adjusted as and when needed. The AU consulted stakeholders at a quarterly meeting where issue were discussed in an open transparent manner. The supervision mission consulted stakeholders at least semi-annually.
- The Project implementation being assigned to a private sector development bank ensured that competent staff was readily available and that their performance indicators and reward schemes were in line with Project goals.

7. World Bank's Performance

GOSL rates the World Bank's performance during preparation and implementation of RERED and RERED AF as 'Highly Satisfactory'. All stakeholders including MOPE, CEB, SEA, PCIs, Project Developers and/or Industry Associations, Village hydro developers and community representative were regularly consulted during supervision missions. The Bank frequently conveyed the requests of the stakeholders to the government and advocated their cause.

The Bank was responsive to requests to change project parameters such as changing the benchmark interest rate, increasing thresholds for procurements and the AU free limit -- which greatly helped to speed up the rate of approvals and disbursements. The extension of the Project by 6 months ensured that funds were fully utilized.

The Bank provided shared its experiences and provided valuable advice on the various new technologies that were being introduced.

The Bank was particularly involved in efforts to resolve problems relating to the solar programme, assisting in the arranging of workshops and studies etc. In the case of a problem arising from the installation of defective solar panels manufactured by a multinational, the bank staff acted even 'beyond the call of duty' in trying to resolve the problem.

8. Conclusion

In conclusion the Government of Sri Lanka is of the opinion that the RERED Project achieved its objectives and played a pivotal role in the growth of the renewable energy sector in Sri Lanka.

Annex 8. Comments of Cofinanciers and Other Partners/Stakeholders

Not applicable.

Annex 9. List of Supporting Documents

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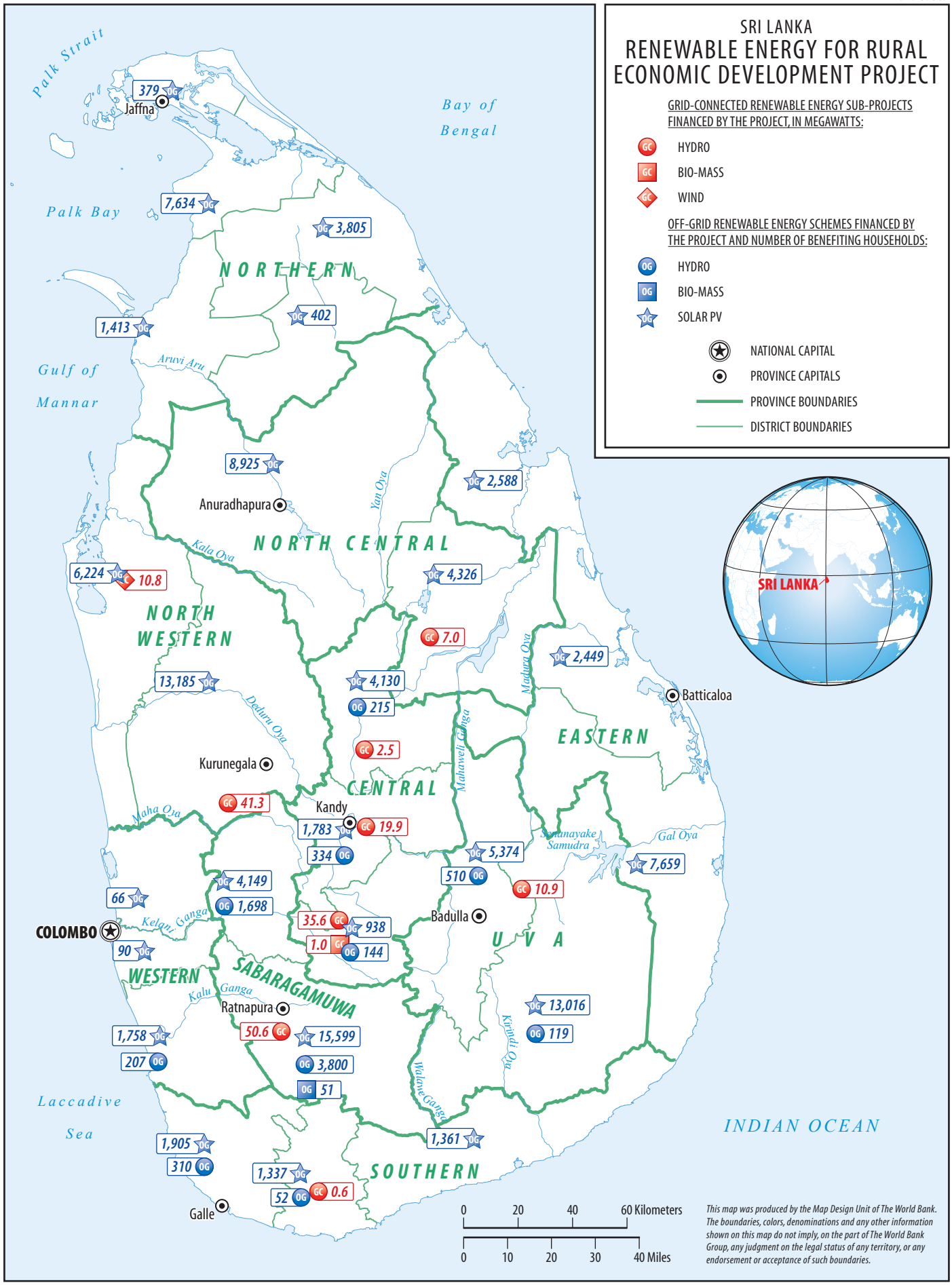

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