Document of
The World Bank

Report No: ICR00002320

IMPLEMENTATION COMPLETION AND RESULTS REPORT
(IDA-38400 TF-53036)

ON A

CREDIT
IN THE AMOUNT OF SDR 27.9 MILLION
(US$40 MILLION DOLLAR EQUIVALENT)

AND A

GLOBAL ENVIRONMENT FACILITY GRANT
IN THE AMOUNT OF US$5.75 MILLION

TO

THE KINGDOM OF CAMBODIA

FOR A

RURAL ELECTRIFICATION AND TRANSMISSION PROJECT

August 30, 2012

Sustainable Development Department
Southeast Asia Country Management Unit
East Asia and Pacific Region

CURRENCY EQUIVALENTS
(Exchange Rate Effective: January 31, 2012)

Currency Unit = Riels (Rs)
Rs 1.00 = US$0.00025
US$ 1.00 = Rs 4068

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank	MTR	Mid-Term Review
CAS	Country Assistance Strategy	MV	Medium Voltage
CO_2	Carbon Dioxide	MW	Mega Watt
CREP	Cambodia Rural Electrification Project	NCB	National Competitive Bidding
EAC	Electricity Authority of Cambodia	NCC	National Control Center
EOCK	Economic Opportunity Cost of Capital	NGO	Non-Governmental Organization
ED	Executive Director	NPV	Net Present Value
EDC	Electricité du Cambodge	O&M	Operation and Maintenance
EIRR	Economic Internal Rate of Return	OBA	Output-based Aid
EMDS	Ethnic Minority Development Strategy	PAD	Project Appraisal Document
EMP	Environmental Management Plan	PAP	Project Affected People
ESMF	Environmental & Social Management Framework	PDO	Project Development Objective
FAUMIS	Financial Accounting and Utility Management Information System	PMU	Project Management Unit
FIRR	Financial Internal Rate of Return	PPF	Project Preparation Facility
FM	Financial Management	PPIAF	Public Private Infrastructure Advisory Facility
FNPV	Financial Net Present Value	RAP	Resettlement Action Plan
FS	Feasibility Study	RE	Rural Electrification
GEF	Global Environment Facility	REAP	Renewable Energy Action Plan
GEO	Global Environmental Objective	REE	Rural Energy Enterprise
GMS	Greater Mekong Sub-Region	REF	Rural Electrification Fund Secretariat
GWh	GigaWatt Hour	REn	Renewable Energy
HH	Household	RGC	Royal Government of Cambodia

HV	High Voltage	RPF	Resettlement Policy Framework
IA	Implementing Agency	SEU	Social and Environment Unit (of EDC)
ICB	International Competitive Bidding	SHS	Solar Home System
IDA	International Development Association	SOP	Standard Operational Procedures
IPA	International Procurement Agent	TA	Technical Assistance
IPP	Independent Power Producers	TL	Transmission Line
IRC	Inter-ministerial Resettlement Committee	TOR	Terms of Reference
kV	kilovolt	VAT	Value Added Tax
kW	kilowatt	W	Watt
kWh	kilowatt Hour	WACC	Weighted Average Cost of Capital
LV	Low Voltage	WTP	Willingness-to-Pay
MEF	Ministry of Economy and Finance	WPP	West Phnom Penh
MIME	Ministry of Industry, Mines and Energy		

Vice President: Pamela Cox
Country Director: Annette Dixon
Sector Director: John A. Roome
Acting Country Manager: Timothy A. Johnston
Sector Manager: Julia M. Fraser
Project Team Leader: Veasna Bun
ICR Team Leader: Veasna Bun

KINGDOM OF CAMBODIA
RURAL ELECTRIFICATION AND TRANSMISSION PROJECT

CONTENTS

A. Basic Information			
Country:	Cambodia	Project Name:	Rural Electrification and Transmission Project
Project ID:	P064844,P071591	L/C/TF Number(s):	IDA-38400,TF-53036
ICR Date:	04/20/2012	ICR Type:	Core ICR
Lending Instrument:	SIL	Borrower:	KINGDOM OF CAMBODIA
Original Total Commitment:	XDR 27.90M, USD 5.75M	Disbursed Amount:	XDR 22.44M, USD 4.96M
Environmental Category: B, A		**Focal Area**: C	
Implementing Agencies: Electricité du Cambodge (EDC) Electricity Authority of Cambodia (EAC) Ministry of Industry, Mines and Energy (MIME) Rural Electrification Fund (REF)			
Cofinanciers and Other External Partners: Asian Development Bank (ADB)			

B. Key Dates

Rural Electrification and Transmission Project - P064844

Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	06/14/2000	Effectiveness:	03/29/2005	03/29/2005
Appraisal:	09/15/2003	Restructuring(s):		02/23/2010
Approval:	12/16/2003	Mid-term Review:		05/02/2008
		Closing:	06/30/2009	01/31/2012

KH-GEF Rural Electrification & Transmission - P071591

Process	Date	Process	Original Date	Revised / Actual Date(s)
Concept Review:	06/14/2000	Effectiveness:	01/31/2005	
Appraisal:	09/15/2003	Restructuring(s):		02/23/2010
Approval:	12/16/2003	Mid-term Review:		05/02/2008
		Closing:	06/30/2009	01/31/2012

C. Ratings Summary

C.1 Performance Rating by ICR

Outcomes	Moderately Satisfactory
GEO Outcomes	Moderately Satisfactory
Risk to Development Outcome	Substantial
Risk to GEO Outcome	Substantial
Bank Performance	Moderately Satisfactory
Borrower Performance	Moderately Satisfactory

C.2 Detailed Ratings of Bank and Borrower Performance (by ICR)

Bank	Ratings	Borrower	Ratings
Quality at Entry	Moderately Satisfactory	Government:	Moderately Satisfactory
Quality of Supervision:	Moderately Satisfactory	Implementing Agency/Agencies:	Moderately Satisfactory
Overall Bank Performance	Moderately Satisfactory	Overall Borrower Performance	Moderately Satisfactory

C.3 Quality at Entry and Implementation Performance Indicators

Rural Electrification and Transmission Project - P064844

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	Moderately Satisfactory		

KH-GEF Rural Electrification & Transmission - P071591

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):	Yes	Quality of Supervision (QSA)	None
GEO rating before Closing/Inactive Status	Moderately satisfactory		

D. Sector and Theme Codes

Rural Electrification and Transmission Project - P064844

	Original	Actual
Sector Code (as % of total Bank financing)		
Central government administration	14	14
Power	78	78

Renewable energy	8	8
Theme Code (as % of total Bank financing)		
Climate change	13	13
Infrastructure services for private sector development	25	25
Regulation and competition policy	13	13
Rural policies and institutions	24	24
Rural services and infrastructure	25	25

KH-GEF Rural Electrification & Transmission- P071591		
	Original	**Actual**
Sector Code (as % of total Bank financing)		
Renewable energy	100	100
Theme Code (as % of total Bank financing)		
Climate change	25	25
Environmental policies and institutions	13	13
Infrastructure services for private sector development	25	25
Rural policies and institutions	24	24
Rural services and infrastructure	13	13

E. Bank Staff

Rural Electrification and Transmission Project - P064844

Positions	At ICR	At Approval
Vice President:	Pamela Cox	Jemal-ud-din Kassum
Country Director:	Annette Dixon	Ian C. Porter
Sector Manager:	Julia M. Fraser	Junhui Wu
Project Team Leader:	Veasna Bun	Rebecca C. Sekse
ICR Team Leader:	Veasna Bun	
ICR Primary Author:	Veasna Bun	
	Defne Gencer	
	Jie Tang	

KH-GEF Rural Electrification & Transmission - P071591

Positions	At ICR	At Approval
Vice President:	Pamela Cox	Jemal-ud-din Kassum
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ICR Primary Author:	Veasna Bun	
	Defne Gencer	
	Jie Tang	

F. Results Framework Analysis

Project Development Objectives (from Project Appraisal Document)

The main development objectives of the project are to: (a) improve power sector efficiency and reliability and reduce electricity supply costs; (b) improve standards of living and foster economic growth in rural areas by expanding rural electricity supplies; and (c) strengthen electricity institutions, the regulatory framework and the "enabling environment" for sector commercialization and privatization.

Revised Project Development Objectives (as approved by original approving authority)

NA

Global Environment Objectives (from Project Appraisal Document)

The Project's global environmental objective is to overcome barriers to renewable energy development in Cambodia, including those related to lack of a policy framework, financing, information and institutional capacity.

Revised Global Environment Objectives (as approved by original approving authority)

NA

(a) Power Sector Outcome and Indicators[1]:

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Actual Value Achieved at Completion or Target Years
Indicator 1	**Power supply increased to match expected average of growth**			
(Value quantitative or qualitative)	0	13%	NA	19%
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	Average supply capacity increased by about 19% between 2005 and 2011, exceeding the target. (Source: EDC 2011 data.)			
Indicator 2	**Rural Electricity coverage increased**			
(Value quantitative or qualitative)	9%	22.5%	NA	14.5%
Date Achieved	November 2003	June 30, 2009		December 31, 2011

[1] This table containing sector indicators was included in the Logical Framework in the PAD, alongside actual PDO and GEO level indicators, in order to report on overall sector performance. It should be noted that the sector indicators are beyond control of the project intervention and are not meant to assess project performance. Nonetheless, the ICR team is of the view that the project contributed to improvements in sector performance, as reflected in the report.

Comments	During the project period, rural electricity coverage increased about 5.48%. This project delivered 117,861 new rural household connections, resulting in an increase of 5% in rural electricity coverage. The remaining 0.48% increase was the result of other investments.			
Indicator 3	**Tons of CO2 directly avoided over the Project period**			
(Value quantitative or qualitative)	0	233,000 tons	NA	393,000 tons
Date Achieved	November 2003	June 30, 2009		December 31, 2011
Comments	CO2 avoided over the project period is calculated based on 2011 data. CO_2 emission directly avoided over the project implementation period is estimated as 393,000 tons. (See Table B of Annex 2.)			
Indicator 4	**CO2 abated directly as result of sustained investment of renewable energy over the period between 2000 and 2020.**			
(Value quantitative or qualitative)	0	1.5 million tons	NA	2.01 million tons
Date Achieved	November 2003	2020		January 31, 2012
Comments	It is estimated that through 2020, 2.01 million tons of CO_2 will be avoided as a direct outcome of project investments. If indirectly avoided CO_2 emissions are taken into account, this figure would reach 14.4 million tons.			

(b) 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	**Cost of EDC's electricity supply reduced**			
(Value quantitative or qualitative)	US$0.15/kWh	US$0.11/kWh	NA	US$ 0.145/kWh
Date Achieved	November 2003	June 30, 2009		March 31, 2012
Comments	EDC’s cost of power supply could not be reduced to the targeted level, primarily due to rising international oil prices and less than expected power imports from Vietnam over the project period.			
Indicator 2	**EDC transmission and distribution losses maintained at 14% (Reduction in EDC distribution losses)**			
(Value quantitative or qualitative)	14%	14%	NA	9.8%
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	The target was exceeded by the closing date, thanks to project investments, a well-designed system, and installation of Financial Accounting and Utility Management Information System, leading to reduction of technical and non-technical losses.			

Indicator 3	**Number of licenses issued to all IPPs and REEs**			
(Value quantitative or qualitative)	54	180	NA	297
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	The target was exceeded by 65% by project closing, with the licensing of 297 REEs and IPPs.			
Indicator 4	**Aggregate demand of industrial consumers switching from self-generation to grid supply.**			
(Value quantitative or qualitative)	0MW	30MW	NA	39.95MW
Date Achieved	September 2003	June 30, 2009		January 31, 2012
Comments	Target achieved. As EDC supply became more reliable and relatively cheaper, industrial customers, with an aggregate demand of nearly 40 MW, switched from generating their own electricity to using grid electricity supplied by EDC.			
Indicator 5	**Average off-grid tariffs reduced from US$0.5/kWh to US$0.425/kWh**			
(Value quantitative or qualitative)	US$0.5/kWh	US$0.425/kWh	NA	US$0.51/kWh
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	The target was not achieved due to the surge in oil prices in international markets over the project life; this, in turn, led to an increase in prices of diesel and fuel oil, which are the predominant fuels for electricity supply in off-grid areas.			
Indicator 6	**Number of people (including through rural businesses) benefiting from modern electricity services increased**			
(Value quantitative or qualitative)	0	567,000	NA	509,851
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	By the closing date 106,219 household connections were achieved vs. target of 112,000 HH. However, by March 2012, the HH connections achieved 117,861 exceeded the target at appraisal 112,000 and the total beneficiaries was estimated about 565,733. Over the course of the project period, the average HH size in Cambodia dropped from 5.06 at appraisal to 4.8, according to the 2008 Census. If HH size at appraisal is used, the number of beneficiaries would have reached 596,672, exceeding the target at appraisal.			
Indicator 7	**Average number of hours per day electricity is supplied to rural HH by REEs increased**			
(Value quantitative or qualitative)	4 hrs	8hrs	NA	12 hrs
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	The target was substantially exceeded. About 54% of REEs provide 24-hour service, corresponding to a 50% increase over the original target.			

(c) 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	**Percentage of national generation capacity by renewable energy systems increased**			
(Value quantitative or qualitative)	0%	5%	NA	14.5%
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	The project did not directly finance renewable energy projects other than the installation of 12,093 SHS. But it financed partial power evacuation route from Takeo to Phnom Penh. It facilitated development of a 193 MW hydropower plant that connected to the TL built by the project.			
Indicator 2	**Increase in number of renewable energy businesses (serving 500 to 1,500 customers)**			
(Value quantitative or qualitative)	0	5	NA	4
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	The target was 80% achieved. Four companies are directly involved in SHS business, including one firm for SHS supply and delivery, two firms for installation and one firm providing supervision and maintenance services.			
Indicator 3	**Increase in local commercial lending and other financing for rural electrification and renewable energy from about US$ 0.5 million to US$ 15 million**			
(Value quantitative or qualitative)	US$0.5 million	US$15 million	NA	US$50 million
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	The project did not explicitly support this indicator, but it financed the preparation of the Rural Energy Strategy and distribution system planning that provided the platform for commercial lending for RE. Eventually, Chinese Ex-Im Bank provided US$ 50 million for RE.			

(d) 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	**220 kV line and substations operational**			

(Value quantitative or qualitative)	TL and substations non-operational	TL and substations operational	NA	230 kV line and 3 substations operational since 2009
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	Achieved under the parallel financed project by ADB.			
Indicator 2	**115 kV network reinforced**			
(Value quantitative or qualitative)	• 0km (new TL) 23km (existing TL)	• 20 km (new TL) Stringing 23 km (existing TL)	NA	• 14 km double circuit TL built 22 km TL 2nd line stringed
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	The target for 115kV network reinforcement was fully achieved. The new transmission line was re-routed and the substation was relocated, thereby enabling the reinforcement of the network, while using a shorter line.			
Indicator 3	**MV line extensions from WPP and Takeo substation installed**			
(Value quantitative or qualitative)	0km	130km	NA	168.8km
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	The target was exceeded. Competitive prices for goods allowed more materials to be purchased and additional lines built.			
Indicator 4	**Additional rural households connected to the grid**			
(Value quantitative or qualitative)	0	50,000	NA	55,768
Date Achieved	November 2003	June 30, 2009		March 31, 2012
Comments	At Credit closing, only 45,097 new households had been connected; however, EDC continued to connect additional households to the distribution network built under the project and, by March 31, 2012, 55,768 new HHs had been connected to EDC's grid.			
Indicator 5	**REF established**			
(Value quantitative or qualitative)	No REF	REF Operational	NA	REF established and operational since April 2007
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	REF was established, although it took longer than expected, and caused some delays in implementing the REF pilot projects.			
Indicator 6	**Number of new rural connections provided by Rural Energy Enterprises, through sub-grants from REF**			
(Value quantitative or qualitative)	0	45,000	NA	50,000
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	Exceeded the target by 11%.			

Indicator 7	Number of Solar Home Systems installed			
(Value quantitative or qualitative)	0 SHS	12,000	NA	12,093
Date Achieved	November 2003	June 30, 2009		March 31, 2012
Comments	At Credit closing, 11,124 SHS had been installed; however, only two months later, installations had reached 12,093.			
Indicator 8	Feasibility study of mini and village hydropower			
(Value quantitative or qualitative)	No FS study	Installation of 6,000kW of mini and 850kW of micro hydro	Completion of Feasibility Study for 6,850kW; installation of 1200kW mini and micro hydro	Feasibility Study completed; Installation not carried out
Date Achieved	November 2003	June 30, 2009	January 31, 2012	January 31, 2012
Comments	Feasibility studies revealed that selected mini and micro hydropower sites were not financially feasible and should not be constructed under the current social and economic conditions.			
Indicator 9	Sector master plan developed by MIME			
(Value quantitative or qualitative)	No master plan	Master plan prepared	NA	Master plan prepared and used by EDC
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments				
Indicator 10	Number of rural and renewable energy business employees, commercial bank staff, and regulators trained on renewable energy technologies, and participating in the development, financing and regulation			
(Value quantitative or qualitative)	0 person	200 persons	NA	238 persons
Date Achieved	November 2003	June 30, 2009		January 31, 2012
Comments	Target exceeded by 19%.			

G. Ratings of Project Performance in ISRs

No.	Date ISR Archived	DO	GEO	IP	Actual Disbursements (USD millions)	
					Project 1	Project 2
1	12/30/2003	S		S	0.00	0.00
2	06/30/2004	S		S	0.00	0.00

3	12/09/2004	S		S	0.00	0.00
4	06/06/2005	S	S	S	0.30	0.00
5	03/18/2006	S	MS	MS	2.54	0.31
6	01/23/2007	S	S	S	3.20	0.34
7	09/14/2007	S	S	S	3.67	0.38
8	08/22/2008	MS	MS	MS	7.30	0.46
9	06/23/2009	MS	MS	MS	18.99	0.69
10	10/16/2009	MS	MS	MS	20.29	0.76
11	05/01/2010	MS	MS	MS	22.04	0.83
12	11/27/2010	MS	U	MS	24.76	0.90
13	02/10/2012	MS	MS	MS	32.36	4.17

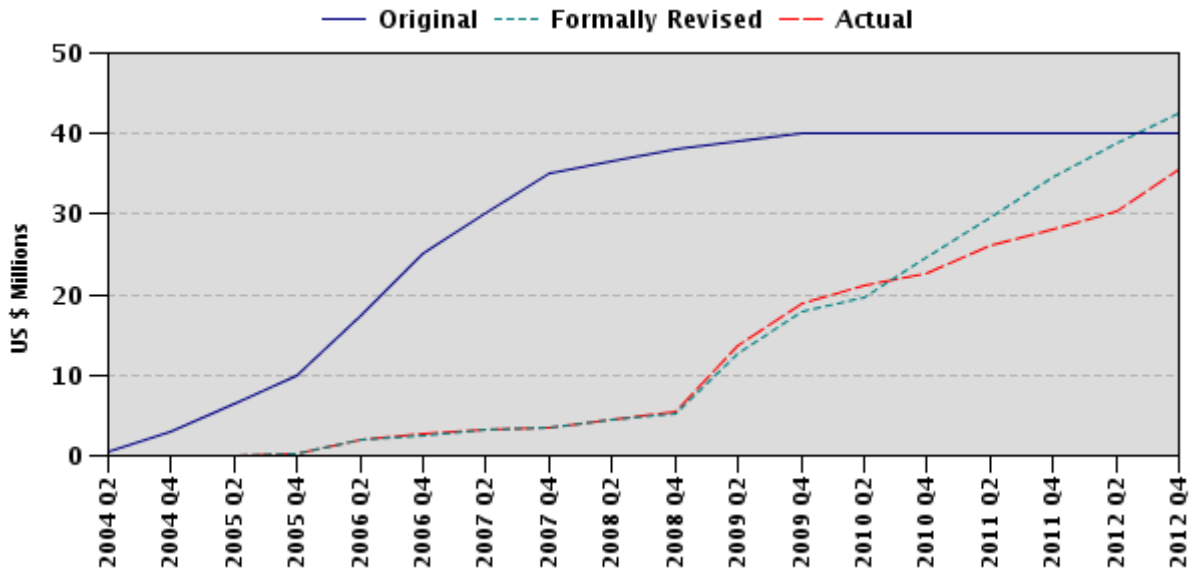
H. Restructuring (if any)

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	
02/23/2010			MS		MS	21.94		RETP IDA-3840 Extension of Closing Date to allow the completion of National Control Center construction. Addition of TA to EDC for MV Network Expansion Planning to guide new investments in rural electrification Support the design and construction of the REF office building for the sustainability of REF operations

02/23/2010				MS	MS		0.81	RETP GEF-TF53036 Introduction of a new delivery model of Hire-and-Purchase through bulk purchase for the SHS program of REF, since the original output-based approach model failed in delivering the targeted outputs Extension of Closing Date to allow the completion of SHS installation and TAs Reduction of the project's output targets from installation of 6MW of mini hydro and 850 kW of micro hydro, to "conduct Feasibility Studies (FS) for 6,850 kW and install 1,200 kW of mini-micro hydro and biomass capacity," since the expected private investments in installation did not materialize.

I. Disbursement Profile

P064844



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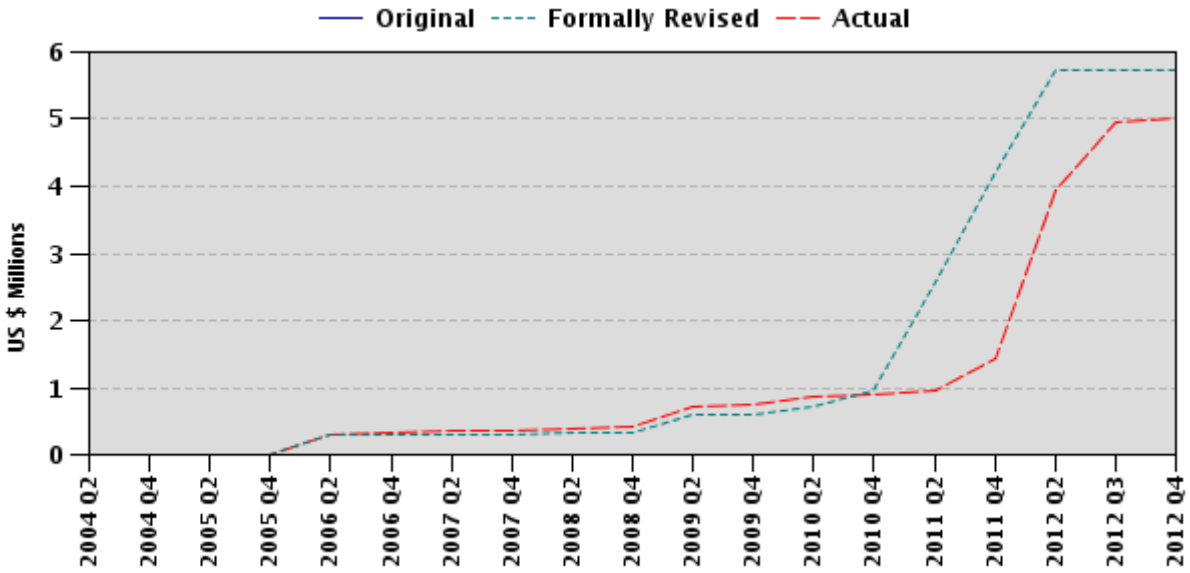
Original
Formally Revised
Actual
US $ Millions
6
5
4
3
2
1
0
2004 Q2
2004 Q4
2005 Q2
2005 Q4
2006 Q2
2006 Q4
2007 Q2
2007 Q4
2008 Q2
2008 Q4
2009 Q2
2009 Q4
2010 Q2
2010 Q4
2011 Q2
2011 Q4
2012 Q2
2012 Q3
2012 Q4

1. Project Context, Development and Global Environment Objectives Design

1.1 Context at Appraisal

At the time of project appraisal in 2003, Cambodia had one of the lowest electrification rates in Asia with only about 12% of its population of 13 million connected to a power supply. Power generation relied almost purely on diesel fuels and costs were among the highest in the world. The total installed capacity was 109 MW. Private independent power producers (IPPs), engaged in early 1994 to reinstate supplies, provided 63% of the power generated, while the state-owned Electricité du Cambodge (EDC) accounted for 32%. There was no national grid and towns were supplied through isolated systems. Key challenges facing the power sector at the time are summarized below.

Shortage of reliable electricity supply. The quality and reliability of power supply to Phnom Penh were poor, and generation reserve margins remained low. Consequently, many large consumers operated high cost, captive diesel-powered generators to meet their energy needs. The national electricity network remained fragmented, precluding pooling of generation capacity. There was no credible master planning for generation and transmission system expansion.

High electricity costs. Electricity tariffs were very high, ranging from about US¢14/kWh on EDC's grid to about US¢30-92/kWh in rural areas served by Rural Electricity Enterprises (REEs). *Urban* supply costs were high because the generation relied on small, inefficient diesel generators with high fuel costs. In addition, IPP contracts provided for high risk premiums. *Rural* supplies were expensive and limited as they (a) used very small diesel generators, using costly fuel; (b) were small networks supplying power for a few hours daily with high losses; (c) had low technical capacity; (d) had high risks borne by operators due to lack of regulation and clear purchasing arrangements; and (e) had limited access to capital for investments to improve efficiency or capture economies of scale.

Remarkably limited access to electricity in rural areas. Only about 6% of rural households had access to grid-supplied electricity, and another 3% had some type of small individual power-generating unit. The remaining 91% of the rural population either used car batteries (costing US$2-3.5/kWh) to meet their most pressing needs, or went without altogether.

Steps toward sectoral reform. In 2001, the Royal Government of Cambodia (RGC) passed a new Electricity Law and in 2002 it established the Electricity Authority of Cambodia (EAC) as an independent regulatory body to license operating entities and to establish electricity prices. The Electricity Law and subsequent implementation steps set the power sector on a path to largely unbundle the sector with substantial private participation in generation and distribution of electricity. The main reform issue was to strengthen the newly established sector structure and further commercialize EDC's operations.

In order to address the main sector issues, in May 2003, the Government adopted a 10 year, three-phase **Renewable Energy Action Plan** (REAP), following extensive consultations with key stakeholders. REAP's three phases were: (a) *market preparation*, focusing on institutional and regulatory development and private and public sector capacity building; (b) an *early growth phase*, move forward with assessment of initial investments to be made in hydropower and solar photovoltaics (PV); and (c) *rapid growth*, when robust market growth was foreseen, with more private sector participation, and improved donor support to leverage successful activities. RGC's near-term strategy involved a combination of new IPP generation and power imports from Vietnam, while its long-term strategy envisaged a

National Transmission System, a 193 MW hydropower plant and interconnections with neighboring countries.

Rationale for IDA Involvement. In view of the challenges faced by the sector, RGC requested IDA to design a rural electricity and transmission project that would facilitate implementation of RGC's strategy by alleviating shortages of reliable power and reducing electricity costs for EDC's grid; improving rural access to electricity; and consolidating and deepening power sector reforms. The Project supported the Country Assistance Strategy of February 2000 in that it contributed to building infrastructure to increase access to electricity in rural and provincial areas, facilitated private sector development, and contributed to institutional capacity building.

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

The main development objectives of the project were to: (a) improve power sector efficiency and reliability and reduce electricity supply costs; (b) improve standards of living and foster economic growth in rural areas by expanding rural electricity supplies; and (c) strengthen electricity institutions, the regulatory framework and the "enabling environment" for sector commercialization and privatization.

Table 1. Key indicators[2] (as stated in PAD Annex 1)

Indicator	At project start	End of project target
Cost of EDC's electricity supply reduced	US$ 0.15/kWh	US$0.11/kWh
EDC transmission and distribution losses maintained	14%	14%
Number of licenses issued to IPPs and REEs	54	180
Industrial consumers switching from self-generation to grid supply	0MW	30 MW
Average off-grid tariffs reduced	US$0.5/kWh	US$0.425/kWh
Increase in number of people (including through rural business) benefiting from modern electricity services	0	567,000
Average number of hours per day in which electricity is supplied to rural households (HH) by REEs	4hrs/day	8hrs/day

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

The Project's global environmental objective was to overcome barriers to renewable energy development in Cambodia, including those related to lack of a policy framework, financing, information and institutional capacity.

Table 2. Key indicators

Indicator	At project start	End of project target
Percentage of national generation capacity by renewable energy systems	0%	5%

[2] Some indicators were reformulated to enhance their understandability. Some (intermediate) indicators that were in the PAD, are not covered in the ICR such as indicators (i) Financing and subsidy mechanisms for REF identified; (ii) EAC regulation and codes issued (iii) EDC staff trained in and applying commercial practices and power investment planning and (iv) small power purchase agreement for RE developers; were not reported in ISRs, and the ICR, due to (a) subsidy mechanisms for REF was part of operational procedures approved before the REF operational (one time action); (b) regulation and codes are routinely used by EAC for issuance of license and are adjusted from time to time, (c) EDC staff trained was jointly reported in indictor 10, and (d) no RE development made.

Increase in number of renewable energy businesses (serving 500 to 1,500 customers)	0	5
Increase in local commercial lending and other financing for rural electrification and renewable energy	US$ 0.5 million	US$ 15 million

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

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

1.6 Main Beneficiaries

Primary beneficiaries expected at appraisal were the 112,000 new consumers in urban and rural areas of Cambodia, including the 100,000 households that would be served by EDC and REEs, and the 12,000 that would be provided Solar Home Systems (SHS). Urban domestic consumers were expected to benefit from better quality, more reliable and lower-priced electricity and commercial consumers would be able to retire their expensive captive generation sets. Rural consumers would benefit from access to electricity, and the globally well-documented welfare impacts associated with such basic amenities as lighting and communication[3]. Households would also benefit through growth in non-farm rural enterprises, and enhanced social services (street lighting, education, health clinics). Rural consumers who already had electricity were expected to benefit from lower electricity prices. ***Secondary beneficiaries*** included the EDC, EAC, the Ministry of Industry, Mines and Energy (MIME), the Rural Electrification Fund (REF), and REEs as well as the broader electricity sector through capacity building and progress towards commercialization.

1.7 Original Components

The project had four components.

Component A. The Transmission Line (TL) *(Total cost US$90.59 million, 60.35% of total, of which US$16.97 million from IDA, 11.30% of total*), implemented by EDC, comprised: (a) the construction of a 109 km double circuit 230 kV line from the border with Vietnam to Phnom Penh and two associated substations; (b) reinforcement of the 115 kV grid around Phnom Penh involving about 20 km of 115 kV lines and modifications to three 115 kV substations and 22 kV extension; (c) the establishment of a National Control Center (NCC) to optimize load dispatch operations in the EDC system and increase system security; and (d) building EDC's capacity in project management, land acquisition, resettlement and environmental monitoring and mitigation.

Component B. Rural Electrification *(Total cost US$14.74 million, 9.82% of total, of which US$ 12.81 million from IDA, 8.53% of total),* implemented by EDC, comprised a grid extension program covering 516 km of medium voltage (MV) and 536 km of low voltage (LV) lines and electrification of about 50,000 consumers in the provinces of Sihanoukville, Battambang, Kampot and Kampong Speu.

[3] Rural electrification impacts are discussed in numerous publications including: The Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits (WB IEG, 2008); Welfare Impacts of Rural Electrification: Evidence from Vietnam (Khandker et al, EB-ASTAE, 2008); Monitoring the Benefits of Rural Electrification in Vietnam: Evaluation Surveys for 2002-2005 (Barnes et al, WB, 2009).

Component C. Pilot Rural Electrification Fund *(Total cost 28.23 million, 18.81% of total, of which US$ 5.10 million from IDA and US$ 1.54 million from GEF, 4.43% of total)*, executed by REF, was to implement an innovative mini- and off-grid electrification program providing assistance to private sector developers for: (a) provision by REEs of about 50,000 new connections; (b) provision of electricity to about 12,000 households using SHS; and (c) addition of at least six MW of mini-hydro and 850kW of micro hydro capacity.

Component D. Institutional Development and Sector Reform *(Total cost US$9.33 million, 6.22% of total, of which US$ 5.12 million from IDA and US$ 4.21 million from GEF, 6.21 of total),* comprised consulting and advisory services to: (a) MIME in renewable energy policy development, power market analysis, and development of a power sector master plan; (b) REF for implementation support, promotion of rural income generation options, renewable energy business development, REE improvement and association building, and capacity building of financial institutions; (c) EAC for institutional strengthening; and (d) EDC for services of a project implementation consultant and in-house advisor, creation of an independent monitoring agency and a project grievance committee, improvement of commercial practices, management training, capacity building for land acquisition, resettlement and environment, and power investment planning.

1.8 Revised Components

Three sub-components were revised through the restructuring in 2010. Reasons for all revisions are provided in Section 2.2.

Solar Homes Systems (Component C(b)). As only 93 SHS had been installed at the time of restructuring, the delivery model was revised from an "out-put based subsidy" approach to a "hire-and-purchase" approach in order to jump-start installations. A new technical assistance (TA) package was also added to help REF supervise the supply and installation of the 12,000 SHS.

Mini and Micro Hydro (Component C(c)). The output was revised from installation of six MW of mini hydro and 850 kW of micro hydro, to "conduct Feasibility Studies (FS) for 6,850 kW and install 1,200 kW of mini-micro hydro and biomass capacity". Using the unallocated balance, a new activity was added for construction of an office building, critical for sustaining the REF's operation after project closing.

TA to EDC (Component D(d)) was revised to add TA for a study on MV line planning to support EDC in MV network expansion planning, identifying power loss locations in its distribution networks for immediate upgrading; and to develop standard MV line technical specifications and bidding documents for speedy expansion of MV lines to scale up rural electrification.

1.9 Other significant changes

In addition, the **closing date** was extended three times. The first was from June 30, 2009 to September 30, 2009; the second was from September 30, 2009 to February 28, 2010; and the third was to January 31, 2012. The first two shorter extensions were granted to allow the REF time to **address financial management issues** that arose in 2009. The 2010 restructuring and extension were approved in order to allow adequate time to achieve the PDOs, especially SHS installation, and included a **reallocation of funds** to accommodate the new TAs and construction of the REF office building mentioned above.

At appraisal the total project cost was estimated about US$142.98 million (baseline) including the ADB loan, IDA credit and Government counterpart funds for ADB and IDA components and Private funds. The actual project cost was recorded at closing date was US$113.68 million. The drop mainly caused by less disbursement from IDA credit and

ADB loans (US$84.3 million at appraisal vs US$74.49 million at closing date) and less disbursement of government counterpart funds (US$29.71 million at appraisal vs US$13.34 million at closing date).

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design and Quality at Entry

Soundness of Background Analysis. The Project was built upon the Energy Sector Strategy for Cambodia and the Renewable Energy Strategy of 2001. Priorities of RGC's long term strategy for the energy sector were to: (i) address the shortage of reliable energy supply; (ii) reduce EDC's high cost of supply; (iii) increase rural electricity coverage; and (iv) reform the power sector. There was consensus among stakeholders that a joint private/public effort was essential to achieve these goals. The project was tailored to contribute to implementing this strategy and address sectoral challenges. Project design took into account **lessons learned** from other countries[4]. For instance, a lesson emerging from international experience at the time of preparation was that targeting subsidies could be an effective way of leveraging private investment in rural electrification. Consequently, the design of the REF component incorporated the concepts of output-based subsidies and transparency, for the purpose of creating "capital enabling" conditions, rather than providing total project funding or credit guarantee.

Assessment of Project Design. The project design, bringing together a transmission line extension and reinforcement component, a rural electrification component involving MV and LV lines, the piloting of a REF to deliver electricity access to remote and off-grid areas, accompanied by technical assistance and capacity building for key entities in the sector, was straightforward, clear and internally consistent. The project was designed to address the key issues facing the sector at the time and responsive to the needs of the client. It was built on prevailing international practice at the time, and its preparation involved solid background analysis, which informed its design. The project components reflected a combination of fundamental requirements that should reasonably be expected in any comprehensive rural electrification effort and innovations such as piloting of the OBA and REF concepts, which were rather novel concepts at the time of preparation. Some highlights of the **strong points** of project design are summarized below.

(a) In order to improve sector efficiency and reliability, the design included new high voltage (HV) lines for power import, reinforcing HV lines, upgrading substations, and building MV and LV lines. These investments not only improved the reliability of supply but also contributed to transmission and distribution efficiency by reducing system losses. The construction of the 230 kV line is a critical component of the effort to alleviate power supply shortages and ensure the security of supply over the medium term.

(b) The decision to complement EDC grid extension with support for provision of new connections by REEs and off-grid solutions was a very sensible way of pursuing the government's electrification target for expanding electricity access in remote areas, especially in view of the time and resources that would be required had this been sought through expansion of the EDC system alone.

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[4] Among others, initiatives that were looked into included the Sri Lanka Energy Services Delivery Project, Indonesia Solar Home Systems Project, Bangladesh Rural Electrification and Renewable Energy Development Project, and Uganda Energy for Rural Transformation Project.

(c) During identification, EDC had neither sufficient capacity nor technical, human and financial resources to extend its modest grid into rural areas, so RGC chose to engage REEs to expand the local networks to serve rural households. Combining the efforts of EDC and REEs to achieve these objectives was a wise choice.

(d) The investment components were complemented by TA activities that enhanced the capacity of key sector participants, by supporting project management and developing business models to encourage private sector participation in renewable energy development and distribution network expansion for rural electrification.

(e) The pilot REF program, which introduced the OBA concept for off-grid access and renewable energy activities to capitalize on the private sector's presence, which was expected to undertake pre-investment studies and initiate investments. Conceptually, it suited Cambodia's situation since government funding for off-grid extension and renewable energy development was very limited.

Overall, the project was a well designed project. However, there were some a few **shortcomings in design.** Even though these shortcomings were relatively minor in the context of a solid rural electrification and transmission project, and did not have a significant impact on the achievement of the key development outcomes, they are discussed below, with a view to informing the design of future projects of this kind. The paragraphs below outline a few areas where things could have been done better.

(a) First, the project results framework could have been designed better. Even though the stated CAS- and sector-wide objectives were relevant and important, the inclusion of sector-level key performance indicators in the results framework meant that the performance of this rural electrification project would be measured against sector-wide outcomes beyond the immediate reach of the project. Section 2.3 contains more discussion about shortcomings in the results framework.

(b) Second, even though it was conceptually sound, the pilot SHS OBA subcomponent, involving piloting the concept of installation of SHS by dealers, companies and REEs complemented with OBA proved challenging to implement. The implementation of this subcomponent faced challenges primarily because most households could not afford the required upfront payment and because SHS sizes offered initially were not found desirable by some households involved. Even though various studies were undertaken to assess the market for SHS[5] during preparation, a more detailed assessment upfront may have been necessary. Nonetheless, during implementation the weak aspects of the approach being piloted was identified, and properly addressed during preparation.

(c) Third, achieving the mini- and micro- hydro capacity targets could have been made possible by the inclusion of more rigorous support under the REF component, going beyond the modest resources and support provided in the form of TA on renewable energy technologies and business models and a small awareness campaign aimed at encouraging local institutions to lend to REEs. Of the shortlist of potential mini- and micro-hydro projects identified through prefeasibility studies during preparation, none had a feasibility study. The provision of completion of feasibility studies before RETP effectiveness, and the presentation of a set of implementation-

[5] These studies cited in the PAD include (i) Investing in solar PV in Cambodia: Market Study and Business Models; (ii) Market Development and promotion plan for SHS; (3) Financing PV Household Electrification in Cambodia and (4) Photovoltaic market development in Cambodia.

ready projects for the private sector to invest in could have made it more likely for the targets to be achieved.

Even though the results framework, the initial pilot SHS delivery scheme, and the mini and micro- hydropower sub-components could have been designed better, these shortcomings did not have a significant bearing on the achievement of the broader development objective, which was the expansion of electricity access to unserved population for fostering growth of rural economy and enhancing the efficiency of the electricity system. The parts of the project where there were weaknesses in design correspond to a rather small portion of the project, and these weaknesses are relatively minor when seen in the context of a much larger and well-designed rural electrification project. Moreover, the issues with the initial design of OBA pilot were addressed during implementation, with the delivery modality being revised, which led to the original target not only being met, but exceeded.

Safeguards. The Project was appropriately assigned "Category B", as potential impacts were expected to be moderate. Two safeguards policies were triggered by the project: Environmental Assessment (OP/BP 4.01) and Involuntary Resettlement (OP/BP 4.12). Detailed studies on potential environmental and social impacts were carried out, and the findings of the studies served as the basis for the mitigation measures outlined in the Environmental Management Plans (EMP), Resettlement Action Plans (RAP), Resettlement Policy Framework (RPF), and Ethnic Minority Development Strategy (EMDS).All key environmental and social safeguards documents were finalized after stakeholder consultations bringing together beneficiaries, community groups, the national government, Non-Governmental Organizations (NGO) and development partners, and were disclosed locally and on the internet. Overall, the impacts identified were accurate, the consultations carried out before and during the project were adequate, and mitigation measures put in place were effective.

Adequacy of Government Commitment. RGC's commitment to sustainable energy development was clear from the start, with the sector reform process that began in 2000 as discussed in Section 1.1 above. In addition to making significant policy decisions, RGC showed its commitment to furthering the rural electrification agenda by requesting IDA financing for the project, and requested an advance from the Project Preparation Facility (PPF) to cover project preparation costs and complete the set-up of EAC. RGC also requested IDA support for a grant from the Private Participation Infrastructure Advisory Facility (PPIAF) to support preparation of a private policy framework and guidelines to encourage private power investment in power generation and distribution in rural areas.

Risk Assessment. Risks to the achievement of the PDO/GEO were appropriately identified and included the possibility of: (a) the emergence of unsolicited and non-competitive Power Purchase Agreements (PPAs), (b) RGC and EDC not honoring their financial commitments, (c) lack of transparency in implementation of regulatory rulings and EAC decisions, and (d) Vietnam not honoring the PPA. The overall risk rating was "moderate". In hindsight, however, the several additional risks could have been included:

(a) First, the oil price volatility risk was not adequately assessed. During project preparation, the lower cost power anticipated to be supplied Vietnam was expected to be the main driver of cost reduction. However, when the imports from Vietnam did not materialize at the volumes envisaged as a result of the country's own struggle to keep up with rapidly growing demand, the cost of electricity supply in Cambodia continued to be exposed to oil prices, given the heavy reliance on diesel and fuel oil. Meanwhile, the financial analysis carried out at appraisal was exploring scenarios where international crude oil prices would stay constant at the US$ 30 range, or decrease to a yearly average of around US$25 per barrel from 2004 and stabilize thereafter. So when the average price of a barrel of crude oil

jumped from US$30 at appraisal to US$50 at project effectiveness, and then soared to over US$133 a barrel by July 2008, the achievement of the cost reduction objective was no longer feasible.

(b) A second under-assessed risk was that of unavailability of financing from local commercial banks and financial institutions to REEs for investment in small renewable energy and rural electrification. This can be explained partly by the 2009 global financial crisis, which could not have been anticipated at the time of preparation, and partly by the limits to the technical and financial capacities of REEs to prepare feasibility studies leading to bankable projects. Even though the team correctly identified the performance of REEs and local financial institutions in expanding rural electricity supply as a condition for ensuring sustainability of the project components, the risk of local financial institutions' unwillingness to lend to REEs was not adequately emphasized. Had this risk been assessed properly, the project scope could have adopted mitigation measures beyond a small awareness campaign and directly target local institutions to encourage them to lend to REEs.

(c) The risk of significant delays in the REF becoming operational was not foreseen. This delay – a total of 24 months – affected the realization of component's output targets on time and was one of the factors leading to the need for extension of the project's closing date.

Overall the project's quality at entry is rated moderately satisfactory.

2.2 Implementation

Delays in Start-up. At the beginning of project implementation, delays were experienced for three main reasons:

- ***Delays in formation of government after elections.*** Although the Bank approved the project in November 2003, the signing of the legal documents was delayed by a year, to November 2004, due to delays in the formation of a new government. These delays forced the borrower and Bank to extend the refinancing date of the PPF several times in line with Credit effectiveness.
- ***Delays in appointing key PMU staff.*** Even though two Project Management Units (PMUs) were formally established prior to Credit effectiveness, the implementation of the EDC and MIME components faced delays and bottlenecks due to delays in appointing key staff. Appointments were completed in early 2006, nearly a year after effectiveness.
- ***Slow progress in establishing the REF.*** There were delays in selecting the technical advisor and financial management consultant; delays in appointing the Executive Director (ED); and delays in hiring key REF Secretariat staff. Thus the REF could not begin full operations until April 2007, two years after effectiveness.

Revisions during Mid-Term Review. The project's mid-term review (MTR) carried out in 2008 confirmed that both the PDOs and GEO remained valid, but that their achievement would require a restructuring and extension of the closing date. Of particular concern was the progress in **SHS installation.** By the end of December 2009, only 93 SHS had been installed out of the target of 12,000, primarily because rural households could not afford the upfront payments to the suppliers. Consequently, the delivery model was changed to a "hire-and-purchase" model based on successful experience in neighboring Lao PDR, with REF carrying out bulk purchases of SHS and with the private sector providing installation and services. When households were allowed to pay in installments over as much as 48 months, interest grew rapidly and the installation target was reached in less than six months.

Regarding the **mini and micro hydropower** subcomponent, by the MTR, no FS had been completed. As discussed above, the key factors included the REEs' weak capacity and unavailability of the legal, regulatory and financing environment to support the needs of the REEs. By January 2010, it became clear the original targets could not be met, so the subcomponent was restructured to reduce the targets to completing FS for 6,850 kW and installation of 1,200 kW of mini-micro hydro and biomass capacity.

Procurement delays also affected the timely completion of the NCC (Component A(c)). A complaint from one of the bidders resulted in the delays. The bidder was eventually provided with adequate clarifications and the case was resolved. The NCC was finally completed in January 31, 2012, about 44 months behind schedule.

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

Design. The M&E framework was moderately satisfactory, particularly in terms of indicators set at the level of project outputs. A key shortcoming of the M&E framework was that some outcome indicators were not fully within the control of the project and some indicators were not directly linked to the project design. Although this was a well-designed rural electrification and transmission project, the formulation of the PDO level indicators created the impression that the project would address sector level issues, over which the project could only have partial impact. Examples are provided below.

(a) The indicator on the *reduction of EDC's electricity supply cost*, was not fully under control of the project. Although imported power from Vietnam was expected to reduce the cost of EDC's supply, when the delivery of the anticipated volumes turned out to not be feasible, imports from Vietnam represented only a portion (44%) of the energy supplied in 2011, while the rest (56%) was supplied by fossil fuel-fired power plants and hydropower as well as purchases from other neighboring countries. As explained in Section 2.1, the higher than expected reliance on fossil fuel-fired generation, amid high international oil prices, in turn, rendered the achievement of the cost reduction indicator unfeasible. The project had no control over how much energy Vietnam was able to deliver through the interconnection, amid its own rapidly growing demand, nor did it have control over international oil prices.

(b) Another indicator not having any directly linked activities was "*Increase in local commercial lending and other financing for rural electrification and renewable energy*". It was expected that local commercial banks and other financing institutions would lend REEs/IPPs up to US$ 15 million for rural electrification and renewable energy development. However the only activities supporting this indicator were capacity building for financial institutions and REEs to improve their understanding of the renewable energy technology, business, and increase appraisal and supervision ability of the financial institutions.

(c) At appraisal, RGC's target for rural electricity coverage, combining EDC's grid, stand-alone mini-grids and remote off-grid solutions, was 70% by 2030. While the project certainly contributed to the achievement of this target, it is obvious that what happens by 2030 was beyond the project's control.

Even though the results framework could have been improved in terms of the formulation of some indicators, it was consistent with Bank practice at the time. Overall, the results framework accurately captured the PDO and contained indicators that could reasonably be expected from a rural electrification and transmission project.

Implementation. All four implementing agencies (IAs) had adequate arrangements for providing timely monitoring and progress reports. They regularly collected data relating to the indicators agreed during project preparation and those redesigned during the restructuring. The intermediate results indicators were regularly monitored and reported. EAC collected data beyond project indicators and published them for public access annually. EDC published its annual reports regularly while REF collected its own data for project indicators.

Utilization. The M&E framework was useful in monitoring project implementation progress, and allowing the client and the Bank to take proactive actions and make changes to allow the realization of project objectives. Two cases where this was done were the revisions of (i) the SHS delivery modality; and (ii) the KPI concerning the "construction of 6,850 kW hydropower" to completion of feasibility studies during the restructuring in 2010. There was certainly a missed opportunity during the MTR, when the results framework was revised, but stopped short of addressing remaining weaknesses, as discussed in Section 5.

2.4 Safeguard and Fiduciary Compliance

Safeguards

The project's social and environmental documents were disclosed in line with the Bank policy. EMP containing mitigation measures were prepared for the construction and operations of the 230 kV (HV) transmission lines, substations, reinforcement of 115 kV transmission lines, and grid extension. Under the REF pilot program, the EMP provided measures for off-grid connections, construction of mini and micro hydropower plants, and SHS installation. At the restructuring, the EMP of the REF pilot program was revised as an Environmental and Social Management Framework (ESMF) to provide clearer guidance for construction of mini and micro hydropower projects, biomass project development and SHS installation.

Environmental and resettlement issues for RETP were insignificant, as the lines were pole--mounted and did not involve major land acquisition. Some tree-cutting and pruning occurred and EDC provided compensation to the private tree owners. There was land acquisition of 64,217m^2 for substation construction at West Phnom Penh and land owners were compensated in a timely manner according to the RAP.

One complaint was registered by Project Affected People (PAPs) in November 2008 when construction of the 115 kV line began before the Inter-ministerial Resettlement Committee (IRC) provided full compensation. In response to the complaint, EDC, with support from the Bank, suspended construction in the field and conducted a series of public consultations and discussions with the PAPs, which led to agreement on an acceptable resettlement compensation package and construction schedules. The case was satisfactorily resolved in December 2008. In 2010, in response to EDC's need to quickly acquire land for construction of hydropower plants and transmission lines supported by other sources, RGC delegated tasks related to land acquisition and compensation to EDC for its own projects. To discharge its newly delegated task, EDC increased its Social and Environmental Unit (SEU) staff from three to eight. Since then, all land acquisition and compensation works have been carried out by SEU in cooperation with local authorities and with PAPs involvement. Monitoring and recording quality of EMP implementation were relatively poor at the beginning, but the IAs gradually improved with assistance from the supervision consultants and the Bank. An external monitoring consultant was engaged to assess the safeguard implementation and concluded "RAP implementation was going well…", "people have known well about the project and its benefit…", and "affected households were well aware of the project."

Fiduciary

Procurement. At appraisal, responsibility for procurement was delegated to the IAs. The procurement capacity assessment determined the overall procurement risk was *average*. A procurement plan was prepared as part of the Project Implementation Plan including procurement packaging, procurement methods, contract types, schedules, etc. More than 95% of the procurement of goods was to be carried out through ICB procedures and subject to IDA prior review.

As discussed in Section 2.2, EDC experienced delays in contracting the NCC supply and installation due to complaints lodged by a bidder. Following the appropriate procedures for handling procurement complaints, with guidance from the Bank, the complaint case was eventually resolved.

EAC and MIME did not experience any procurement related issues. The only issue was the limited capacity of MIME in carrying out procurement within its authorized thresholds, which caused some delays in securing TA services, such as the sustainable charcoal pilot TA, one of the activities under Rural Energy Strategy formulation TA, which supported Renewable Energy Policy Development sub-component D1.1.

Engagement of IPA. Following evidence of corruption found in seven Bank-financed projects in 2006 (RETP was not implicated), and as part of remedial measures designed to mitigate the risk of misprocurement in Bank-financed projects, the RGC and the Bank agreed in 2007 to engage an IPA to handle procurement for all Bank-supported projects in Cambodia. It was decided in December 2008 that the IPA would carry out all procurement under RETP, except for the following activities, which would be undertaken by the IAs: (i) Selection of Individual Consultants and hiring of NGOs; (ii) Direct Contracting (for Goods and Works) and Single Source Selection (Consulting Services); (iii) Procurement of Goods estimated to cost less than US$50,000; and (iv) Procurement of Works estimated to cost less than US$100,000.

Introduction of the Good Governance Framework. Another remedial measure put in place following the identification of fiduciary issues in 2006 was the preparation and implementation of Good Governance Frameworks (GGF) by all IAs (EDC, EAC, MIME, and REF) in 2009. The GGF aimed at mitigating risks through (i) information disclosure; (ii) civil society involvement; (iii) complaints and remedies mechanism; (iv) Code of Ethical Conduct; and (v) sanctions. GGF was translated into local languages for easy observance by staff of the IAs. All IAs reported on GGF implementation regularly and implementation performance was satisfactory.

Financial management. Two incidences of forgery of invoices were identified in June 2009 in REF's request for disbursement. This resulted in a downgrading of the FM rating to Unsatisfactory for the Project as a whole as of June 2009. A series of remedial actions were taken by REF to correct the situation. They included (i) appointment of a new finance manager to replace the old one who was asked to resign; (ii) appointment of a senior accountant; (iii) appointment of an internal auditor; and (iv) reconstruction of the books of accounts and reconciliation of each source of funds (IDA, GEF, and counterpart funds); (v) refunding of the ineligible and un-reconciled amounts found; and (vi) completion of the external audit of the project's reconstructed books of accounts for the fiscal years 2007 and 2008. Resolution of these issues took some time, leading to further delays in processing the restructuring in 2009, but clean audits were received thereafter.

2.5 Post-completion Operation/Next Phase

EDC performance after project completion. Following the revision of EDC's tariff in 2010, EDC revenue has increased substantially. EDC's revenue is expected to be sufficient to support operation and maintenance and small scale investment up to 2016. All costs of 668 km of LV line construction under the project (in five provinces) were covered by EDC funds. With EDC's ability to increase supply about 19% per annum on average, EDC's revenue is expected to continue to increase accordingly. According to the economic and financial analysis (Annex 3) EDC is expected to continue to remain financially viable. With well-designed arrangements for system expansion planning supported by the project and other sources, and after installation of Financial Accounting and Utility Management Information System (FAUMIS), EDC's combined technical and non-technical losses are expected to be maintained below 10%. EDC has prepared a MV line expansion plan for its entire service area, with a total investment cost of about US$ 600 million. EDC will need to revise the plan from time to time to align it with population growth and availability of capital investment.

A critical challenge for EDC will be to ensure the availability of adequate staff with required technical knowledge, especially for the newly established NCC and the SEU. Under RETP, eight NCC core staff received extensive overseas training during the set-up of the Supervisory Control and Data Acquisition (SCADA) system. Even though this capacity building was effective, more effort is needed to ensure continuous operation of the NCC. Consistent with advice from the Bank, EDC hired additional staff for NCC operation, and their training should start in January 2013, under TA from JICA. Similarly, continued capacity building for SEU staff will be necessary to allow it to perform EDC's recently assigned responsibilities for land acquisition and compensation. EDC intends to use funding under other ongoing donor-funded projects to this end.

Replicating and scaling up of project accomplishments. A new project, the proposed "Cambodia Rural Electrification Project" was intended to build on the accomplishments of RETP. Its intent was to fund MV lines to reach un-served rural villages, traversing existing REE areas in some cases. Outside REE areas, EDC would install LV network including metering points to connect new rural households. Inside REE areas, REEs would purchase electricity in bulk from EDC to dramatically reduce its generation costs. However, no new energy sector project is present in the Bank's pipeline. If follow-up engagements are contemplated, they could include: (i) support to further extension of MV and LV lines, (ii) continuation of TA for key sector entities, especially for system development planning, and (iii) financing for power generation, particularly low cost generation options and renewable energy resources for remote areas.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design and Implementation

The PDO remained highly relevant to Cambodia's economic and social development and suitable to the country's needs in the power sector. Cambodia's electrification rate remains among the lowest in East Asia. Increasing access to electricity to foster economic growth and improve living standards continues to be a priority objective for RGC. At closing however, the Bank did not have an up-to-date CAS to address the remaining issues in the power sector. Still, the Project remained consistent with the last CAS progress report discussed by the Board in 2008.

3.2 Achievement of Project Development Objectives and Global Environment Objectives

PDO Overall Rating: Moderately Satisfactory

Cambodia's energy sector made solid progress over the life of RETP, in part, due to the support it provided. Complementing investment support through the provision of TA in system planning, RETP was able to guide sector investments to achieve sustainable, reliable power supply in the medium and long term. The project's achievements with regard to the PDO and GEO are elaborated below.

Objective (a): Improving power sector efficiency and reliability and reducing costs of electricity supply

Rating: Moderately Satisfactory

Through the project's investments in the transmission network and rural electrification, under Components A and B, complemented by the TA provided, Cambodia's electricity supply is now more efficient and reliable as elaborated below.

- ***Power sector efficiency has improved.*** The project contributed to improving capacity both through investments made in HV, MV and LV system expansion, support to REEs, and TA for various stakeholders. The project not only helped improve distribution system efficiency, but also allowed industrial and commercial users and REEs to switch from inefficient diesel generators to clean, grid-supplied electricity. The total power consumption of commercial and industrial consumers switching from diesel generators to grid supply was recorded as nearly 40 MW as of March 2012, exceeding the 30 MW target at appraisal. In addition, 53% of REEs retired their relatively small, inefficient diesel generators and switched to the EDC grid for their energy supply. (Total power switch figure is not available.)

  The project also contributed to efficiency improvements in the broader power sector, through: (i) supporting enhanced power system development planning, to allocate resources more efficiently; (ii) contributing to the preparation of the master plan and subsequent development of the Kamchay hydropower plant and associated HV transmission line connecting the power plant, which further enhanced generation efficiency; (iii) enhancing the capacity and effectiveness of key sector participants, including EDC, REEs, MIME, EAC and REF. With better network design and the new FAUMIS, EDC was able to **reduce systems losses from 14% at appraisal to 9.8%** at closing, well exceeding the target of maintaining losses at 14%.

- ***Supply reliability has improved.*** At appraisal, the total installed generation capacity in the country was 109 MW, or about 10% short of demand (118MW), forcing EDC to cut power supply to about three hours per day. At closing, capacity was able to meet demand, with installed generation capacity at 620 MW, and with generation capacity owned by EDC having increased from 52 MW at appraisal to 153MW. The System Average Interruption Duration Index was nearly halved in the first part of 2012 alone, decreasing from 60 minutes per customer per day in February to 31 minutes by the end of May, according to EDC data.

- Furthermore, the reliability of rural supply has improved, with REEs' daily service hours having risen from four hours at appraisal to 12 hours by closing, or a 50% increase over the target of eight hours of service. In fact, some 54% of REEs provide 24 hour service.

- ***Reducing costs***. The desired reduction in EDC's cost of power supply was not achieved. The average cost of power supply was slightly reduced from US$0.15/kWh at appraisal to US$0.145/kWh (including VAT and imported tax), but fell short of the target of US$0.11/kWh. As explained in Section 2.2, this was primarily due to factors beyond the control of the project, particularly the increase in the cost of fuel for power

generation, resulting from a surge in oil prices on international markets. Moreover, the cheaper imported power that was expected to come from Vietnam did not fully materialize, as Vietnam has provided only 135MW out of the 200MW agreed in the PPA. Out of the total 2,564.07 GWh of energy supplied by EDC in 2011, about 1,662 GWh (65%) was purchased from neighboring countries and about 902 GWh (35%) supplied by domestic IPPs (fuel, coal-fired and hydropower).

Objective (b): Improving standards of living and fostering economic growth in rural areas by expanding rural electricity supplies

Rating: Satisfactory

Through the expansion of distribution networks, the **living standards of targeted rural households have improved**.

- Overall, the project has helped expand rural electricity coverage with some 565,733 people (117,861 households) having gained access to modern energy services, nearly meeting the target of 567,000 people. (More people will be able to access modern energy services as new connections to the established distribution networks, as a result of RETP, continue.) Although no surveys were done, observations made and conversation with randomly selected households, supervision missions indicate that standards of living in the project areas have improved, with households now using refrigerators, fans, water pumps, radios and televisions for the first time.
- The retail tariff charged for electricity supply to households in rural areas covered by licensed REEs declined from US$0.60/kWh to US$0.35/kWh, exceeding the US$0.425/kWh target. This reduction was made possible when REEs switched from inefficient, expensive self-generation to EDC's grid supply. As a result of expanding electricity access and lower tariffs, income-generating opportunities became available to rural households. In anticipation of this, the project offered customized training on various types of income-generating activities such as sewing clothes for the garment industry, dress-making, tailoring, hair-dressing, and agricultural processing.
- Although systematic surveys determining the impact of electricity access on income-generation were not carried out, anecdotal evidence from Bank supervision, REF consultants, and the Borrower's completion report suggests that about 15% of newly electrified households started up businesses (see photos 4 - 12 in Annex 2) and their self-reported increase in income has ranged between Riel 300,000 (US$75) to Riel 1,000,000 (US$250) per month, depending on the type of business.

Objective (c): Strengthening electricity institutions, the regulatory framework and the "enabling environment" for sector commercialization and privatization

Rating: Moderately Satisfactory

The TA provided under the project supported development of required Regulations and Codes to be used by EAC and facilitated the licensing and operation of private REEs in the electricity business. To date, all 11 required Regulations and Codes were issued and are being used by EAC, except for the "Distribution Codes" which are being finalized. With these Regulations and Codes in place, EAC issued licenses to 297 REEs, exceeding the original target of 180, which was facilitated by the extension of the closing date. The licensing of the REEs, in turn, contributed to the extension of grid supplied electricity services to 50,000 new households. The project also resulted in the development of four private companies active in the renewable energy business, one short of the original target of five companies. This difference can be explained by the reluctance of local commercial banks to finance renewable energy and/or rural electrification businesses, as discussed in Section 2.

The project also indirectly contributed to the development and operation of 193 MW of hydropower capacity, through the support provided for the preparation of a power system

master plan, construction of a partial power evacuation route connected to this power plan, and the establishment of NCC. Further details on strengthening the electricity institutions and regulatory framework development are described in Section 3.5(b) below.

GEO Overall Rating: Moderately Satisfactory

The project's success in overcoming barriers to renewable energy development, including those related to lack of a policy framework, financing, information and institutional capacity, is rated moderately satisfactory.

The project supported the removal of barriers to renewable energy development through multiple channels. Barriers to be overcome (lack of renewable energy policy, strategy and capacity to plan, provide and finance renewable energy systems; high initial costs and lack of awareness and confidence in renewable energy systems among potential suppliers and consumers) were addressed through support for policy development, financing outreach and institutional capacity building, complemented by support for SHS and the mini-hydro capacity development. These achievements are summarized below.

(a) *Policy development.* The project supported the development of measures and analyses to contribute to *Renewable Energy Policy (activity D.1.1)* that created a level playing field for renewable energy private sector investors based on renewable energy assessments and least cost planning. The engagement through project provided a channel for continued policy dialogue with the government. For instance, as a result of the dialogue carried out through the project, the government recognized that the relatively high cost of imported SHS was one of barriers in renewable energy development. To remove this barrier, on August 21, 2009, the RGC issued the Circular No. 697 to exempt renewable energy technologies and equipment, including SHS and bio-digesters, from import taxes.

(b) *Financing.* The project provided an output-based grant of US$100 per system to encourage private companies to invest in and install 12,000 SHS among rural households. However, during implementation, it became evident that rural households could not afford the upfront cost of SHSs (about US$300 each) to private companies. In order to remove this barrier identified during implementation, the OBA delivery modality was changed to "hire-and-purchase" as part of the 2010 restructuring. The new approach attracted great interest from rural households as it allowed them to finance the cost of SHS over time, with terms up to 48 months. Although installation started two years behind schedule, the installation of 12,000 SHS was eventually completed in less than six months. The new delivery mechanism made it possible for households to obtain SHS, thereby removing barriers to rural households to access renewable energy.

(c) *Outreach and information sharing.* The project supported the *Promotion of Renewable Energy Technologies.* The promotion campaign was carried out through booklets, posters and signage, TV and radio spots geared mainly toward the private sector and financing institutions and local banks. The project also supported public consultations (see photo 18) with HHs on benefits of SHS, including subsidies available, cost savings, convenience and improved security by switching from kerosene lamps. The outreach efforts generated strong interest among rural households.

(d) *Institutional capacity improvement.* The project supported managerial, technical procurement oversight, and M&E by the IAs, in order to enhance their capacity to effectively perform their responsibilities well beyond project closing. The project also financed *capacity building of financial institutions and REEs*. It contributed to

improving the understanding of renewable energy technologies, the business, and enhanced their skills to appraise and supervise such projects. By closing date, some 122 trainees participated in renewable energy business development, 229 participated in capacity building for financial institutions, and 60 REE representatives participated in renewable energy promotion training sessions.

Percentage of national generation capacity by renewable energy systems increased. By project closing date, installed hydropower generation capacity reached 14.5%[6] of the total installed capacity in the country compared to 5% renewable energy capacity targeted. Although the project did not directly finance renewable energy projects, it did fund the update of the Power Master Plan and construct partial power evacuation route that connected to the Kamchay hydropower plant which indirectly contributed to this success. This hydropower plant was connected to the national grid in December 2011.

In the case of SHS subcomponent, although there were challenges encountered in implementation, the bulk purchase scheme for SHS was ultimately successful. However, the performance of this subcomponent is rated moderately satisfactory, since the SHS installation was not fully completed at Credit closing due to delays in procurement.

On the other hand, the planned installation of micro hydropower capacity of 1,200 kW as approved during the 2010 restructuring could not be completed, as the feasibility study of the five selected sites concluded they were not economically or financially viable. However, this had little impact on achievement of the targets for reducing Greenhouse Gas emissions. Based on data provided by EDC, as of December 2011, carbon dioxide ($CO_{2)}$ emissions directly and indirectly avoided through the project – through provision of SHS to new households, improved power system efficiency, loss reduction, import of electricity from Vietnam, replacement of small inefficient diesel generators with grid supply, and domestic hydropower financed through other sources – reached more than 511,000 tons, greatly exceeding the 233,000 tons targeted for the project period. The estimated CO_2 emission to be directly avoided by the Project over by 2020 is estimated about 2 million tons – exceeding even the combined direct and indirect target for avoided CO_2 emission of 1.5 million tons. (See Table B of Annex 2.)

The target for the other key performance indicator for the GEO, "***increase of local commercial lending and other financing for rural electrification and renewable energy development***" US$ 15 million was not achieved. This is mostly because local financing for rural electrification and renewable energy was not available due to external factors such as the financing environment not being conducive to lending to REEs, and the unwillingness of local commercial banks to lend for rural electrification and renewable energy. Nevertheless, EDC still was able to access financing from bilateral or multilateral agencies and other sources notably the China Export Import Bank, which contributed US$50 million equivalent for investment in the distribution network.

The GEO rating was downgraded to "unsatisfactory" in November 2010 as the key outcome indicator supporting the GEO – installation of 12,000 SHS – was not on track as closing approached. Following the adoption of the new delivery model, REF successfully concluded procurement by signing a contract with a supplier in May 2011, and a contract

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6 It counts only 10MW supplied by the Kamchay hydropower plant by December 2011. Total capacity of Kamchay hydropower plant is 193MW

for the supervision of SHS installation in September 2011. By December 2011, some 9,875 SHS had been installed. (The remarkable progress can be observed in the sharp upturn in the disbursement curve in the datasheet.) In light of the rapid progress of key outcome indicator supporting the GEO in the second half of 2011, (beside quick installation of SHS in second half of 2011, the increase financing for RE from null in 2010 to US$ 50 million in 2011, and increase percentage of national generation capacity by renewable energy from 2.3% in 2010 to 14.5% in 2011), the GEO rating was upgraded to "moderately satisfactory" during the implementation support mission from December 12-22, 2011. The upgraded "moderately satisfactory" GEO rating was reported in ISR sequence #13 on January 18, 2012. Because it was archived on February 10, 2012 (after closing date) the last ISR in the system still shows a GEO rating of unsatisfactory.

3.3 Efficiency

Rating: Moderately Satisfactory

Economic and financial analyses were carried out for different components of the project: (i) grid extension under EDC; (ii) grant-assisted household connections under REEs; and (iii) the installation of SHS under REF. The main findings and conclusions are summarized below, and further detail is available in Annex 3.

The Economic Internal Rate of Return (EIRR) of *the grid extension sub-component under EDC* is 28.9% compared with 19.8% at appraisal; the Financial Internal Rate of Return (FIRR) of the subcomponent is 7.3% compared with 4.4% at appraisal; and the Financial Net Present Value (FNPV) is US$4.9 million compared with a negative US$ 1.3 million at appraisal. The higher economic return is primarily due to the higher consumer willingness-to-pay estimate based on the actual weighted average tariff off-grid households in the project area paid in 2008. At appraisal, the willingness-to-pay estimate was based on the average cost of off-grid supply in 2003 when fuel prices were substantially lower. The higher financial return is primarily due to higher than estimated retail tariff in the project area.

	EIRR (%)		**NPV ($ million)** @ EOCK=12%	
	Appraisal	Completion	Appraisal	Completion
Grid extension under EDC	19.8	28.9	7.9	64.9
	FIRR (%)		**FNPV ($ million)** @ WACC = 6%	
	Appraisal	Completion	Appraisal	Completion
	4.4	7.3	(1.3)	4.9

Note: **NPV**- Net Present Value; **EOCK** - Economic Opportunity Cost of Capital; **WACC** - Weighted Average Cost of Capital

The EIRR of the ***Grant-supported household connections by REEs*** is estimated at 17.5% compared with 22.3% at appraisal; the NPV of the subcomponent is estimated at US$ 8.9 million compared with US$ 9.6 million at appraisal. The FIRR of the subcomponent is estimated at 9.8% compared with 22.2% at appraisal and the FNPV is estimated at US$ 10.5 million compared with US$ 4.3 million at appraisal. The lower EIRR and FIRR are primarily due to higher costs of supply from diesel based generation. The higher NPV and FNPV in spite of the lower EIRR and FIRR are due to an additional 5,000 households being connected compared with the original plan.

Grid extension under REEs	**EIRR (%)**		**NPV ($ million)**@ EOCK=12%	
	Appraisal	Completion	Appraisal	Completion
	22.3	17.5	9.6	8.9

FIRR (%)		FNPV ($ million)@ WACC = 6%	
Appraisal	Completion	Appraisal	Completion
22.2	9.8	4.3	10.5

Every US$50 increase in REEs' cost of connection will decrease the FNPV by about US$3.2 million.

No economic and financial analyses were conducted for the SHS program at appraisal. At completion, the economic analysis of the ***SHS pilot*** first assessed the economic return of the subcomponent, and then estimated the levelized cost of electricity to end users under the following three scenarios: (i) Scenario 1 without interest free financing, all capital costs paid up front; (ii) Scenario 2 with interest free financing; and (iii) Scenario 3 with interest free financing and $100 subsidy per household.

	EIRR (%)		NPV ($) @ EOCK=12%		Levelized Cost to End-Users (US$/ kWh)		
	S1 without Financing	S2 with Financing	S1 without Financing	S2 with Financing	S1 without Financing	S2 with Financing	S3 with Financing + Subsidy
1 SHS 30W	35.4	59.0	180.5	291.1	$1.00	$0.91	$0.57
1 SHS 50W	36.6	71.8	243.0	366.3	$0.75	$0.68	$0.47

The analysis shows that the levelized cost of electricity from SHS is highly sensitive to under-utilization. For example, with four hours of usage per day, the 50 WP and 30 WP systems deliver electricity at around US$ 0.75 per kWh and US$ 1.00 per kWh; the cost will double if the system is used for only two hours a day.

Financial Performance of EDC

Assessment of the financial viability of EDC at appraisal highlighted several issues: insufficient tariff to recover costs of supply; high costs of production; outstanding government arrears; and high distribution losses. Based on the assumptions made, the financial projections for the period 2001-10 indicated that EDC's financial outlook would remain fragile unless the following measures were taken: (i) procuring fuel on the basis of competitive bids; (ii) converting one of its power plants to cheaper fuels; (iii) negotiating with IPPs for lower tariffs and reduced level of off-take; (iv) reducing staffing costs; (v) shutting down older plants to reduce O&M costs; vi) reducing system losses; and (vii) updating the company's bad debt provisions and write-offs.

To promote continued prudent financial management, the following financial covenants were agreed as well at appraisal: (a) sufficient cash flow to cover operating expenses and the amount by which debt service requirements exceed the provision for depreciation; (b) debt service coverage ratio no less than 1.3 times from 2007 onward; and (c) long-term debt to equity ratio less than 1.5 times. All covenants were met, except for the break-even covenant in 2007 when EDC's cost of supply was around KH Riel 1,012 per kWh and the average tariff around KH Riel 996 per kWh. In that year, the Cambodia Utility Private Limited provided EDC with a Riel 54 million refund for liquidated damages, which helped make up for the shortfall in the company's cash flow.

3.4 Justification of Overall Outcome and Global Environment Outcome Rating

Rating: Moderately Satisfactory

The project remained highly relevant to RGC's priorities from concept review in 2000 to closing in 2012. All major physical targets achieved or exceeded as well as the target for CO2 emission reduction albeit with cumulative extensions of 31 months. Achievement of

the PDO, GEO and efficiency are rated moderately satisfactory. Therefore, the overall rating is justifiably moderately satisfactory.

3.5 Overarching Themes, Other Outcomes and Impacts

(a) Poverty Impacts, Gender Aspects, and Social Development

As a result of the project, some 565,733 rural residents (52% female) now have either grid-supplied or off-grid electricity services for the first time. Although no detailed impact survey was carried out, certain impacts are apparent: (a) rural households now have access to safer, better lighting (compared kerosene lamps) for students to do homework at night, for socializing or for watching television; (b) households have started home businesses that can potentially increase incomes; and (c) 174 primary, secondary and high schools, over 200 houses of worship, and 132 health centers and hospitals now offer better services.

Gender. It is commonplace for all housework in rural areas – including collection of drinking water, preparation of meals and rice husking – to be carried out by female household members. Anecdotal information gathered during site visits indicated that the physical and time burden of these tasks has been significantly reduced in households with electricity – consistent with findings of studies documenting similar experience in other countries. For example, in visits, it was observed that villagers gaining access to electricity have obtained electric water pumps near their homes, thus reducing time and energy spent fetching water, and some families are using electricity for cooking and boiling water. Females feel safer in the evening, with electric lighting and feel better positioned in the family since they can work in the evening on household businesses such as weaving to increase incomes..

(b) Institutional Change/Strengthening

Implementation Support for Creation of REF. The creation of REF provided an important instrument for delivering subsidies and providing off-grid electrification to targeted households in rural areas that could not be reached by the grid in the medium term. This provided an important complement to grid extension by EDC and REEs. The implementation capacity of the REF Secretariat was developed on technical aspects, procurement oversight, supporting REE development, and M&E. About 135 sub-grants to 95 REEs were evaluated and appraised by REF staff, and with the support of the TA, REF staff successfully managed the SHS program. The knowledge obtained will help REF perform similar tasks after closing, provided continued support is available to implement and revise the REF strategic plan as needed.

Capacity Building for REE and Support for the Establishment of a REE Association. Through capacity building to REEs, the project contributed to enhancing their ability to further expand electricity access in rural areas, complementing EDC's efforts. The project helped REEs organize themselves to communicate effectively with RGC and relevant organizations (local commercial banks) to accrue more benefits, and to assist one another with technical and financial challenges. As part of the TA, a road map was prepared for REE improvement, and a strategic plan was developed for strengthening the REE association in order to build long-term capacity. In addition to sub-grants to REEs, the project fostered private sector participation in the power sector through training on technical and financial management of the energy enterprises.

Strengthening of EAC Institutional Capacity. The Project strengthened EAC's capacity to carry out its responsibilities mandated in the Electricity Law and helped put in place regulations and codes to improve the quality of the supply and services and to ensure

transparency in EAC's operations. To date, all 11 required Regulations and Codes were issued and are being used by EAC, except for the "Distribution Codes" which are being finalized. With these Regulations and Codes in place, EAC issued licenses to 297 REEs, exceeding the original target of 180, which was facilitated by the extension of the closing date. Continued capacity building was provided to EAC through various training programs on technical and financial regulations. The success of the capacity building was demonstrated when EAC was able to reduce the services of the in-house advisor (financed by its own funds) from full time to an as-needed basis.

EDC Institutional Capacity Strengthened. The project enhanced EDC's capacity significantly in the areas of:

(a) ***Commercial practices and management*** by installing and providing training on FAUMIS, first at its head office, and then at provincial branch offices;

(b) ***Power investment planning*** by helping EDC to identify and estimate system loads, assess and reduce losses, ensure reliability and quality of existing supplies, develop a plan for the 22 kV backbone system, evaluate existing substations and existing 22 kV and LV network and rehabilitation requirements. EDC's technical staff were provided with and trained for use of planning software and load monitoring tools and other related items in preparing EDC's power investment plan. These skills can be used for future power investment planning; and

(c) ***Project implementation.*** The project enhanced the capacity of EDC in procurement, contract management and site supervision for transmission and distribution projects, and associated environmental and social safeguards management.

In addition, a ***project grievance mechanism*** established a committee to address safeguards related issues. Safeguards training sessions to enhance the capacity of this committee's members and the staff of SEU were carried out under the ADB parallel financing for RETP. Nevertheless, EDC's SEU staff also received rounds of training on World Bank safeguards policies. As a testament to SEU's enhanced capacity, RGC delegated to SEU all land acquisition and compensation tasks for EDC projects.

MIME. Some 27 MIME staff benefited directly or indirectly from the project. They obtained knowledge on energy policy/strategy formulation; however, they still need external support for comprehensive studies and or strategy formulation.

(c) Other Unintended Outcomes and Impacts (positive or negative)

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

A half-day stakeholder workshop was organized on March 23, 2012. The workshop provided an opportunity for primary and secondary beneficiaries to share project outputs and outcomes, challenges, lessons learned and to express their views and recommendations for better project preparation and implementation. Secondary beneficiaries (officials of MIME, EAC, EDC and REF), consultants, contractors and ADB representatives attended the workshop. A list of participants, a power point presentation and a summary of workshop proceedings are shown in Annex 6.

4. Assessment of Risk to Development Outcome and Global Environment Outcome

Rating: Significant

Risks to Power Sector Efficiency and Reliability

- ***Reliability of power demand growth forecast.*** At appraisal, the annual electricity demand growth rate was estimated at about 13% between 2003 and 2008 and beyond.

However, the growth rate of electricity generation and purchases surged to 25% in 2007 and an additional 23% in 2010 to meet power demand. Higher than expected demand growth could put reliability of the power supply at risk, potentially reversing efficiency improvements.. In order to maintain power sector efficiency and reliability it will be important to accurately forecast power demand and make commensurate investments. Risk is rated "moderate".

- ***Imports from Vietnam.*** It was expected that from 2008 onwards, up to 200 MW would be imported from Vietnam, based on the 2005 PPA. However, due to a surge in domestic power demand, Vietnam was unable to export as much power as expected. Currently, Vietnam sells Cambodia around 135MW of power, and this is unlikely to increase in the coming years. Therefore, the risk to improving power sector efficiency and reliability from imports is rated "significant".

Risks to Cost Reduction

- ***Purchased power from neighboring countries.*** EDC's total electricity supply in 2011 was about 2,564 GWh, of which 1,662 GWh (65%) was imported from its neighbors. However, Vietnam's inability to supply the expected amount of energy negatively impacts EDC's efforts to reduce its supply costs. As the quantity of energy that will be available for import from Vietnam is not certain, and the possibility of an increase in the tariff for energy is being explored, the risk to cost reduction is "significant".
- ***Cost competitiveness of new independently owned generation capacity***. Currently, domestic IPPs' share in EDC's energy mix is about 900 GWh (35%) (fuel oil, coal, hydropower) and most of PPAs solicited with IPPs are only modestly cost-competitive at best. If solicitation of independently owned power generation does not involve adequate competition among IPPs, there is a significant risk of inability to reduce power supply costs.
- ***Limited cost reduction opportunities offered by domestic hydropower plants.*** The domestic supply is expected to significantly increase in the short term (2012 to2015), with the completion of a series of hydropower plants with a total installed capacity of about 800 MW. (The current supply capacity of EDC including international purchases is about 620 MW.) With this additional supply, it is generally expected that the supply cost of EDC will decline drastically. However, with the average generation cost at hydropower power plants of about US$0.070/kWh (excluding VAT), the average cost of EDC supply for the end-user is estimated at about US$0.128/kWh. Regardless of the increased capacity of domestic hydropower, the risk to cost reduction remains "significant". (See Annex 3)
- ***Cost of REE in providing off-grid electricity services.*** Complementing EDC, REEs are extending electricity connections and providing services to rural consumers. Out of 297 licensed REEs, about 155 REEs have connected to EDC grids throughout the country. Tariffs for REEs that connected to EDC's grid declined remarkably from KH Riel 2,800-3,000/kWh (US$0.68-0.730/kWh) to KH Riel 1,100-1,700/kWh (US$0.26 – 0.41/kWh). The average REE retail tariff (off-grid tariff) is US$0.51/kWh, which is even higher than the baseline tariff of US$0.5kWh. Even with current international oil prices, the average REE retail tariff can be reduced to below target *if* most REEs connect to EDC's grid and the bulk purchase tariff charged by EDC is reasonably regulated targeting lowering down retail tariff. However, the prospect of getting most REEs to connect is very slim as REEs are facing technical and financial constraints, and EDC has its own challenges as described above. Risk to reducing cost of REEs and subsequently the average off-grid tariffs is "significant".

Risks to Expansion of Access to Modern Energy Services

Rating: Significant

Sustainability of REF. REF has been successful in attracting grants and securing support of donors and government and in achieving off-grid electrification targets. Retaining and improving the governance of the REF and other institutions in the rural electrification business is critical for continued support from RGC and donors to realize RGC's targets. On December 8, 2011 the REF Board and MIME decided to merge REF and its Secretariat with the EDC to support REF operations after project completion due to REF's perceived vulnerability in sustaining its functions due to budget shortfalls.

The decision to merge REF and its Secretariat with the EDC would compromise REF's governance system and may jeopardize the off-grid electrification progress. So far REF is the only instrument for providing off-grid electrification to unserved households in the country. It is of paramount importance to retain REF's current autonomous status, in order to enable REF to complement the efforts of EDC and REEs, and mobilize resources to provide affordable off-grid electricity services to unserved households that are unlikely to be connected to the national grid on a commercial basis in the medium term. RGC's commitment to allocating sufficient budget to REF in 2016 and beyond and retaining REF's current status is critical. Hence risk to expanding rural electricity supplies and renewable energy is "*significant"*.

EDC ability to expand supply, while maintaining sustainability. EDC's financial performance is a major factor to measure its management performance, while expansion of access is not taken into account. Various donors provided financing to EDC on concessionary terms and EDC used it for major upgrades to improve its financial performance. EDC has undertaken limited LV line stringing and delivers rural household connections only when it expected a return on its investment. It is understandable that EDC is unwilling to expand distribution networks in remote rural areas—anticipating increased system losses—without sufficient subsidies to recover its cost of supply. Therefore, EDC's pace of connecting rural households has been very slow. The pace of expansion is likely to remain sluggish unless more favorable conditions are put in place, such as providing grant support, transferring capital to EDC specifically for rural electrification, and revisiting EDC's retail tariff covering rural areas, to allow EDC to recover cost and achieve a reasonable return on its assets. In light of the above, the risk to future expansion of the rural electricity supply is rated as "*significant"*.

SHS installation and sustainability. Despite public awareness programs organized for SHS users on the benefits, constraints, and appropriate O&M, some households are using their systems improperly. Such practices could negatively affect the durability of the SHS and cause wide-spread SHS inefficiency which could prove detrimental to the SHS market. Another risk for scaling up the use of SHS is the subsidy itself – the households are receiving SHSs below market price. To continue expanding the SHS in remote areas, RGC should consider a similar subsidy regime to allow private companies to supply SHS to rural households. Without such subsidy, the risk of increasing access through SHS installation is "*significant"*.

Risks to sustainability of enabling environment for renewable energy

Involvement of financial institutions in the power sector. The "enabling environment" for private participation in the power sector can be assured only with the active participation of local commercial banks or financial institutions. An environment conducive to private sector participation would be predicated on: (a) a transition strategy for supporting renewable energy lending, through a mechanism aimed at mitigating the unwillingness of commercial banks to provide favorable lending rates for REEs/IPPs possibly through the provision of loan guarantees, or offering concessional financing to "buy down" the cost of the financing; (b) a predictable policy and regulatory environment; and (c) continued TA to REEs and commercial financial institutions. If these elements are not in place, the risk to the sustainability of the enabling environment for renewable energy would be *"significant"*.

5. Assessment of Bank and Borrower Performance

5.1 Bank Performance

(a) Bank Performance in Ensuring Quality at Entry

Rating: Moderately Satisfactory

During preparation, the Bank carefully reviewed RGC's strategy, laws and other relevant documents pertaining to the energy sector and renewable energy in particular. The Bank team carried out studies, and supported the client to perform its own analyses, to ensure the preparation of a good quality project. The team also reviewed lessons learned from rural energy projects in other countries and designed implementation arrangements that were client appropriate and consistent with Bank policy. The team mobilized much needed financial resources to help the client prepare the Project. For example, upon the client's request, the Bank processed an advance of US$290,840 from the Project Preparation Facility. The Bank team comprised a well-rounded mix of skills and expertise on policy, technical, financial and implementation aspects of rural electrification, and the team was supported by international expert consultants as needed. Project preparation stretched between 2000 and 2004, using about 140 staff weeks and costing just over $806,000.

On the other hand, some aspects of project preparation could have been stronger, particularly those under the REF pilot, especially the absence of bankable renewable energy projects, and associated issues with mobilization of commercial financing for those projects, and the affordability of the payment terms for SHS, which were all critical factors for success of those components.

The Bank helped the client prepare a technically sound rural electrification and transmission project, based on good technical knowledge and reflecting good international practices of the time, while addressing the government's priorities for the sector. Nonetheless, the Bank's performance in ensuring quality at entry is rated moderately satisfactory, to reflect the weaknesses in the initial background and risk analysis, as summarized here and discussed in detail in Section 2.2, and the mismatch between the project activities and the results framework, as discussed in Section 2.4.

(b) Quality of Supervision

Rating: Moderately Satisfactory

The Bank actively and effectively supervised this project and provided advice on implementation problems as they arose. At least 13 implementation support missions, as well as an MTR mission were undertaken by the Bank. Timely guidance and advice were provided for corrective actions when needed to ensure achievement of the PDOs, including restructuring of the project in 2010, realignment of the GEF technical assistance component to meet changing needs and refining project delivery modalities. A number of field visits were undertaken to ensure compliance with safeguards policies, and to verify physical progress and achievements. As of 2007, most of the project core team was field based, with the team leader moving from Washington to the field, which allowed for continual implementation support outside formal missions. Some examples of cases when the Bank

provided effective implementation support are summarized below. (Further details are in Sections 2.2 and 2.4.)

- ***Project management.*** In moving from approval and effectiveness, the Bank team closely monitored the resolution of delays in the formation of the new government and the signing of the legal agreements. In the intervening period, the Bank worked closely with the ADB and helped the IAs finalize a joint RAP which was disclosed in late January 2005, thus meeting a condition of effectiveness.
- ***Safeguards.*** In the case of the PAP complaints, the Bank team took immediate action to work with EDC, providing guidance on the required procedures, advising them to halt construction immediately, and closely cooperating with the EDC on oversight of implementation remedial actions. This enabled the satisfactory resolution of these issues in a very short period.
- ***Financial management.*** Issues over REF governance were identified by the Bank in a timely manner, and the Bank immediately worked with RGC counterparts to provide guidance and support to address the issue, including the adoption of mitigation measures and remedial time-bound actions for REF to address the issue.
- ***Procurement.*** Following identification of concerns with procurement under projects unrelated to RETP, the Bank, in mutual agreement with the Borrower, supported the engagement of IPA to handle procurement and helped IAs prepare GGF for the project. Moreover, when there was a procurement complaint under an EDC activity, guidance provided to EDC was proactive, timely and effective, with successful conclusion of all procurement complaints.
- ***Fine tuning project design***. The need for revising the SHS delivery model and the mini/micro hydropower targets were identified during MTR in May 2008 and Bank's advice on a revised model was critical for REF to turn the failing SHS program around, and make it a success in a very short period.

On the other hand, a key shortcoming of Bank supervision was that the Bank task team did not seize the opportunity of the MTR or the 2010 restructuring to address the weaknesses of the project results, framework, and revise certain indicators such as those beyond control of the project.

In light of the above, Bank performance during supervision is rated as Moderately Satisfactory.

(c) Justification of Rating for Overall Bank Performance

Considering the "moderately satisfactory" rating of Bank performance in ensuring quality entry and supervision, the overall Bank performance is rated *Moderately Satisfactory.*

5.2 Borrower Performance

(a) Government Performance

Rating: Moderately Satisfactory

As discussed in sections 1.1 and 2.1, the power sector in Cambodia underwent significant changes during the project period. RGC demonstrated strong commitment to the power sector by taking significant policy decisions, particularly with the passage of the Energy Law in 2000, establishment of the EAC in 2001, finalization of the Energy Sector Strategy and the Renewable Energy Strategy of 2003, and establishment of REF in 2005. At the project level, RGC's commitment during preparation was demonstrated by close engagement and cooperation, as well as by its willingness to request a PPF advance to finance project preparation. During implementation, RGC's commitment to the sector, and

achievement of outcomes continued, despite the various challenges faced. The remarkable increase in the number of licensed REEs in the rural energy program underlines the relevance and implementation effectiveness of the rural energy policy set by MIME and the regulatory oversight of REEs by EAC.

On the downside, as a result of long delays in the formation of a new government, it took four-and-a-half months for RGC to fulfill the conditions of effectiveness. Delays were caused by prolonged finalization of the PIP and appointment of staff in order to complete the set-up and staffing arrangements of the PMUs. The performance of MIME, as the line ministry in the energy sector in charge of setting policy for the sector, was moderately satisfactory. Limitations in MIME's procurement capacity led to delays in engaging consultants to support the preparation of select strategies and implementation plans. This delay, in turn, had a negative effect on the quality of the studies, which were completed just before closing, missing the opportunity to seek potentially valuable inputs from stakeholders to improve relevance, build ownership, and implement some key recommendations.

(b) Implementing Agencies' Performance

Rating: Moderately Satisfactory

Performance of EAC is rated satisfactory. EAC management closely oversaw implementation with strong support of an international advisor. With the knowledge and skills obtained as a result of the project's institutional strengthening support, EAC licensed 297 REEs, well surpassing the target of licensing 180 REEs.

Performance of EDC is rated moderately satisfactory. EDC's performance in implementing the project investments is rated satisfactory as all the relevant intermediate indicators were achieved. EDC was proactive and effective in implementing its investment activities. Of particular note is the company's outreach for its network extensions and new connections, as the company carried out door-to-door consultations, setting up an on-site mobile office to take applications from households, and helped people sign up for connections on the spot. However, two factors negatively influenced EDC's performance rating. First, the procurement delays in NCC installation were a key contributor to the need for an extension of the closing date. Second, EDC showed weakness in social safeguard management when it allowed contractors to start construction prior to full compensation which resulted in PAP complaints in 2008. Under TA activities, EDC relied heavily on consultants to oversee project implementation and made only modest efforts to regularly manage the project.

Performance of REF is rated moderately satisfactory. Performance of this newly established institution was marked with both noteworthy achievements and shortcomings. In terms of accomplishments, despite being fully operational only starting April 2007, REF was able to: (i) review and appraise 135 applications submitted by REEs for off-grid sub-grants for connection to 50,000 new households, (ii) conduct prior consultations with SHS households, (iii) oversee installation of SHS and get the "hire and purchase" agreements signed by households, (iv) inspect and issue acceptance certificates; and (v) collect payments from SHS beneficiaries. On the other hand, there were two instances of suspected fraud during implementation per Section 2.4. Resolution of these concerns caused delays in processing the restructuring. With guidance from the Bank team, REF took satisfactory corrective actions outlined in a time-bound mitigation action plan to improve internal controls on financial management. In light of the above, the overall performance rating of the Implementing Agencies (EAC, EDC and REF) is moderately satisfactory.

(c) Justification of Rating for Overall Borrower Performance

Rating: Moderately Satisfactory

As the performances of both RGC and the implementing agencies are rated moderately satisfactory, the Borrower's overall performance is moderately satisfactory.

6. Lessons Learned

The main lessons learned are presented below.

A well designed M&E framework is essential for properly assessing the real achievements of a project, and garnering support for replication and future scale-up. A misalignment between a project's activities and its stated outcomes, which in turn, inform the key performance indicators through which "success" is measured, can make a well-performing project appear less successful. In the case of RETP, indicators such as improved power sector efficiency, increased local financing, or reduced power supply costs measured progress in the *entire sector,* instead of focusing on outcomes for a specific intervention. Sector-level goals are affected by many factors far beyond the reach of a single project, and are better pursued and measured through a series of interventions. Furthermore, setting PDO-level indicators reflecting factors not directly targeted by any project activity, or which received very modest support, should be avoided. The evaluation of project outcomes purely through the perspective of sector-wide goals could end up overshadowing the project's accomplishments, could prevent the replication of the successful approaches the project included.

In order to make private sector investments happen in renewable energy in rural areas, the basic policy and regulatory enabling environment should be complemented with carefully designed and well targeted financing support, technical assistance and capacity building. Experience under RETP suggests that the enabling environment for private sector investment in renewable energy in rural areas, particularly with regard to access to financing and technical support is critical. Fundamental components of the enabling environment include straightforward and non-time consuming technical and environmental clearance and permitting procedures, as well as simple, transparent and predictable regulatory requirements. In addition, decision-makers should equip key sector participants – particularly developers, financing institutions, permitting bodies, and regulatory entities – with the necessary resources, tools and skills to understand, identify, appraise, invest and finance renewable energy projects for rural electrification. In some cases, even with all these essentials, small-scale renewable energy projects might not be able to attract international investors, while local private developers may not have the capacity to handle the upstream risks of project identification and preparation. Small renewable energy development stands to benefit from identification and preparation of a batch of bankable projects, in order to attract private investment. Encouraging commercial banks to develop product lines able to address the specific challenges associated with renewable energy business, including flexible terms and appropriate repayment schemes, can be very useful. At least initially, until a significant demand base can be built up, expansion of electricity access to rural areas may not be based purely on commercial principles. In order to allow service providers to deliver new connections and ensure sustainability and affordability of continued service for rural consumers, service providers should be allowed to recover their costs through a combination of tariffs and government support in the form of concessional debt financing, grants, and subsidies.

Customized support for developing, scaling up and sustaining productive uses is highly likely to make a significant impact on the feasibility and viability of rural electrification investments. EDC and REF dedicated special attention to engaging the owners of commercial and manufacturing businesses to abandon self-generation facilities and connect to their systems. These efforts were complemented by TA for the development of additional productive uses of electricity. This combination successfully built the necessary

consumer base to make the network investments viable. Support to productive use of electricity helped build up demand, and led to increased use and efficiency of the existing assets of REEs and EDC; this resulted in increased revenues for REEs and EDC and helped improve affordability of electricity for local consumers. RETP experience also showed that the availability of favorable financing to local business owners for productive uses was a very useful complement in ensuring the success.

In designing SHS programs for rural areas, the choice of appropriate system sizes based on robust upfront analysis, suitable delivery approaches, and post-installation operation and maintenance arrangements is likely to have a significant bearing on the efficiency, cost effectiveness, and sustainability of those programs. The original SHS delivery approach under RETP attracted little market response, as rural households could not afford to pay the up-front charges to the dealers and the dealers were not successful in marketing and delivery due to limitations to their capacity and resources. The revised delivery model resulted in (i) the realization of the installation target for the whole project in a period of ten months; (ii) better, though not perfect, matching of households' needs, through the bulk purchase of two different sizes of SHS; (iii) resolution of the affordability issues, firstly through the cost reductions resulting from bulk purchase of systems through ICB, and secondly, by allowing households to make monthly repayments for the systems; and (iv) greater chance of sustainability of post-installation operation of the systems, through the hiring of international contractors through competitive bidding for supplying, delivering and installating the SHS, as well as installation supervision and post-installation maintenance. Even though post-installation sustainability is yet to be seen, since the SHS installation was completed very recently, the RETP experience shows that an efficient, effective and sustainable SHS program design is likely to combine: (i) selection of system sizes appropriate for varying household needs, based on extensive surveys carried out at the outset; (ii) procurement modalities that deliver efficiency and cost reductions; (iii) implementing arrangements that assist households in overcoming affordability issues in an environment of limited affordability and financing challenges, and (iv) arrangement that allow for recovery of capital costs and working capital requirements through some other channel than upfront user charges.

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

(a) Borrower/implementing agencies

The Borrower and the IAs agreed with the content of this ICR. Their inputs[7] and comments are provided in Annex 7. Borrower comments were mainly editorial and issues raised on implementation delays which cited in section 2.2 of the ICR. They confirmed it was satisfaction with the clarification provided.

The borrower (ICR) cited that overall rating for achievement of the PDOs and the GEO of the Project should be rated "satisfactory". Owing thorough review and assessment in section 3.2 above, the rating of PDO and GEO is maintained as "moderately satisfactory"

There was a borrow' s view that to accommodate the needs of some households, who had earlier purchased a system and required more power, the project should provide an addition SHS to them. As this hire-and-purchase SHS scheme included a subsidy of US$100 per system, the already installed households should not be given additional system.

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7 Including summary of the Borrower's ICR

The government acknowledged frequent power cut remains an issue in rural areas supplied by REEs, some of them connected to EDC grids. They were in the same view that there is a need to reduce REE tariff as to promote generation of rural income through use of electricity.

(b) Co-financiers

Comments from the co-financier (ADB) are provided in Annex 8. All comments from ADB were incorporated.

(c) Other partners and stakeholders

N/A

ANNEX 1

PROJECT COSTS AND FINANCING

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

Rural Electrification and Transmission Project - P064844					
Components	Total cost at Appraisal including ADB, and other sources (USD million)	IDA Financing only (USD million)			
		Appraisal Estimate, only IDA financing	Revised Allocation	Actual	Percentage of Appraisal
A. Transmission Component	90.59	16.97	16.97	15.17	89.36
B. Rural Electrification	14.74	12.81	12.81	10.85	84.71
C. Rural Electrification Fund (REF)	28.23	5.10	4.27	3.01	70.49
D. Institutional Capacity and Sector Reform	9.33	5.12	7.45	6.75	90.64
Total Baseline Cost	142.89	40.00	41.50*	35.59	88.98
Service charge (IDA)	0.54				
Commitment fee (IDA)	0.44				
IDC (ADB)	6.24				
Total Project Costs	**150.11**	**40.00**	**41.50***	**35.59**	**88.98**
PPF		0.29			
Total Financing Required					

Note: (*) USD 1.5 million accrued due to exchange rate fluctuations between Negotiations in November 2003 and the restructuring of 2010.

KH-GEF Rural Electrification & Transmission - P071591				
Components	Appraisal Estimate (USD millions)	Revised Allocation (USD Million)	Actual (USD millions)	Percentage of Appraisal
C. REF Component	1.54	3.47	3.06	88.29
D. Institutional Development and Sector Reform	4.21	2.28	1.90	83.22
Total Baseline Cost	5.75	5.75	4.96	86.28
Physical Contingencies	0.00	0.00	0.00	0.00
Price Contingencies	0.00	0.00	0.00	0.00
Total Project Costs	5.75	5.75	4.96	86.28
PPF	0.00	0.00	0.00	0.00
Front-end fee IBRD	0.00	0.00	0.00	0.00
Total Financing Required	5.75	5.75	4.96	86.28

(b) Financing

P064844 - Rural Electrification and Transmission Project				
Source of Funds	**Type of Financing**	**Appraisal Estimate (USD millions)**	**Actual (USD millions)**	**Percentage of Appraisal**
Borrower for IDA components	Counterpart	6.33	4.74*	74.88
Borrower for ADB component	Counterpart	21.15	8.60	40.66
International Development Association (IDA)	Credit	40.00	35.59	88.98
ADB and other	Loan	55.30	51.81**	93.68
Private Commercial Sources (unidentified)	Private	21.59	25.85***	119.73
TOTAL	All sources	150.12****	126.59	84.32
P071591 - KH-GEF Rural Electrification & Transmission				
Source of Funds	**Type of Financing**	**Appraisal Estimate (USD millions)**	**Actual (USD millions)**	**Percentage of Appraisal**
Borrower	Counterpart	0.17	0	0.00
Global Environment Facility (GEF)	Grant	5.75	4.96	86.28

***Note**: * including EDC's investment on LV lines of 668 km*
*** Excluding Project Processing TA (PPTA) amount of US$ 714,232.26 for the project preparation and Nordic Development Fund*
**** private investment by REE*
***** including GEF funding*

ANNEX 2

OUTPUTS BY COMPONENT

I. SUMMARY OF OUTPUTS

The Project was designed with a number of subcomponents to respond to the most pressing needs of Cambodia's power sector as summarised below together with the respective outputs.

	Component/subcomponent	Planned Output	Actual Output
A	**TRANSMISSION LINE**		
A1	230 kV TL and SS and other ADB-financed components	109 km of double circuit	Installed 109 km of line. ADB financed and controlled
A2	115 kV TL and Substations and MV extensions at WPP and Takeo		
-1	Reinforcement of TL	20 km of new TL, 23 km 2nd line stringing	14.04 km of double circuit TL built, 22 km of 2nd line of existing TL stringing
-2	Upgrade of 3 substations	GS1, GS2, GS3 substations upgraded	3 substations upgraded and operational
-3	MV Network expansion	130 km of MV line	168.8 km of MV line installed
-4	Operational Support to EDC/PMU	Vehicles, Computers, Office equipment purchased	All items procured
A3	National Control Centre	New NCC building and SCADA system	New building complete and SCADA system installed and commissioned
B	**RURAL ELECTRIFICATION**		
B1	EDC RE Grid Extension	516 km of MV lines 536 km of LV lines 50,000 new connections	613 km MV Line 656 km LV Lines 55,768 new households connected
B2	Warehouse to store RE Equipment and Materials	New warehouse	Canceled and financed by EDC
C	**RURAL ELECTRIFICATION FUND (REF)**		
C1	REE off-grid extension	50,000 new connections through REEs	50,000 new connections through REEs
C2	Solar Home System	12,000 SHS	12,093SHS installed (11,124 installed at closing)
C3	Mini Hydro	6MW of mini hydro stations	Feasibility study Canceled as non feasible
C4	Village Hydro	850kW Micro Hydro	Canceled – (Restructured)
C5	REF Office building (new item added during restructuring)	REF office built	REF office in operation
D	**INSTITUTIONAL CAPACITY AND SECTOR REFORM COMPONENT**		
D1	**TA to MIME**		
1	Renewable Energy Policy Development	Policies/programs prepared	Three sets of documents: (a) Rural Energy Strategy and Implementation Plan (RESIP); (b) Renewable Energy Policy/development program; (c) Wood and Biomass Energy Strategy
2	Development of Master Plan	Master Plan,	Master plan delivered

	Component/subcomponent	Planned Output	Actual Output
		Baseline survey	
D2	**TA to REF**		
1	Implementation Support for REF	REF establishment; Training conducted, Equipment purchased	REF established 2007 and is operational with the necessary training and equipment
2	Rural Income Generation Promotion	Training	Training on income generation and on productive use of electricity provided to HHs in newly electrified areas provided
3	Renewable Energy Business models development for Solar and Mini/Micro Hydro	Pipeline development	Business models were developed
4	REE Improvement and Association Building	Training and capacity building	Basic and advanced trainings on technical and financial aspects for REEs conducted. REEs association was established and roadmap for association was prepared.
5	Capacity building of Financial Institutions	Enable REE borrowing through commercial banks	Training for financial institutions conducted
D3	**TA to EAC**		
1	Operational Support	Consultancy Services	In-house technical advisory services provided
2	Training EAC staff on financial and technical regulation	Training on financial and technical regulation conducted	Training completed. Knowledge gained helped EAC perform its duties better.
3	Facility Support	Purchase of portable meter testing equipment	Equipment purchased and being used as intended.
D4	**TA to EDC**		
1	Project Implementation Consultant	Consultancy for supervision	The performance of PIC was satisfactory. Service of PIC was extended as Project closing date.
2	In-house advisor services	Services of In-house advisor	Services of in-house advisor provided
3	Independent Monitor Agency and Project Grievance Committee	Project Grievance Committee established	Project Grievance Committee established and is operational
4	Improvement of EDC Commercial Practices and management Training	New accounting system and training	FAUMIS installed and training provided. Being used as intended.
5	Capacity building for Land Acquisition	Training provided	Training on safeguards and land acquisition provided during the project implementation period
6	Power Investment Planning	Master Plan	Master plan complete

II. DETAILS OF SUBCOMPONENT OUTPUTS

A. COMPONENT A: THE TRANSMISSION LINE

A-1 The Construction of 230 kV Transmission Line - interconnection to Vietnam

The scope of this component included: a) the 230 kV TL portion in Cambodia, b) two new substations, at West Phnom Penh (WPP) and Takeo; and c) capacity building. (The 230 kV portion of the system in Vietnam, comprising 98 km of 230 kV TL between the existing substation at That Not and Chau Doc was funded from an ongoing project.)

The component was successfully completed following the original designs. The 220kV transmission component was fully financed by the ADB (together with financing from the Nordic Development Fund) under ADB's Greater Mekong Sub-region Transmission Project. The detailed outputs and outcomes of this component will be included in the ADB's Project Completion Report.

A-2 The 115 kV TL and Substations and MV extensions at WPP and Takeo

This component was aimed at addressing the urgent needs of the transmission system around Phnom Penh which is the major load centre, by undertaking: a) 115 kV network expansion around Phnom Penh, b) upgrading of 115 kV substations to accept these transmission lines and enhance their transformation and load discharge capacity; and c) as an integral package extend the MV network around the new substations West Phnom Penh (WPP) and Takeo to distribute the additional load. These components are discussed separately below.

A-2-1 Reinforcement of 115 kV Transmission Lines

The reinforcement of 115 kV TL included (a) 20 km of new 115 kV TL to connect the new WPP substation (financed by ADB) and grid substation-3 (GS3), and (b) stringing the second circuit of about 23 km of 115 kV conductors between the three existing grid substations. The sub-component was successfully completed. About 14 km of a double circuit transmission line were built instead of the planned 20 km due to routing changes of the power line and the line was completed in May 2009 or with about a one year delay due to land acquisition problems. The system has been in full operation since August 2009.

A-2-2 Upgrading of 115 kV Substations

The three substations were upgraded to improve reliability of supply for existing customers as well as improvement of transmission and distribution efficiency with reduction of system losses. This included switchyard extensions to accommodate additional switches for the new transmission lines, additional 115/22kV power transformers and reactive compensation to reduce losses and improve voltage regulation.

The sub-component was successfully completed according to design. It provided items in the original scope of works for the rehabilitation of the three substations, and included the switchyard extension to accommodate the new 115 kV TLs, the new MV lines, additional power transformer capacity and capacitive compensation for loss reduction and voltage improvements.

The project was effectively completed in August 2010 following three extensions from the original date of May 2009. The delays were mainly due to major equipment manufacturing changes and some changes in the materials which required approvals from the consultant, EDC and the World Bank. Minor items which were outstanding

concerned mainly SCADA/communication interfaces, which could not be completed until the SCADA system was installed and commissioned. This forced EDC not to sign the completion certificates to ensure good interface with the National Control Centre. The contract was finally declared complete with the commissioning of the SCADA system, on January 31, 2012.

A-2-3 MV network expansion at WPP and Takeo (includes sub-component B1 – EDC's RE Grid Extension)

The scope included the installation of additional MV lines around the above substations to remove overloads on existing lines and enable the additional load to be distributed from the substations including new areas along roads No 3 and 4 at WPP and from Takeo to Samraong, and to Kampong Chrey.

For project implementation efficiency this sub-component was combined with the EDC Rural Electrification Grid Extension subcomponent for procurement of materials and installation. The sub-component was successfully completed according.

For the WPP and Takeo component, 168.8 km of new MV lines were built against a planned figure of 130 km which was completed in June 2011, almost two years beyond the original date. The installed MV lines for the rest of the areas totalled 448 km against a planned 516 km. In addition to the MV lines, some 656 km of LV lines were installed using EDC funds against a planned 536 km some 120 km (22%) more than the initially plans.

Overall the installed system exceeded the initial plan, with the MV network being less and the LV more than planned. This is considered acceptable and expected with a live system.

Details of MV and LV line installation by province are shown below.

No.	Province	Length installed (km)	
		MV line	LV line*[8]
1	Sihanoukvile	139.34**[9]	150.00
2	Battambang	190.90	206
3	Kampot	43.83	60.00
4	Kampong Speu	73.94**	88.00
5	Takeo	70.69**	134.00
6	West PNH	98.13**	18.00
	TOTAL	**612.82**	**656**

It was estimated that some 50,000 new consumers would be connected to the grid as a result of the system expansion. As of March 2012, it was reported that some 55,768 new consumers were connected vs 45,097 at closing. New connections occur daily as more consumers apply to be connected to the system in the electrified areas after the initial phase.

A-3 National Control Centre (NCC)

The introduction of a control centre was considered essential as the transmission system develops and Cambodia's system is interconnected with neighbouring countries. This sub-component included the construction of a building to house the NCC and the purchase of a

[8] Financed by EDC's budget

[9] Including underground cables

SCADA system together with the data engineering for the system control, generation scheduling and load dispatching.

The sub-component was successfully completed. Delays occurred due to slow procurement and a change in location of the NCC building. This also resulted in additional requirements for a fibre optic link between the initial location (substation GS2) which acted as the data concentrator for the NCC and the current position.

Delays occurred with the construction of the building as EDC requested foundation reinforcement for a multi-storey building with the view to build additional floors for offices. This caused extensive contract change negotiations, and construction was delayed another six months. The NCC – and SCADA system was installed and commissioned by the closing date. All work was completed, except minor end-to-end testing between NCC and a couple of remote terminal units at existing power generation plants. This part of testing will eventually be completed by EDC staff.

B. COMPONENT B: RURAL ELECTRIFICATION

B.1 EDC Grid Extension

This was discussed under item "A-2-3 MV network expansion at WPP and Takeo" above.

B.2 Warehouse to store RE Equipment and Materials - Restructured

This sub-component, which was designed to provide storage and management facilities for materials procured for the rural electrification component. It was cancelled due to a contractual problem and was financed by EDC instead.

C. COMPONENT C: RURAL ELECTRIFICATION FUND

C.1 REE off-grid Extension

This subcomponent provided sub-grant assistance to REEs to facilitate the connection of new households in rural areas. This encouraged the REEs to invest in and extend their electric power facilities to provide new connections to the target of 50,000 new rural households and to expand access to electricity in rural areas.

Some 135 subprojects/sub-grants were executed by 95 REEs in fifteen provinces and the target number of 50,000 new connections was achieved. Delays in the establishment and operationalization of the REF led to delays in issuing sub-grants to REEs, who depended on the availability of cheap and easily accessible capital to expand further to rural areas. The total disbursement amount of sub-grant was recorded as US$ 2.25 million for connection to 50,000 new households in rural areas under REE's coverage areas. See table A of Annex 2.

C.2 Solar Home System (SHS)

This subcomponent was to provide renewable electricity to about 12,000 households using SHS. It was envisaged to be implemented through existing SHS dealers, companies and REEs with the use of a subsidy or grant (OBA) towards the cost of the SHS. However, as of 2009, only 93 SHS had been installed, so the delivery mechanism was changed to bulk purchase and installation under REF with customers being eligible to repay in instalments over as long as four years. Once the delivery mechanism was changed, implementation made tremendous progress and by the December 2011 closing date, 11,124 SHS had been installed, with the remaining 876 installed within a month of closing. The final number installed rose to 12,093. The SHS scheme included a consultant who supervised the installation and who will provide maintenance support and collect loan instalment payments after closing.

C.3 & C4 Mini Hydro and Village Hydro

These sub-components were to support the development of several mini hydro schemes by the private sector through OBA. Despite little interest from the market since the RGC need to develop a model for private participation in mini-micro hydropower, the sub-components were restructured in 2010 to include the preparation of the relevant feasibility studies and construction of 1,200 kW . The feasibility studies concluded that the hydro schemes for the selected sites were not feasible under the current tariff and legal framework, and detailed engineering was not recommended and the construction of 1,200 kW could not started. Hence the balance of this component was cancelled.

C.5 REF Office building (new activity added during restructuring)

The activity was added during the restructuring to support sustainability of REF by removing office rental costs, which could then be use for rural electrification expansion or provision of renewable energy (SHS) to rural households.

Work was fully completed by project closing date, i.e., in less than six months, following concerted efforts of all involved. The activity was considered a major success showing that it is possible to undertake demanding tasks with close collaboration of the relevant stakeholders.

D. COMPONENT D: INSTITUTIONAL CAPACITY AND SECTOR REFORM

D.1 TA to MIME

TA to MIME included:

D.1.1 Renewable Energy Policy Development: to develop policy that would create a level playing field for renewable energy private sector investors based on renewable energy assessments and least cost planning. As agreed, international consultant services were engaged to support MIME in developing a set of power sector policies and strategies such as (a) Rural Energy Strategy and Implementation Plan (RESIP); (b) Renewable Energy Policy/development program; and (c) Wood and Biomass Energy Strategy. These policies and strategy were prepared and serve as platform for renewable energy development in Cambodia.

D1.2 Development of a Power Master Plan: TA complemented the assistance provided by JICA and Australia in the fields of RE master planning and energy consumption forecasting. The TA (a) surveyed energy consumption in provincial and rural areas to serve as a baseline survey of areas to be included in the grid extension component; and (b) prepared a power system expansion master plan including generation additions, transmission and distribution expansion, and zoning of grid versus off-grid areas. The Power Master Plan was prepared in 2006 and guided development of a series of generation plants (hydro and coal-fired power plants) and back-bone high voltage transmission lines.

The TA component also provided face-to-face training to MIME staff on the following subjects: (i) Strategic Management; (ii) Project Management; (iii) Human Resource Management; (iv) Marketing Management; (vi) Managerial Economics; (vii) Financial Management; (viii) International Finance; (ix) Corporate Finance; (x) Auditing and Accounting Practices; and (xi) English language training. Staff members are able to lead the sector policy review, however they still need support for comprehensive studies and or strategy formulation.

D.2 TA to REF

The TA component to REF included:

D.2.1 Implementation Support for creation of REF: REF established and fully operational since 2007.

D.2.2 Rural Income Generation Promotion promoted productive use of electricity for rural income generation, which was completed in December 2011. It directly benefited about 1,200 villagers, who are business owners, prospective business owners, and other villagers.

D.2.3.a. Renewable Energy Business Development (SHS, renewable project and mini hydro implementation support for REF). Deliverables included (a) Biomass Review Reports, (b) Biomass Business Plan and Models, (c) SHS review Reports, (d) SHS Program Business Plan and Models. However, the FS on mini hydropower concluded that sites chosen for the study were non-feasible or not bankable projects, so no further study was undertaken.

D.2.3.b. Promotion of Renewable Energy Technologies: Promotion campaign was done by booklets, posters and signage, TV and radio spots geared mainly toward the private sector and financing institutions and local banks.

D.2.4a REE Improvement/ Training: A series of basic and advanced training on technical and financial aspects were provided to REEs especially those receiving sub-grants from REF. As result, most REEs that received training are better at managing their businesses and losses have been reduced.

D.2.4b REE Association Building: This TA helped finalize REE association's operational procedures, road map and other documents. The association benefited from the TA by establishing networks and contacts to help themselves.

D.2.5. Capacity building of financial institutions and REEs. The TA was to improve the understanding of the renewable energy technology, business, and increase the appraisal and supervision ability of the financial institutions.

SHS Installation Supervision, Maintenance and Collection of Payment (new activities): This activity helped REF supervise the SHS installation process, perform maintenance services (after the warranty period) and collect payments made by SHS beneficiaries for the entire four year period. Before SHS installation began, the supervision consultant: (a) undertook public consultations on the new SHS arrangements, roles and responsibilities of REF, the suppliers, the consultancy services and the users; (b) engaged the households to sign the hire-to-purchase agreement, a copy of which is retained by each household, and collected the first payment for REF. After installation, the consultant performed payment-cum- maintenance services every two months. The TA was regarded as successful resulting in fast SHS installation and timely collection of repayments.

REF office design and construction supervision service (new activity): This successfully helped REF to design its new office building and supervised its construction.

Study on REF sustainability (new activity): This TA helped REF take stock of REF operations and proposed options to sustain REF's operations after completion of the project. The options were presented to REF's Board in December 2011. The Board decided to merge REF with EDC.

D.3 TA to EAC

The TA would strengthen EAC's capacity to discharge its responsibilities mandated in the Electricity Law, and have regulations and codes in place to improve the quality of the supply and services and to ensure transparency in EAC's operations. The TA included:

D3-1 Operational Support Consultancy Services: to assist EAC in (a) issuing licenses to existing service providers and service providers seeking assistance from the REF; (b) dealing with tariff applications, fixing of tariffs and writing of tariff orders; (c) monitoring of licensees in identifying information to be recorded and the format to report the information to the EAC; (d) regulations and codes including preparation of a Grid Code and Distribution Code and to issue procedures to amend existing regulations/procedures to enable EAC to carry out its duties properly; and (e) development of technical standards to ensure consumer safety and a minimum quality of service by REEs and to build capacity

and awareness on renewable energy in EAC. With this TA, eleven regulation standards and codes were prepared and used and about 297 licenses were issued.

D3-2 Training to EAC staff: Training was provided in areas of (a) foundation skill in computers, administration and management, and English language; (b) job-specific training including power sector regulation, pricing control and a methodology for tariff setting; and public hearings, complaints and dispute resolution; (c) practical training for managers and senior staff on best practice management and operation of a regulatory body. Training courses provided were:

- Reform and Regulation of the Electricity Sectors in Developing Countries
- Electricity Sector Reform in Developing Countries: A Survey of Empirical Evidence on Determinants and Performance
- Electricity Sector Restructuring, Reform, and Trends in the Global Experience
- Political and Institutional Dynamics in Regulation
- Rationale for Economic Regulation
- Determining the Cost of Capital
- Conducting a Rate Review: Procedure and Practical Matters
- Regulation by Contract: A New Way to Privatize Electricity Distribution
- Overview of the Properties of Regulatory Mechanisms
- Fundamental Policy Choices in Regulation
- Rate of Return Regulation - methods of incentive regulation: using rate of return tools
- Designing Price Cap and Revenue Cap Regulation: Practical Considerations
- Benchmarking Techniques for Regulation
- Incentive Regulation in Theory and Practice: Electricity Distribution and Transmission Networks
- Designing Hybrid Regulatory Mechanisms
- Basics of Rate Design: Pricing Principles and Self-Selecting Two-Part Tariffs
- Cross-Subsidies through Fixed Charges: Minimizing Electricity Consumption Distortions
- Pricing Exercises
- Cost Allocation and Rate Design: Consideration for Efficiency and Pro-Poor Policies
- Customer Relations in Regulation
- International Experience: Lessons from Specific Cases
- Evaluating Regulatory Systems for Legitimacy, Independence, Accountability, and Substantive Results
- Institutional, Organizational, and Personnel Issues for Regulatory Agencies
- Financial Statements, Assessing Past Performance and Allowable Costs

D.3.3 Facility Support: This consisted of portable meter testing equipment and accessories were provided.

D.4 TA to EDC

TA to EDC included the following.

D4.1. Project Implementation Consultant (supervision consultant): This TA assisted EDC in engineering supervision, inspection, coordination, training, and implementation of the IDA financed 115 kV and EDC grid extensions components of the Project, as well as in the establishment of the NCC. .

D4.2. In-house advisor: An in-house procurement advisor was hired to assist EDC in all activities related to project preparation, including procurement, and performed related tasks as determined by EDC.

D4.3. Independent Monitoring Agency (IMA) and Project Grievance Committee: It supported a services of IMA to help EDC and IRC monitor the resettlement and land compensation process per the agreed RAP. The IMA produced reports periodic reports. As agreed, the Project Grievance Committee was established and operational for handling complaints and grievances not only for the project but for EDC as a whole.

D4.4 - Improvement of EDC Commercial Practices and management training: it supported the installation of new accounting system FAUMIS and relevant training courses to EDC staff. In the beginning the new accounting system was installed for the use of EDC headquarters only, but it was rolled out to seven provincial branches later on.

D4.5. Capacity Building for Land Acquisition, Resettlement and Environment. EDC initially did not hire the consultant for safeguard capacity training because IRC was appointed to handle land acquisition and resettlement from the start, and EDC was reluctant to spend project funds (on-lent to EDC) for training. However, staff of the Social and Environmental Unit of EDC were invited to various trainings on social and environmental safeguards organized by the consultants and/or Bank. After RGC delegated land acquisition and resettlement to EDC, a strong need for training emerged. Finally, TORs were prepared, but due to time constraints, this activity was dropped. EDC will carry out this training under the ADB-financed project.

D4.6. MV Network Expansion - Power Investment Planning: Developing a Distribution Network Plan: A study was carried out on the existing system load, to assess losses and propose reduction measures, to assess reliability and quality of existing supplies, to develop a plan for the 22kV backbone system, to assess existing substations and rehabilitation requirements, assess existing 22kV and LV network and rehabilitation requirements. Planning software and load monitoring tools and other related items were included in the services. The distribution plan mainly focused on the Phnom Penh System which includes the Phnom Penh metropolitan area, Kandal, Kampong Speu and Takeo provinces. The TA also developed stand-alone specifications for MV system, by taking into account the existing specifications, which can be used country-wide.

Based on the definition of the distribution system development and the modular specifications, a tender document was produced for the works identified in the plan. The tender document included the purchase of the SCADA system for the distribution network.

Table A : Outputs of the Project under EDC's Rural Electrification Component by Province

Source: *EDC data (May 2012)*
Note: (a) additional 12km of LV line was installed compared to status of December 2011
(b)Power switch was reduced from 42 MW to 39.95 MW due to closure of some industries

Outputs and Outcomes	Takeo	Kampot	Sihanouk	Kg. Speu	Battambang	West Phnom Penh	Total
Length of MV Constructed (km), incl. underground cable	70.69	43.83	139.34	72.91	190.90	98.13	615.80
Length of LV Constructed (km), (financed by EDC)	134	72	150	88	206	18	668
Number of Transformer Installed (by the Project)	31	30	75	44	103	9	292
200kVA							-
160kVA	-	2	1	-	-	-	3
100kVA	7	16	24	3	60	1	111
50kVA	22	9	43	25	34	5	138
25kVA	2	3	7	16	9	3	40
Additional household connected (by the Project only)							
to EDC's LV line (grid)	4,000	1,500	307	2,336	37,074	2,500	47,717
to REE's LV line (grid)	4,153	2,231	7,409	1,950	39,541	4,656	59,940
Total	8,153	3,731	7,716	4,286	76,615	7,156	107,657[10]
Number of People benefited (a)	39,134	17,909	37,037	20,573	177,955	17,343	309,951
Sale tariff (residential, (KH Riel/kWh)	920	920	720	720	1,000	1,100	-
Power switch to entire/whole EDC grid, (kVA),by:	3,130	2,010	10,330	10,030	8,125	6,330	39,955
Ice factory	2,500	500	680	1,000	3,600	400	8,680
Shoe factory	630	250		1,200	-	630	2,710
Garment factory	-	630	2,700	5,250	-	680	9,260
Special Economic Zone I (SEZI)	-	-	1,975	-	-	1,760	3,735
Special Economic Zone II (SEZII)	-	-	630	-	-	-	630
Special Economic Zone III (SEZIII)	-	-	680	-	-	-	680
Guest House	-	630	975	780	2,125	720	5,230
Hotel	-	-	1,910	300	1,900	720	4,830
Water Supply	-	-	730	1,500	500	700	3,430
Waste water treatment plant	-	-	50	-	-	720	770

[10] Including old consumers (households) of REEs. The new households connected to the project is 55,768.

Outputs and Outcomes	Takeo	Kampot	Sihanouk	Kg. Speu	Battambang	West Phnom Penh	Total
Energy loss (%)							
2010	8.51	4.87	8.78	6.30	8.25	6.30	-
2011	8.25	5.64	8.22	7.33	7.21	7.33	-
Facility/Institution connected by the Project							
Shoe factory	1	1	-	1	-	2	5
Ice factory	2	1	7	1	-	3	14
Garment factory	2	2	2	8	-	5	19
Brick kiln	1	1	1	-	23	1	27
Water supply facility	1	1	2	1	1	1	7
Plastic factory	1	-	1	-	-	2	4
Guest House	22	16	39	12	85	5	179
Hotel	-	4	8	1	19	2	34
Restaurant	20	5	15	-	72	10	122
Night club	15	7	10	12	4	6	54
Recreation center	6	3	-	1	3	2	15
Wielding workshop	12	15	20	3	-	-	50
Health center/hospital	24	12	4	4	83	5	132
School (Primary, Secondary, High)	22	5	16	9	112	10	174
Temple (Buddhist)	2	2	25	10	44	15	98
Catholic/Christian Church	3	2	15	3	50	4	77
Chinese Temple	2	2	3	-	4	1	12
Islamic Mosque	-	1	5	1	5	1	13
Korean Temple	2	-	1	1	-	2	6
Gasoline service station	-	11	13	6	46	7	83
Pump (irrigation)	-	1	-	-	4	1	6
Commune Office	8	9	10	8	76	7	118
Car garage	-	9	10	9	154	15	197
Fish sauce factory	-	1	2	-	4	-	7
Salt farm	-	1	1	-	-	-	2
Agriculture farm (fruit)	-	4	2	13	-	15	34
Beer Factory (Angkor Beer)	-	-	1	-	-	1	2
Concrete mixer	-	1	2	-	2	1	6
Theater	-	-	1	1	2	-	4
Stadium	-	-	1	-	-	-	1
Sea Port/Dry port	-	-	-	-	-	1	1

Outputs and Outcomes	Takeo	Kampot	Sihanouk	Kg. Speu	Battambang	West Phnom Penh	Total
Waste water treatment plant	-	-	1	-	2	2	5
Vocational Training Center (NGO)	-	-	-	1	4	-	5
Furniture workshop	-	-	-	2	16	1	19
Factory (steel processing)	-	-	-	1	-	2	3
Rice mill	-	-	-	-	47	-	47
Cement factory	-	1	-	-	-	-	1
Stone crashing plant	-	-	-	-	2	-	2

Table B: Estimated Direct and Indirect CO2 Emission Reduction

A. Direct CO2 emission Reduction																		
Import of clean energy		**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Electricity import (VN) - capacity	MW	0	0	0	0	100	120	135	135	135	135	135	135	135	135	135	135
Electricity import - output	h	0	0	0	0	3,752	7,955	8,303	8,300	8,300	8,300	8,300	8,300	8,300	8,300	8,300	8,300
Electricity import (VN) - operational hours	GWh	-	-	-	-	375	955	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121	1,121
out of which, clean electricity (20%)	GWh	-	-	-	-	75	191	224	224	224	224	224	224	224	224	224	224
Emission factor of Cambodia grid (baseline)	tCO2e/GWh	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800
CO2 emission reduction	**tCO2e(*1,000)**	-	-	-	-	60	153	179	179	179	179	179	179	179	179	179	179
EdC's T&D loss reduction		**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
EdC's total energy generation and purchaser	GWh	906	1,106	1,378	1,625	1,818	2,242	2,564	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820
Baseline losses	%	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Actual T&D losses	%	10.02	8.80	8.87	8.93	9.0	8.98	9.8	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Loss reduction	%	3.98	5.20	5.13	5.07	5.00	5.02	4.20	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Electricity savings due to loss reduction	GWh	0	0.06	0.07	0.08	0.09	0.11	0.11	113	113	113	113	113	113	113	113	113
Emission factor of Cambodia grid (baseline)	tCO2e/GWh	800	800	800	800	800	800	800	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
CO2 emission reduction	**tCO2e(*1,000)**	0.03	0.05	0.06	0.07	0.07	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
12,000 SHS - electricity generation		2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Total Capacity	MW	-	0	0	0	0.019	0.019	0.56	0.56	0.54	0.51	0.49	0.47	0.45	0.45	0.45	0.45
Annual operational hours	h	-	0	0	0	1,460	1,460	120	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460
Annual energy output	GWh	-	0	0	0	0.03	0.03	0.07	0.82	0.78	0.75	0.72	0.69	0.66	0.66	0.66	0.66
Emission factor of Cambodia grid (baseline)	tCO2e/GWh	-	0	0	0	800	800	800	800	800	800	800	800	800	800	800	800
CO2 emission reduction	**tCO2e(*1,000)**	-	0	0	0	0.02	0.02	0.05	0.65	0.63	0.60	0.58	0.55	0.53	0.53	0.53	0.53
Total CO2 emission reduction - annual	tCO2e (*1,000)	0	0	0	0	60	153	179	180	180	180	180	180	180	180	180	180
Total CO2 emission reduction - cumulative	tCO2e(*1,000)	0	0	0	0	60	213	393	573	753	933	1,113	1,293	1,472	1,652	1,832	2,012

B. Indirect CO2 emission Reduction																	
Hydropower installation started in project duration	**Unit**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Kamchay - capacity	MW	-	-	-	-	-	-	35	193	193	193	193	193	193	193	193	193
Kamchay - operational hours	h	-	-	-	-	-	-	250	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460	1,460
Kamchay - output	GWh	-	-	-	-	-	-	9	282	282	282	282	282	282	282	282	282
Kirirom Hydro & other- capacity	MW	-	-	12	12	12	12	12	12	12	12	812	812	812	812	812	812
Kirirom Hydro & other - operational hours	h	-	-	2,190	2,190	2,190	2,190	2,190	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Kirirom Hydro & other - output	GWh	-	-	26	26	26	26	26	36	36	36	2,436	2,436	2,436	2,436	2,436	2,436
Total hydropower output	GWh	-	-	26	26	26	26	35	318	318	318	2,718	2,718	2,718	2,718	2,718	2,718
Emission factor of Cambodia grid (baseline)	tCO2e/GWh	-	-	800	800	800	800	800	800	800	800	800	800	800	800	800	800
CO2 emission reduction	**tCO2e(*1,000)**	-	-	21.02	21.02	21.02	21.02	28.02	254	254	254	2,174	2,174	2,174	2,174	2,174	2,174
EdC's T&D loss reduction		**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Total hydropower output - new hydro	GWh	0	-	26	26	26	26	35	318	318	318	2,718	2,718	2,718	2,718	2,718	2,718
Baseline losses	%	14	14	14	14	14	14	14.0	14	14	14	14	14	14	14	14	14
Actual T&D losses	%	10.02	8.80	8.87	8.93	9.00	8.98	9.8	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Loss reduction	%	3.98	5.20	5.13	5.07	5.00	5.02	4.20	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Electricity savings due to loss reduction	GWh	-	-	1.3	1.3	1.3	1.3	1.47	12.7	12.7	12.7	108.7	108.7	108.7	108.7	108.7	108.7
Emission factor of Cambodia grid (baseline)	tCO2e/GWh	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800
CO2 emission reduction	**tCO2e(*1,000)**	-	-	1.08	1.07	1.05	1.06	1.18	10.17	10.17	10.17	86.97	86.97	86.97	86.97	86.97	86.97
Total CO2 emission reduction - annual	tCO2e(*1,000)	-	-	22	22	22	22	29	264	264	264	2,261	2,261	2,261	2,261	2,261	2,261
Total CO2 emission reduction - cumulative	tCO2e(*1,000)	-	-	22	44	66	88	118	382	646	911	3,172	5,433	7,694	9,955	12,217	14,478

Assumptions:

- *Emission factor of grid in Cambodia: 0.8 tCO2e/MWh, with diesel-based generators (unit capacity >135 kW) operating 6 hours/day as the baseline at appraisal;*
- *Import from Vietnam (started at 80 MW in 2009 and increased to 135 MW in 2011, at 50% load factor)*
- *EDC's total energy supply during 2005 -2011 is actual (EDC data April 2012);*
- *SHS - assuming generation at 4 h/day, and 30 days in 2011; 365 days in 2012 and afterwards; and capacity reduced by 2% per year up to 20% of total reduction in life;*
- *Hydropower capacity operating at 1,460 h/year (Kamchay for Peak time supply), for Kirirom it is assumed 2,190 h/year, the other hydropower is 3,000h/year;*
- *EdC is maintaining its T&D losses at 10% over the project life and beyond.*

Photo 01: National Control Center – the Building (Photo: Task Team)

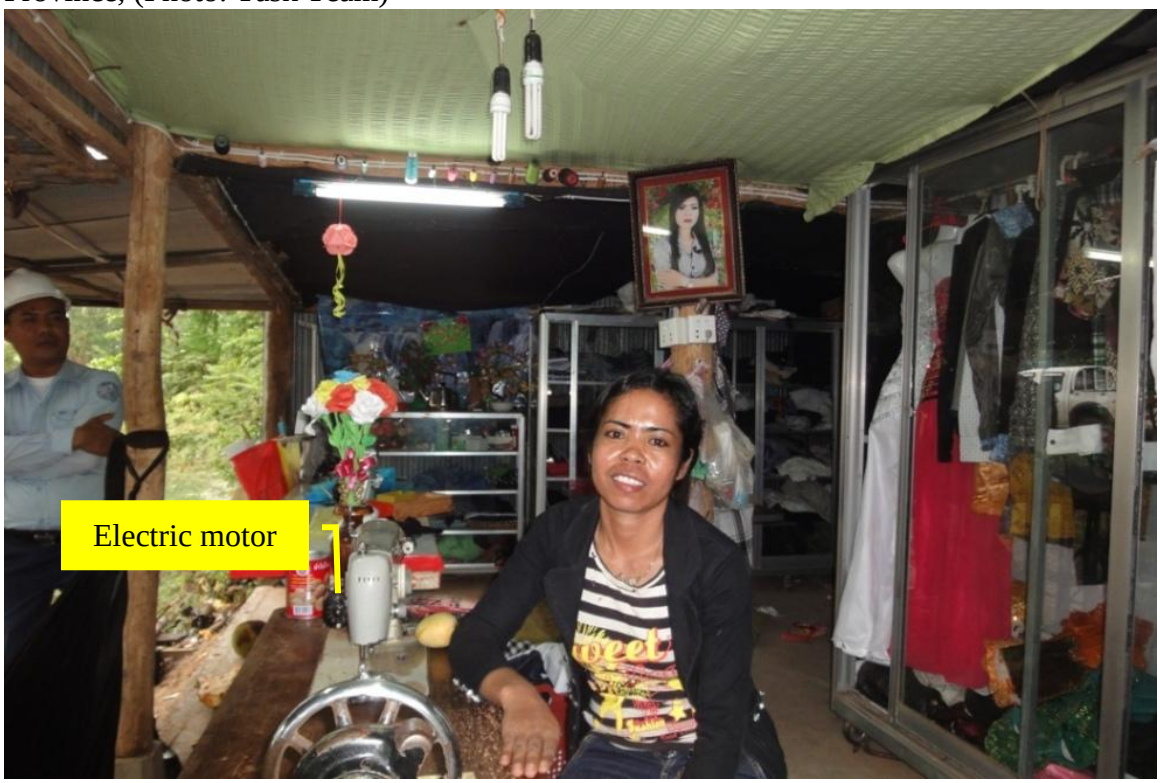
Photo 02: National Control Center – the Control Room (Photo: Task Team)

Photo 03: National Control Center – A crew of Operators, one of four crews set up by EDC (Photo: Task Team)

Photo 04: Ice Factory set up after the commune was electrified by REE in Puok District, Siem Reap Province. (Photo: Task Team)

Photo 05: Ice produced in Puok District, Siem Reap Province. (Photo: Task Team)

Picture 06: Sewing stand set up after village is electrified by EDC in Battambang Province, (Photo: Task Team)



Picture 07: REE switched to EDC grid in Thmar Korl district, Battambang province (Photo: Task Team)

Photo 08: Shop connected to REE grid in Puok district, Siem Reap province. *The shop sells and repairs electric appliances* (Photo: Task Team)

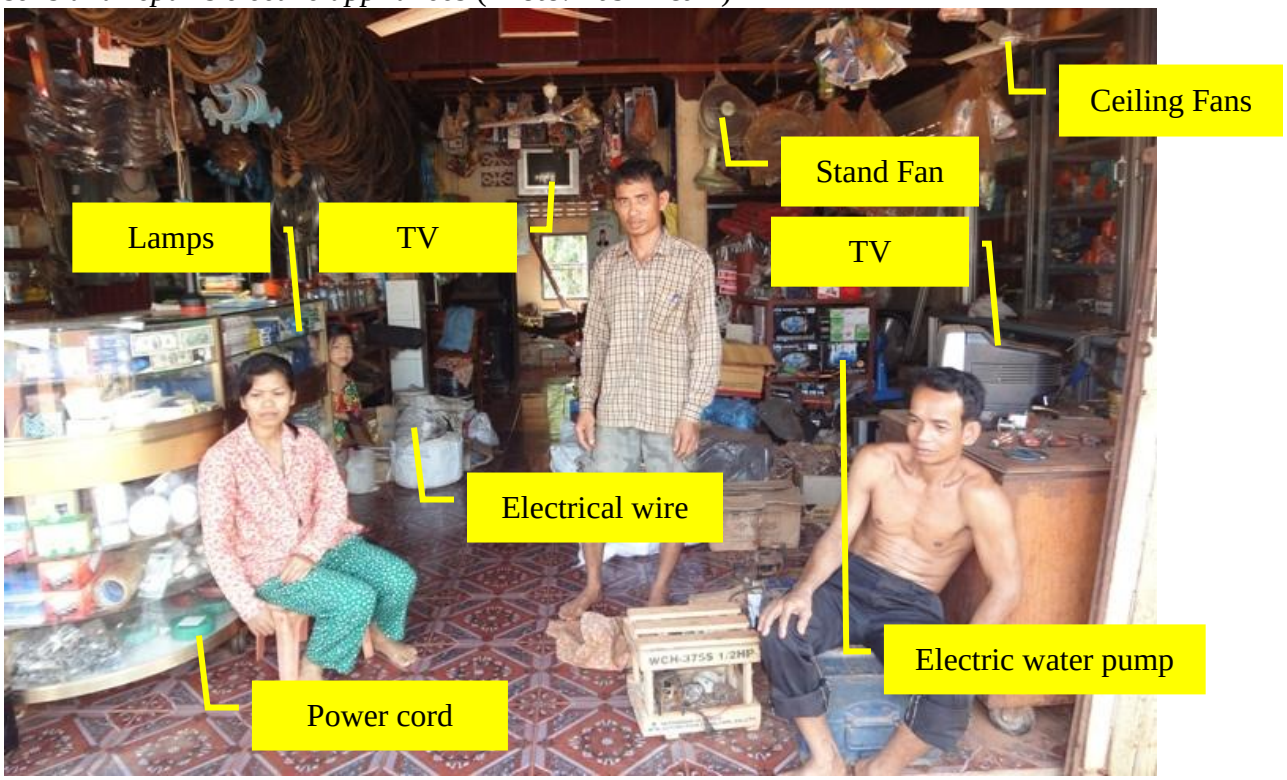


Photo 09: Welding workshop set up after village is electrified by EDC in Daun Keo district, Takeo province – *some electric tools used at the workshop* (Photo: Task Team)

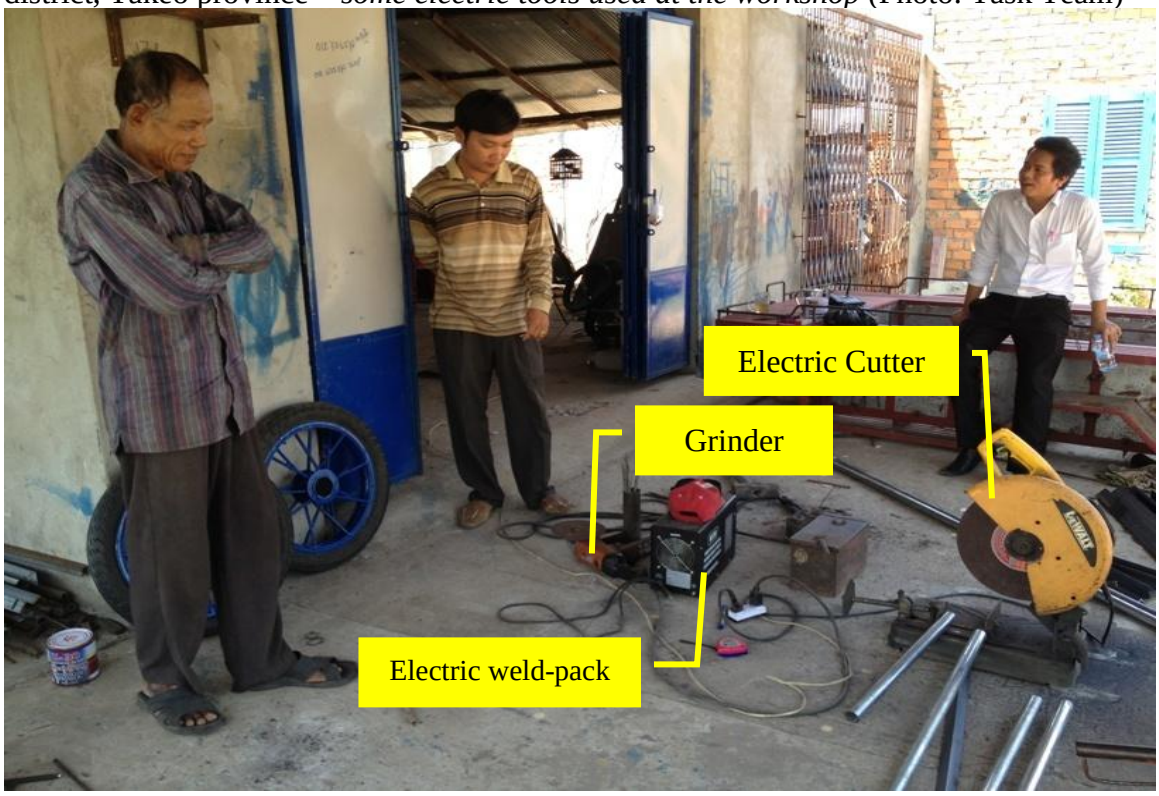


Photo 10: Wielding workshop set up after village is electrified by EDC in Daun Keo district, Takeo province – *motorbike trailer popular mode of transport in Cambodia* (Photo: Task Team)

Photo 11: Wielding workshop set up after village is electrified by EDC in Daun Keo district, Takeo province (Photo: Task Team)

Photo 12: Groceries shop set up after village is electrified by EDC in Daun Keo district, Takeo province (Photo: Task Team)

Picture 13

Picture 14:

Picture 15:

Picture 16

Picture 17

Picture 13, 14, 15: SHS inspection by Task Team/Engineer
Picture 16: One of **12,093** SHS beneficiaries benefited from the project. He and his family are enjoying watching TV, listening to the radio, recharging their phone battery and having lighting at night for 3-4 hours every day.
Picture 17: SHS installation Team & Task Team (Photo: Task Team)

Photo 18: Public consultation and awareness campaign on SHS (photo: REF's Team)

Photo 19: One of 12,000 SHS beneficiaries benefited from the Project, (Photo: REF's Team)

ANNEX 3

ECONOMIC AND FINANCIAL ANALYSIS

I. Project Economic and Financial Analyses

This section comprises: (i) the economic and financial analyses of the grid extension subcomponent under EDC, (ii) the economic and financial analyses of the grant-assisted household connection subcomponent under REEs, and (iii) the economic analysis of the installation of 12,000 solar home systems (SHS) subcomponent under REF. The economic and financial analyses of the transmission component are not included, and will be carried out separately by ADB. For the SHS subcomponent, the economic analysis also evaluates the unique impacts of the subsidy and interest-free financing on the levelized cost of electricity to the end users.

Even though the economic and financial analyses of the first two subcomponents were covered at the time of appraisal, substantial details on the model specifications were lacking for replicating the same analyses at the project completion. As a result, all economic and financial assessments in this annex are derived from models built from scratch; therefore any difference in assessment in this annex from the analysis at appraisal is in part due to potential differences in methodology.

A. Grid Extension under EDC

a. Summary of Assumptions

Willingness-to-pay (WTP)*:* At appraisal, the economic benefit of electricity consumption was estimated as the cost of off-grid supply, which was US$0.38 per kWh. Due to the surge in oil prices in the past half a decade, the cost of diesel-based electricity supply has increased substantially. The growing proportion of supply from imports has helped partially offset the impact of rising fuel costs. Consumption from the newly connected households, starting from a meager 7 kWh per month in 2009, is expected to grow rapidly to 49 kWh in 2019 and 105 kWh in 2029. A single value of willingness-to-pay (WTP) would not be appropriate for such a wide range of consumption. A two-tier WTP is therefore assumed based on a detailed analysis of the tariff and household consumption history in the project area:

- *First tier: KH Riel 2320 per kWh (US$0.55 per kWh) for the first 18 kWh every month* based on the weighted average tariff and consumption among households served by REEs in the project area in 2008. Over 90 percent of the HH connections through the project were added after 2009. Therefore, data from 2008 were deemed to be appropriate natural baselines for the project. Moreover, in response to the oil price surge in 2008, EAC adopted fuel-cost based tariff adjustments. Therefore, the tariffs in 2008 are likely closer to the WTP "ceiling."
- *Second tier: KH Riel 1436 (US$0.34) per kWh for consumption above 18 kWh each month* based on the weighted average tariff among all REE household customers in the project area in December 2010.

Investment Costs The actual cost of the MV grid extension subcomponent was US$ 9,859,275. The corresponding LV investment funded separately by EDC funds is estimated at about 60 percent of the cost of the MV investment. Any additional cost

of US$100 per connection including in-house wiring is assumed for any household connection added after the project completion.[11]

O&M costs at 4 percent of capital costs.

Cost of MV supply to EDC in the project area estimated based on an average import tariff at around US$0.09 per kWh and a wheeling charge of US0.029 per kWh, factoring in the average transmission loss at 3 percent. The economic cost of supply excludes tax and VAT of 17.7 percent.

Connection charge at US$ 58 per connection based on EDC's weighted average connection charge in the project area.

Tariffs at 911 KH Riels (US$0.217) per kWh for EDC retail customers, and 630 KH Riels (US$0.150) per kWh to licensees supplied by EDC. Both estimates are based on the weighted average retail and bulk tariff in the project area by end 2010.

HH Connection Growth Rate at an annual rate of 6.5 percent in the project area serviced directly by EDC and 4.5 in the area serviced by REEs. With the population growing at 1.5 percent annually and the electrification rate at 30 percent presently, an annual growth of 6.5 in HH connections will allow electrification rate to reach the government target of 70 percent in 2030.

Distribution Losses at 9.7 percent for EDC and 16.4 for REEs based on the weighted average distribution losses in the project areas in 2010. Distribution loss has decreased substantially among the REEs in the project area from 23.0 percent in 2008 to 16.4 percent 2010. EDC's distribution loss decreased from 10.6 percent to 9.7 percent in the same period.

Exchange rate at KH Riel 4,200 to US$1.00

Discount rates. To be consistent with the appraisal, an economic opportunity cost of capital (EOCK) of 12 percent is applied for the economic analysis, and a weighted average cost of capital (WACC) of 6 percent for the financial analyses. A sensitivity analysis is carried out with a WACC range from 4-12 percent to assess the financial return of this project component.

b. Economic Analysis Results

The economic internal rate of return (EIRR) of the EDC grid extension subcomponent is estimated at 28.9 percent compared with 19.8 percent at appraisal. At a 12 percent EOCK, the project NPV is estimated at US$ 64.9 million compared with US$ 7.9 million. An estimated US$ 2.8 million out of the project NPV is attributed to lower distribution losses in the project area. The higher economic return is primarily due to higher estimates of consumer WTP. At appraisal, WTP was estimated based on the average cost of off-grid supply in 2003 when fuel price was substantially lower.

[11] The outcome of the economic analysis suggests the NPV of the project is not sensitive to the additional cost of connections.

	EIRR (%)		NPV ($ million) @ EOCK=12%	
Grid extension under EDC	Appraisal	Completion	Appraisal	Completion
	19.8	28.9	7.9	64.9

c. Financial Analysis Results

The financial internal rate of return of the subcomponent is estimated at 7.3 percent compared with 4.4 percent at appraisal. At a 6 percent WACC, the FNPV is estimated at US$ 4.9 million compared with a negative US$ 1.3 million at appraisal. Distributional loss reduction in the project area alone contributed to an estimated US$ 8.8 million in financial Net Present Value (FNPV). The higher financial return is primarily due to higher than estimated retail tariff in the project area.

	FIRR (%)		FNPV ($ million) @ WACC = 6%	
Grid extension under EDC	Appraisal	Completion	Appraisal	Completion
	4.4	7.3	(1.3)	4.9

B. Grid Extension under REE

a. Summary of Assumptions

- *Willingness-to-pay* same as in the previous analysis.
- *REE cost per connection* at US$500 per connection. Sensitivity analyses were carried out to measure the responsiveness of the project's economic and financial returns to changes in REEs' connection costs.
- *REE source and costs of supply*. Based on EAC 2010 Statistics, about 34 percent of the supply to the REEs having received the REF grant was from their own generation, which is largely diesel at an estimated cost of US$0.28 per kWh before tax and VAT. The remaining 66 percent was supplied either by EDC or other licenses at rates similar to EDC's bulk tariff which is around US$ 0.15 per kWh. The cost of supply to REEs is therefore estimated as the weighted average of both.
- *REE retail tariff* at 1,654 riels per kWh based on the weighted average by year end 2010 among all REEs having received the REF grant.
- *Distribution Losses* at 16.4 percent based on the 2010 weighted average distribution loss among all REEs having received the REF grant.
- *Discount rates* with an EOCK of 12 percent for the economic analysis and a WACC at 6 percent for the financial analysis. Recognizing the costs of capital for the REEs are likely higher than 6 percent, a sensitivity analysis is carried out with a WACC range from 4-12 percent to assess the financial return of the REF grant-assisted household connections under REEs.

b. Economic Analysis Results

The economic internal rate of return of the project is estimated at 17.5 percent compared with 22.3 percent at appraisal. At a 12 percent EOCK, the NPV of the subcomponent is estimated at US$ 8.9 million compared with US$ 9.6 million at appraisal. The lower EIRR is primarily due to higher costs of supply from diesel based generation. The higher

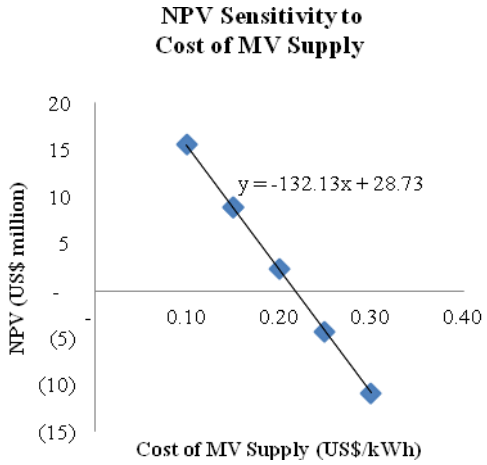
NPV in spite of the lower EIRR is due to an additional 5,000 households being connected compared with the original plan.

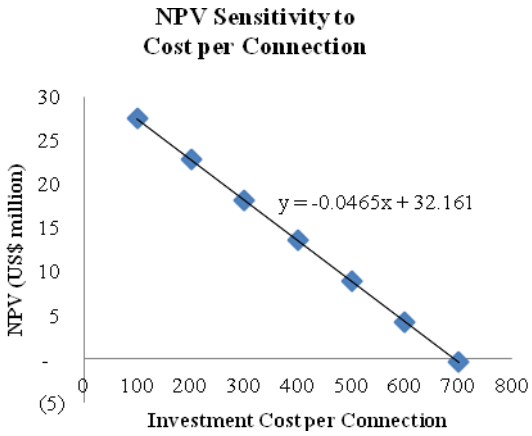
	EIRR (%)		NPV ($ million) @ EOCK=12%	
Grid extension under REEs	Appraisal	Completion	Appraisal	Completion
	22.3	17.5	9.6	8.9

c. Economic Analysis Sensitivities

Changes in two cost factors can alter the evaluation of the economic return of the subcomponent:

- *The Economic Cost of MV supply to REEs:* every 1 US cent per kWh increase in the cost of supply (excluding taxes and VAT) will decrease the NPV of the subcomponent by US$ 1.32 million. However, the actual effect of rising supply cost may be less severe because a rise in the cost supply may correspond to a rise in the WTP.
- *Cost per household connection*: every US$50 increase in connection costs will decrease the NPV by about US$2.3 million.





d. Financial Analysis

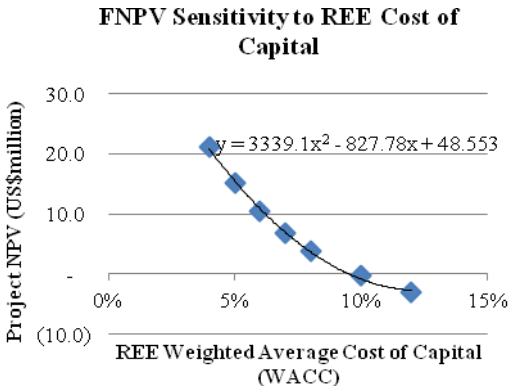
In the base case, the financial internal rate of return of the project is estimated at 9.8 percent compared with 22.2 percent at appraisal. At a 6 percent WACC, the FNPV is estimated at US$ 10.5 million compared with US$ 4.3 million at appraisal. The lower FIRR is primarily due to higher costs of supply from diesel based generation. The higher FNPV in spite of the lower FIRR is due to an additional 5,000 households connected compared with the original plan.

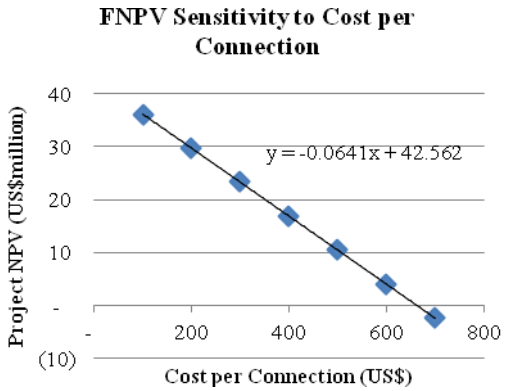
	FIRR (%)		FNPV ($ million) @ WACC = 6%	
Grid extension under REEs	Appraisal	Completion	Appraisal	Completion
	22.2	9.8	4.3	10.5

e. Financial Analysis Sensitivities

Recognizing REE's costs of capital can vary and be often higher than 6 percent, a sensitivity analysis is carried out to measure the respondents of the subcomponent's FNPV to changes in WACC from 4 to 12 percent. The FNPV turns out to be highly sensitive to changes in WACC. When a REE's WACC increases from 6 percent in the based case to 10 percent, the project FNPV drops from a gain of US$10.5 million to a loss of US$0.3 million.

Every US$50 increase in REEs' cost of connection will decrease the FNPV by about US$3.2 million.





C. Installation of 12,000 SHS

a. Summary of assumptions

	30W System	50W System
System cost	US$260 per system	US$333 per system
Subsidy	US$100 per system	US$ 100 per system
Repayment schedule	4 years	4 years
Evaluation period	10 years	10 years
Battery cost and resale value	50,000 riel per battery 5,000 resale value	60,000 riel per battery 10,000 resale value
Battery life	2 years	2 years
Current expenditure on car batter recharge	US$ 2 per month	US$ 2 per month
Income generation due to additional working hour(s) and more productive use of machineries	US$ 50 per year	US$ 60 per year
EOCK	12 %	12%

b. Economic Analysis

Under a *Bulk Supply and Delivery* scheme, the REF will pay for the initial capital and installation costs; the beneficiary households would pay back the capital costs through bi-monthly installments over four years. A US$100 subsidy is offered on each system. The economic analysis first assesses the economic return of the subcomponent, and then estimates the levelized cost of electricity to end users under the following three scenarios:

- Scenario 1 without interest free financing, all capital costs paid up front

- Scenario 2 with interest free financing
- Scenario 3 with interest free financing and $100 subsidy per household

Economic analysis usually does not take into account the impact of financing. However, in this case, the interest-free financing is an important incentive provided by the program. It can be viewed as a form of subsidy transfer from the global community to the Cambodian people[12]. Since the economic analysis is carried out from the perspective of the Cambodian economy and the cost of financing is born entirely by the global community, it is therefore feasible to assess the unique impact of financing by comparing the economic cash flows of Scenario 1 and 2.

The real impact of the interest-free financing and the capital subsidy is to reduce the cost of supply to the end users, which is measured here in terms of levelized cost of electricity to the end users.

Under Scenario 1 without financing, the EIRR is 35.4 percent for 30W systems and 36.6 percent for 50W systems; the NPV is US$180.5 for a 30W system and US$243.0 for a 50W system. Under Scenario 2 with financing, the EIRR is 59.0 percent for 30W systems and 71.8 percent for 50W systems; and the NPV is US$ 291.1 for a 30W system and US$366.3 for a 50W system.

The levelized costs of electricity to end-users are US$1.00, US$0.91 and US$0.57 per kWh from the 30W units; and US$0.75, US$0.68 and US$0.47 per kWh from the 50W units under Scenarios 1, 2 and 3 respectively. The incentives provided by the program have helped bring down the cost of electricity to an affordable level to the rural households.

	EIRR (%)		**NPV ($)** @ EOCK=12%		**Levelized Cost to End-Users (US$/ kWh)**		
	S1 without Financing	S2 with Financing	S1 without Financing	S2 with Financing	S1 without Financing	S2 with Financing	S3 with Financing + Subsidy
1 SHS 30W	35.4	59.0	180.5	291.1	$1.00	$0.91	$0.57
1 SHS 50W	36.6	71.8	243.0	366.3	$0.75	$0.68	$0.47

Sensitivity analysis

The levelized cost of electricity from SHS is highly sensitive to under-utilization. For example, with four hours usage per day, the 50 WP and 30 WP systems deliver electricity at around US$ 0.75 per kWh and US$ 1.00 per kWh; the cost will double if the system is used for only two hours a day.

[12] Cost differences between what HHs pay for electricity and what they would have to pay without the financing. The difference is about 7-9 cents per kWh

Cambodia: Rural Electrification and Transmission Project

Rural Electrification - EdC Grid Extension Component

Economic Analysis

																D-loss reduction	
														EIRR	**28.9%**		
														NPV ($ million)	**64.9**		**2.8**
Year	HH connect EDC direct (HH)	HH connect thru REE (HH)	HH Consum. (kWh/mos)	Net energy consum. (GWh)	WTP ($m)	Investments MV ($m)	LV ($m)	Add. conn. ($m)	Gross energy consum. (GWh)	Unit energy cost ($/kWh)	Energy cost ($m)	O&M cost ($m)	Total net benefit ($m)	PV of net benefit ($m)	PV of accumul. benefit ($m)	D-loss saving (GWh)	Energy saving ($M)
2008						6.80	4.08		-	0.119	-	0.44	(11.32)	(10.10)	(10.10)	-	-
2009	1,767	3,533	7.0	0.45	0.25	2.80	1.68	0.18	0.54	0.119	0.06	0.62	(5.10)	(4.06)	(14.17)	*0.03*	*0.00*
2010	10,158	20,315	12.0	4.39	2.42	0.26	0.16	0.84	5.31	0.119	0.63	0.67	(0.13)	(0.10)	(14.26)	*0.34*	*0.04*
2011	15,032	30,065	17.0	9.20	5.08			0.49	11.13	0.119	1.32	0.69	2.58	1.64	(12.62)	*0.71*	*0.08*
2012	18,589	37,179	22.0	14.72	7.61			0.36	17.81	0.119	2.12	0.71	4.43	2.51	(10.11)	*1.13*	*0.13*
2013	19,798	38,852	27.0	19.00	9.21			0.12	22.98	0.119	2.73	0.71	5.64	2.86	(7.25)	*1.45*	*0.17*
2014	21,085	40,600	33.0	24.43	11.20			0.13	29.53	0.119	3.51	0.72	6.84	3.10	(4.16)	*1.85*	*0.22*
2015	22,456	42,427	35.6	27.75	12.49			0.14	33.53	0.119	3.99	0.72	7.64	3.08	(1.07)	*2.09*	*0.25*
2016	23,916	44,336	38.5	31.53	13.93			0.15	38.08	0.119	4.53	0.73	8.53	3.08	2.00	*2.37*	*0.28*
2017	25,471	46,331	41.6	35.82	15.56			0.16	43.25	0.119	5.15	0.73	9.53	3.07	5.07	*2.67*	*0.32*
2018	27,127	48,416	44.9	40.70	17.41			0.17	49.13	0.119	5.85	0.74	10.65	3.06	8.14	*3.02*	*0.36*
2019	28,890	50,595	48.5	46.25	19.49			0.18	55.81	0.119	6.64	0.75	11.92	3.06	11.20	*3.41*	*0.41*
2020	30,768	52,872	52.4	52.56	21.84			0.19	63.40	0.119	7.54	0.75	13.35	3.06	14.26	*3.86*	*0.46*
2021	32,768	55,251	56.6	59.74	24.49			0.20	72.04	0.119	8.57	0.76	14.96	3.06	17.32	*4.36*	*0.52*
2022	34,898	57,737	61.1	67.90	27.50			0.21	81.85	0.119	9.74	0.77	16.77	3.06	20.38	*4.92*	*0.59*
2023	37,166	60,335	66.0	77.18	30.90			0.23	93.01	0.119	11.07	0.78	18.82	3.07	23.45	*5.56*	*0.66*
2024	39,582	63,050	71.2	87.74	34.75			0.24	105.70	0.119	12.58	0.79	21.14	3.08	26.53	*6.29*	*0.75*
2025	42,155	65,887	76.9	99.76	39.11			0.26	120.13	0.119	14.30	0.80	23.75	3.09	29.62	*7.10*	*0.85*
2026	44,895	68,852	83.1	113.43	44.04			0.27	136.54	0.119	16.25	0.81	26.71	3.10	32.72	*8.03*	*0.96*
2027	47,813	71,950	89.7	128.98	49.64			0.29	155.21	0.119	18.47	0.82	30.06	3.12	35.84	*9.07*	*1.08*
2028	50,921	75,188	96.9	146.68	55.99			0.31	176.44	0.119	21.00	0.83	33.85	3.13	38.97	*10.25*	*1.22*
2029	54,231	78,571	104.7	166.82	63.19			0.33	200.60	0.119	23.87	0.85	38.14	3.15	42.12	*11.58*	*1.38*
2030	57,756	82,107	113.1	189.75	71.35			0.35	228.08	0.119	27.14	0.86	43.00	3.17	45.29	*13.09*	*1.56*
2031	61,510	85,802	122.1	215.84	80.62			0.38	259.35	0.119	30.86	0.88	48.51	3.20	48.49	*14.79*	*1.76*
2032	65,508	89,663	131.9	245.55	91.14			0.40	294.93	0.119	35.10	0.89	54.75	3.22	51.71	*16.72*	*1.99*
2033	69,766	93,698	142.4	279.36	103.09			0.43	335.43	0.119	39.92	0.91	61.84	3.25	54.96	*18.90*	*2.25*
2034	74,301	97,914	153.8	317.86	116.66			0.45	381.51	0.119	45.40	0.93	69.88	3.28	58.23	*21.36*	*2.54*
2035	79,131	102,320	166.1	361.70	132.08			0.48	433.97	0.119	51.64	0.95	79.01	3.31	61.54	*24.14*	*2.87*
2036	84,275	106,924	179.4	411.63	149.61			0.51	493.68	0.119	58.75	0.97	89.38	3.34	64.88	*27.28*	*3.25*

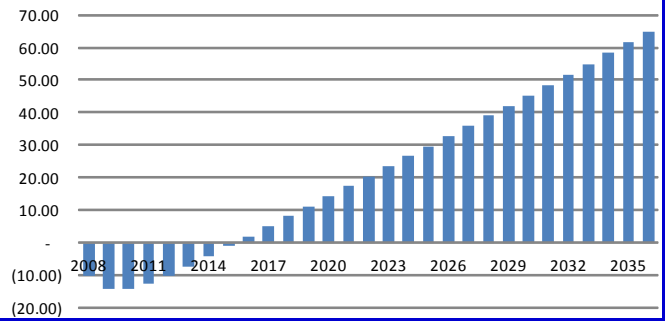
Assumptions

Economic cost of capital (EOCK)			12%			
Exchange rate			4200	Riel = US$1		
HH growth rate			1.5%			
Annual connection growth in EDC area			6.5%			
Annual connection growth in REE area			4.5%			
Annual HH conumption growth from 2015			8.0%			
LV investment incl. meter, in-house wiring			60%	of MV investment		
O&M cost			4.0%	of capital costs		
EDC MV loss incl. HV and MV			3.0%	Incl. HV, MV		
EDC d-loss in the project area			10.6%	before	9.7%	after
REE distribution loss in the project area			23.0%	before	16.4%	after
Import tariff excluding VAT			0.090	US$/kWh		
Wheeling Charge			0.029	US$/kWh		
Willingness to pay for initial	18	kWh	0.552	US$/kWh	2320	Riel/kWh
Willingness to pay thereafter			0.342	US$/kWh	1436	Riel/kWh
Extra cost of extra HH connection			100	$/HH incl meter, indoor wiring		

Grid Extension - EdC Component

Present Value of Accumulated Economic Benefits

(US$ million)



Cambodia: Rural Electrification and Transmission Project
Rural Electrification - EdC Grid Extension Component
Financial Analysis - EdC's Perspective

FIRR	**7.3%**
NPV ($million)	**4.90**

D-loss reduction

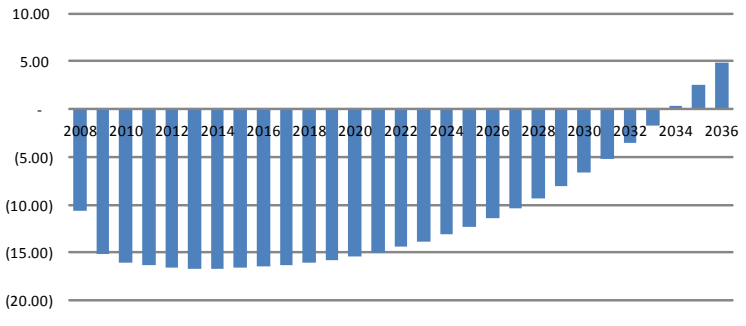
$8.8

Year	HH connect EDC direct (HH)	HH Consum. (kWh/mos)	Net energy consum. (GWh)	Retail energy sales ($m)	Conn. Charge ($m)	HH connect thru REE (HH)	Bulk sale REE (GWh)	Bulk sales ($m)	Investments MV ($m)	Investments LV ($m)	Investments Add. conn. ($m)	Gross energy consum. (GWh)	Energy cost ($m)	O&M cost ($m)	Total net benefit ($m)	PV of net benefit ($m)	PV of accumul. benefit ($m)	D-loss saving (GWh)	Energy saving ($M)
2008									6.80	4.08		-	-	0.44	(11.32)	(10.67)	(10.67)	-	-
2009	1,767	7.0	0.15	0.03	0.10	3,533	0.36	0.05	2.80	1.68	0.10	0.54	0.07	0.62	(5.09)	(4.53)	(15.20)	*0.03*	*0.00*
2010	10,158	12.0	1.46	0.32	0.49	20,315	3.50	0.53	0.26	0.16	0.49	5.31	0.72	0.65	(0.94)	(0.79)	(15.99)	*0.34*	*0.05*
2011	15,032	17.0	3.07	0.67	0.28	30,065	7.34	1.10			0.28	11.13	1.50	0.67	(0.40)	(0.32)	(16.31)	*0.71*	*0.10*
2012	18,589	22.0	4.91	1.06	0.21	37,179	11.75	1.76			0.21	17.81	2.40	0.67	(0.25)	(0.19)	(16.50)	*1.13*	*0.15*
2013	19,798	27.0	6.41	1.39	0.07	38,852	15.07	2.26			0.12	22.98	3.10	0.68	(0.18)	(0.13)	(16.62)	*1.45*	*0.20*
2014	21,085	33.0	8.35	1.81	0.07	40,600	19.24	2.89			0.13	29.53	3.98	0.68	(0.02)	(0.02)	(16.64)	*1.85*	*0.25*
2015	22,456	35.6	9.60	2.08	0.08	42,427	21.72	3.26			0.14	33.53	4.52	0.69	0.07	0.04	(16.60)	*2.09*	*0.28*
2016	23,916	38.5	11.05	2.40	0.08	44,336	24.51	3.68			0.15	38.08	5.14	0.70	0.18	0.11	(16.49)	*2.37*	*0.32*
2017	25,471	41.6	12.71	2.76	0.09	46,331	27.66	4.15			0.16	43.25	5.84	0.70	0.30	0.17	(16.32)	*2.67*	*0.36*
2018	27,127	44.9	14.61	3.17	0.10	48,416	31.22	4.68			0.17	49.13	6.63	0.71	0.45	0.24	(16.09)	*3.02*	*0.41*
2019	28,890	48.5	16.81	3.65	0.10	50,595	35.23	5.29			0.18	55.81	7.53	0.72	0.61	0.30	(15.78)	*3.41*	*0.46*
2020	30,768	52.4	19.33	4.19	0.11	52,872	39.77	5.96			0.19	63.40	8.55	0.72	0.80	0.38	(15.41)	*3.86*	*0.52*
2021	32,768	56.6	22.24	4.82	0.12	55,251	44.88	6.73			0.20	72.04	9.72	0.73	1.02	0.45	(14.95)	*4.36*	*0.59*
2022	34,898	61.1	25.58	5.55	0.12	57,737	50.65	7.60			0.21	81.85	11.04	0.74	1.27	0.53	(14.42)	*4.92*	*0.66*
2023	37,166	66.0	29.42	6.38	0.13	60,335	57.16	8.57			0.23	93.01	12.55	0.75	1.56	0.62	(13.81)	*5.56*	*0.75*
2024	39,582	71.2	33.84	7.34	0.14	63,050	64.52	9.68			0.24	105.70	14.26	0.76	1.90	0.70	(13.10)	*6.29*	*0.85*
2025	42,155	76.9	38.92	8.44	0.15	65,887	72.81	10.92			0.26	120.13	16.21	0.77	2.28	0.80	(12.30)	*7.10*	*0.96*
2026	44,895	83.1	44.77	9.71	0.16	68,852	82.18	12.33			0.27	136.54	18.42	0.78	2.72	0.90	(11.41)	*8.03*	*1.08*
2027	47,813	89.7	51.49	11.17	0.17	71,950	92.74	13.91			0.29	155.21	20.94	0.79	3.23	1.01	(10.40)	*9.07*	*1.22*
2028	50,921	96.9	59.23	12.85	0.18	75,188	104.67	15.70			0.31	176.44	23.81	0.80	3.81	1.12	(9.28)	*10.25*	*1.38*
2029	54,231	104.7	68.12	14.78	0.19	78,571	118.13	17.72			0.33	200.60	27.07	0.82	4.48	1.24	(8.04)	*11.58*	*1.56*
2030	57,756	113.1	78.36	17.00	0.20	82,107	133.32	20.00			0.35	228.08	30.77	0.83	5.24	1.37	(6.66)	*13.09*	*1.77*
2031	61,510	122.1	90.12	19.55	0.22	85,802	150.47	22.57			0.38	259.35	34.99	0.85	6.12	1.51	(5.15)	*14.79*	*2.00*
2032	65,508	131.9	103.66	22.49	0.23	89,663	169.82	25.47			0.40	294.93	39.80	0.86	7.14	1.66	(3.49)	*16.72*	*2.26*
2033	69,766	142.4	119.23	25.87	0.25	93,698	191.66	28.75			0.43	335.43	45.26	0.88	8.30	1.82	(1.67)	*18.90*	*2.55*
2034	74,301	153.8	137.14	29.75	0.26	97,914	216.30	32.45			0.45	381.51	51.48	0.90	9.63	2.00	0.33	*21.36*	*2.88*
2035	79,131	166.1	157.74	34.22	0.28	102,320	244.12	36.62			0.48	433.97	58.56	0.92	11.16	2.18	2.51	*24.14*	*3.26*
2036	84,275	179.4	181.43	39.36	0.30	106,924	275.51	41.33			0.51	493.68	66.61	0.94	12.92	2.38	4.90	*27.28*	*3.68*

Assumptions

Weighted average cost of capital	6.0%			
Exchange rate	4200	Riel= US$1		
HH growth rate	1.5%			
Annual connection growth in EDC area	6.5%			
Annual connection growth in REE area	4.5%			
Annual HH conumption growth from 2015	8.0%			
LV investment incl. meter and in-house wiring	60%	of MV investment		
O&M cost	4.0%	of capital costs		
Import tariff excluding VAT	0.090	US$/kWh		
VAT and tax	17.7%			
Wheeling Charge	0.029	US$/kWh		
EDC retail tariff	0.217	US$/kWh	911	Riel/kWh
EDC bulk tariff to licensees	0.150	US$/kWh	630	Riel/kWh
Average connection charge in project area	58	per HH	242,891	Riel per HH
Extra cost of extra HH connection	100	US$/HH incl meter, indoor wiring		
EDC MV loss incl. HV and MV	3.0%	Incl. HV, MV		
EDC d-loss in the project area	10.6%	before	9.7%	after
REE distribution loss in the project area	23.0%	before	16.4%	after

Grid Extension - EdC Component
Present Value of Accumulated Financial Benefits
(US$ million)



Cambodia: Rural Electrification and Transmission Project

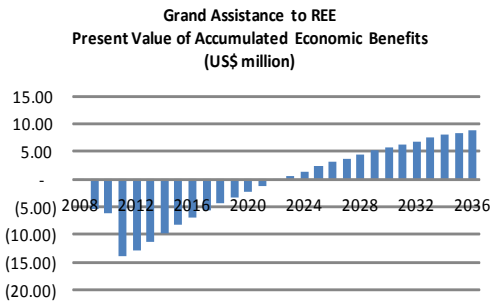
Rural Electrification - Grant Assistance to REE for 50,000 HH Connections

Economic Analysis

										EIRR	**17.5%**	
										NPV	**$8.9**	**million**
Year	HH connect (HH)	HH connect accumul (HH)	HH Consum. (kWh/mos)	Net energy consum. (GWh)	WTP ($m)	Invest. cost ($m)	Gross energy consum. (GWh)	Energy cost ($m)	O&M cost ($m)	Total net benefit ($m)	PV of net benefit ($m)	PV of accumul. benefit ($m)
2007	691	691	7.0	0.06	0.03	0.35	0.07	0.01	0.01	(0.34)	(0.30)	(0.30)
2008	13,623	14,314	12.0	2.06	1.14	6.81	2.47	0.48	0.29	(6.44)	(5.13)	(5.44)
2009	3,911	18,225	17.0	3.72	2.05	1.96	4.45	0.86	0.36	(1.13)	(0.80)	(6.24)
2010	29,708	47,933	22.0	12.65	6.54	14.85	15.14	2.93	0.96	(12.20)	(7.76)	(13.99)
2011	2,067	50,000	27.0	16.20	7.85	1.03	19.38	3.75	1.00	2.06	1.17	(12.82)
2012		50,000	29.2	17.50	8.29	-	20.93	4.05	1.00	3.24	1.64	(11.18)
2013		50,000	31.5	18.90	8.77	-	22.61	4.38	1.00	3.39	1.54	(9.65)
2014		50,000	34.0	20.41	9.29	-	24.42	4.73	1.00	3.56	1.44	(8.21)
2015		50,000	36.7	22.04	9.85	-	26.37	5.10	1.00	3.74	1.35	(6.86)
2016		50,000	39.7	23.80	10.45	-	28.48	5.51	1.00	3.94	1.27	(5.59)
2017		50,000	42.8	25.71	11.10	-	30.76	5.95	1.00	4.15	1.19	(4.40)
2018		50,000	46.3	27.76	11.80	-	33.22	6.43	1.00	4.37	1.12	(3.28)
2019		50,000	50.0	29.99	12.56	-	35.88	6.94	1.00	4.62	1.06	(2.22)
2020		50,000	54.0	32.38	13.38	-	38.75	7.50	1.00	4.88	1.00	(1.22)
2021		50,000	58.3	34.97	14.27	-	41.85	8.10	1.00	5.17	0.94	(0.27)
2022		50,000	63.0	37.77	15.23	-	45.19	8.75	1.00	5.48	0.89	0.62
2023		50,000	68.0	40.79	16.26	-	48.81	9.45	1.00	5.81	0.85	1.47
2024		50,000	73.4	44.06	17.38	-	52.72	10.20	1.00	6.17	0.80	2.27
2025		50,000	79.3	47.58	18.58	-	56.93	11.02	1.00	6.56	0.76	3.03
2026		50,000	85.6	51.39	19.88	-	61.49	11.90	1.00	6.98	0.72	3.75
2027		50,000	92.5	55.50	21.29	-	66.41	12.85	1.00	7.44	0.69	4.44
2028		50,000	99.9	59.94	22.81	-	71.72	13.88	1.00	7.93	0.66	5.10
2029		50,000	107.9	64.74	24.45	-	77.46	14.99	1.00	8.46	0.62	5.72
2030		50,000	116.5	69.91	26.22	-	83.65	16.19	1.00	9.03	0.59	6.32
2031		50,000	125.8	75.51	28.13	-	90.34	17.49	1.00	9.65	0.57	6.88
2032		50,000	135.9	81.55	30.20	-	97.57	18.89	1.00	10.31	0.54	7.43
2033		50,000	146.8	88.07	32.43	-	105.38	20.40	1.00	11.03	0.52	7.94
2034		50,000	158.5	95.12	34.84	-	113.81	22.03	1.00	11.81	0.49	8.44
2035		50,000	171.2	102.73	37.44	-	122.91	23.79	1.00	12.65	0.47	8.91

Assumptions

Economic cost of capital (EOCK)		12%			
Exchange rate		4200	Riel= US$1		
Annual HH conumption growth		8.0%	from 2012		
Investment costs		500	per connection		
O&M cost		4.0%	of capital costs		
REE distribution loss		16.4%			
Cost of MV supply to REE (non-diesel)		0.150	US$/kWh	66%	of supply
Cost of MV supply to REE (diesel)		0.280	US$/kWh	34%	of supply
Weighted avg. cost of MV supply to REE		0.194	US$/kWh	813	Riel/kWh
Willingness to pay for initial	18 kWh	0.552	US$/kWh	2320	Riel/kWh
Willingness to pay thereafter		0.342	US$/kWh	1436	Riel/kWh



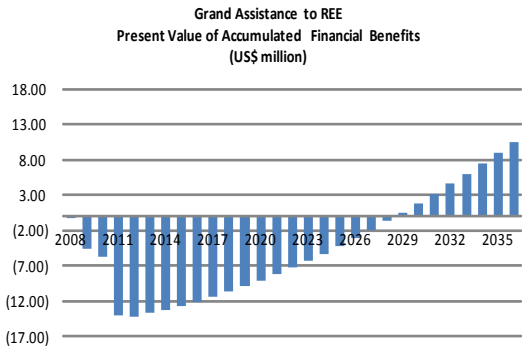
Cambodia: Rural Electrification and Transmission Project
Rural Electrification - Grant Assistance to REE for 50,000 HH Connections
Financial Analysis - REE Perspective

FIRR	**9.8%**
FNPV ($million)	**$10.5**

Year	HH connect (HH)	HH connect accumul (HH)	HH Consum. (kWh/mos)	Net energy consum. (GWh)	Energy sales ($m)	Conn. charge ($m)	Invest. cost ($m)	Subsidy ($m)	Gross energy consum. (GWh)	Energy cost ($m)	O&M cost ($m)	Net cash flow ($m)	PV of net benefit ($m)	PV of accumul. benefit ($m)
2007	691	691	7.0	0.06	0.02	0.07	0.35	0.03	0.08	0.02	0.01	(0.25)	(0.24)	(0.24)
2008	13,623	14,314	12.0	2.06	0.81	1.36	6.81	0.61	3.01	0.62	0.29	(4.93)	(4.39)	(4.63)
2009	3,911	18,225	17.0	3.72	1.46	0.39	1.96	0.18	5.42	1.12	0.36	(1.41)	(1.18)	(5.81)
2010	29,708	47,933	22.0	12.65	4.98	2.97	14.85	1.34	18.45	3.82	0.96	(10.34)	(8.19)	(14.00)
2011	2,067	50,000	27.0	16.20	6.38	0.21	1.03	0.09	23.62	4.89	1.00	(0.24)	(0.18)	(14.18)
2012		50,000	29.2	17.50	6.89	-	-	-	25.51	5.28	1.00	0.61	0.43	(13.75)
2013		50,000	31.5	18.90	7.44	-	-	-	27.55	5.70	1.00	0.74	0.49	(13.26)
2014		50,000	34.0	20.41	8.04	-	-	-	29.76	6.16	1.00	0.88	0.55	(12.71)
2015		50,000	36.7	22.04	8.68	-	-	-	32.14	6.65	1.00	1.03	0.61	(12.10)
2016		50,000	39.7	23.80	9.37	-	-	-	34.71	7.18	1.00	1.19	0.67	(11.43)
2017		50,000	42.8	25.71	10.12	-	-	-	37.49	7.75	1.00	1.37	0.72	(10.71)
2018		50,000	46.3	27.76	10.93	-	-	-	40.49	8.37	1.00	1.56	0.77	(9.94)
2019		50,000	50.0	29.99	11.81	-	-	-	43.72	9.04	1.00	1.76	0.83	(9.11)
2020		50,000	54.0	32.38	12.75	-	-	-	47.22	9.77	1.00	1.98	0.88	(8.23)
2021		50,000	58.3	34.97	13.77	-	-	-	51.00	10.55	1.00	2.22	0.93	(7.30)
2022		50,000	63.0	37.77	14.87	-	-	-	55.08	11.39	1.00	2.48	0.98	(6.33)
2023		50,000	68.0	40.79	16.06	-	-	-	59.49	12.30	1.00	2.76	1.02	(5.30)
2024		50,000	73.4	44.06	17.35	-	-	-	64.25	13.29	1.00	3.06	1.07	(4.23)
2025		50,000	79.3	47.58	18.74	-	-	-	69.39	14.35	1.00	3.38	1.12	(3.11)
2026		50,000	85.6	51.39	20.23	-	-	-	74.94	15.50	1.00	3.73	1.16	(1.95)
2027		50,000	92.5	55.50	21.85	-	-	-	80.93	16.74	1.00	4.11	1.21	(0.74)
2028		50,000	99.9	59.94	23.60	-	-	-	87.41	18.08	1.00	4.52	1.25	0.52
2029		50,000	107.9	64.74	25.49	-	-	-	94.40	19.53	1.00	4.96	1.30	1.82
2030		50,000	116.5	69.91	27.53	-	-	-	101.95	21.09	1.00	5.44	1.34	3.16
2031		50,000	125.8	75.51	29.73	-	-	-	110.11	22.77	1.00	5.96	1.39	4.55
2032		50,000	135.9	81.55	32.11	-	-	-	118.91	24.60	1.00	6.51	1.43	5.98
2033		50,000	146.8	88.07	34.68	-	-	-	128.43	26.56	1.00	7.11	1.48	7.45
2034		50,000	158.5	95.12	37.45	-	-	-	138.70	28.69	1.00	7.76	1.52	8.97
2035		50,000	171.2	102.73	40.45	-	-	-	149.80	30.98	1.00	8.46	1.56	10.53

Assumptions

Weight average cost of capital	6.0%			
Exchange rate	4200	Riel= US$1		
Annual HH conumption growth	8.0%	from 2012		
Investment costs	500	per connection		
O&M cost	4.0%	of capital costs		
Connection charge	100	US$ per HH		
VAT and tax	17.7%			
Power purchase tariff	0.150	US$/kWh	66%	of supply
Cost of self generation using diesel	0.320	US$/kWh	34%	of supply
Weighted average cost of supply	0.207	US$/kWh	869	Riel/kWh
REE tariff to consumer	0.394	US$/kWh	1654	Riel/kWh
REE distribution loss	16.4%			



Cambodia: Rural Electrification and Transmission Project
Rural Electrifica - Solar Home Systems
Economic Analysis
Without Subsidy and Interest-Free Financing

1 x 30 WP System

Levelized cost ($/kWh)	**1.00**
Levelized cost to end users ($/kWh)	**1.00**
EIRR	**35.4%**
NPV	**$180.5**

Discount rate (EOCK) **12%**

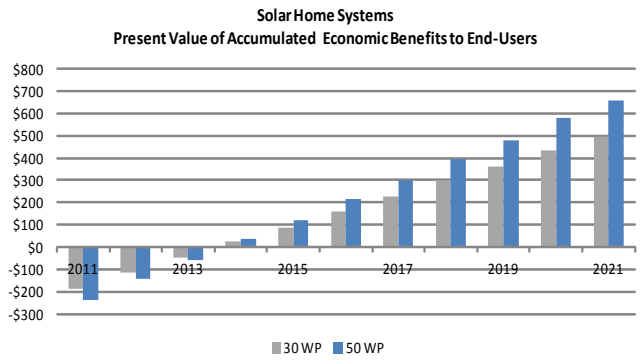
	Use per day (hr.)	Energy output (kWh)	PV of energy output (kWh)	HH avoided costs (US$)	HH add. benefit (US$)	Total benefit (US$)	System cost incl. install. (US$)	O&M cost (US$)	Cost to end-user (US$)	Total cost (US$)	Net benefit to end-user (US$)	Total benefit (US$)	PV of end-user benefit (US$)	PV of accumul. end-user benefit
2011	4.0	43.8	39.1	24.0	50.0	74.0	260.0		260.0	260.0	(186.0)	(186.0)	(166.1)	(186.0)
2012	4.0	43.8	34.92	24.0	50.0	74.0			-	-	74.0	74.0	59.0	(112.0)
2013	4.0	43.8	31.18	24.0	50.0	74.0		11.3	11.3	11.3	62.8	62.8	44.7	(49.3)
2014	4.0	43.8	27.84	24.0	50.0	74.0			-	-	74.0	74.0	47.0	24.8
2015	4.0	43.8	24.85	24.0	50.0	74.0		11.3	11.3	11.3	62.8	62.8	35.6	87.5
2016	4.0	43.8	22.19	24.0	50.0	74.0			-	-	74.0	74.0	37.5	161.5
2017	4.0	43.8	19.81	24.0	50.0	74.0		11.3	11.3	11.3	62.8	62.8	28.4	224.3
2018	4.0	43.8	17.69	24.0	50.0	74.0			-	-	74.0	74.0	29.9	298.3
2019	4.0	43.8	15.79	24.0	50.0	74.0		11.3	11.3	11.3	62.8	62.8	22.6	361.0
2020	4.0	43.8	14.10	24.0	50.0	74.0			-	-	74.0	74.0	23.8	435.0
2021	4.0	43.8	12.59	24.0	50.0	74.0		11.3	11.3	11.3	62.8	62.8	18.0	497.8
			260.1										**180.5**	

1 x 50 WP Systems

Levelized cost ($/kWh)	**0.75**
Levelized cost to end users ($/kWh)	**0.75**
EIRR	**36.6%**
NPV	**$243.0**

Discount rate (EOCK) **12%**

	Use per day (hr.)	Energy output (kWh)	PV of energy output (kWh)	HH avoided costs (US$)	HH add. benefit (US$)	Total benefit (US$)	System cost incl. install. (US$)	O&M cost (US$)	Cost to end-user (US$)	Total cost (US$)	Net benefit to end-user (US$)	Total benefit (US$)	PV of end-user benefit (US$)	PV of accumul. end-user benefit
2011	4.0	73.0	65.2	36.0	60.0	96.0	333.0		333.0	333.0	(237.0)	(237.0)	(211.6)	(237.0)
2012	4.0	73.0	58.20	36.0	60.0	96.0			-	-	96.0	96.0	76.5	(141.0)
2013	4.0	73.0	51.96	36.0	60.0	96.0		12.5	12.5	12.5	83.5	83.5	59.4	(57.5)
2014	4.0	73.0	46.39	36.0	60.0	96.0			-	-	96.0	96.0	61.0	38.5
2015	4.0	73.0	41.42	36.0	60.0	96.0		12.5	12.5	12.5	83.5	83.5	47.4	122.0
2016	4.0	73.0	36.98	36.0	60.0	96.0			-	-	96.0	96.0	48.6	218.0
2017	4.0	73.0	33.02	36.0	60.0	96.0		12.5	12.5	12.5	83.5	83.5	37.8	301.5
2018	4.0	73.0	29.48	36.0	60.0	96.0			-	-	96.0	96.0	38.8	397.5
2019	4.0	73.0	26.32	36.0	60.0	96.0		12.5	12.5	12.5	83.5	83.5	30.1	481.0
2020	4.0	73.0	23.50	36.0	60.0	96.0			-	-	96.0	96.0	30.9	577.0
2021	4.0	73.0	20.99	36.0	60.0	96.0		12.5	12.5	12.5	83.5	83.5	24.0	660.5
			433.5										**243.0**	



Cambodia: Rural Electrification and Transmission Project
Rural Electrifica - Solar Home Systems
Economic Analysis
With Subsidy and Interest-Free Financing

1 x 30 WP System

Levelized cost ($/kWh)	**0.91**
Levelized cost to end users ($/kWh)	**0.57**
EIRR	**59.0%**
NPV	**$291.1**

Discount rate (EOCK) **12%**

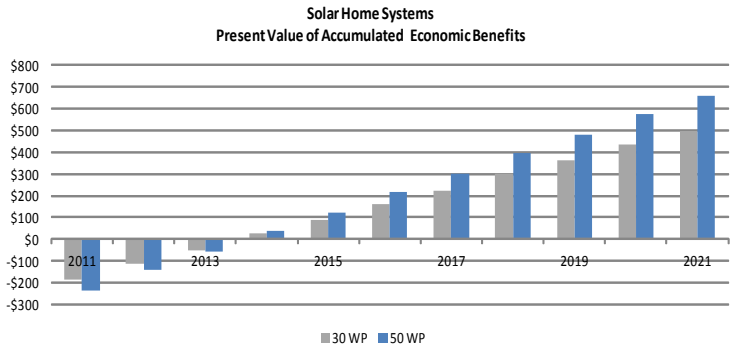
	Use per day	Energy output	PV of energy output	HH avoided costs	HH add. benefit	Total benefit	Subsidy	System cost to end user	O&M cost	Cost to end-user	Total cost	Net benefit to end-user	Total benefit	PV of end-user benefit	PV of accumul. end-user benefit
	(hr.)	(kWh)	(kWh)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	benefit
2011	4.0	43.8	39.1	24.0	50.0	74.0	100.0	40.0		40.0	140.0	34.0	(66.0)	30.4	(66.0)
2012	4.0	43.8	34.92	24.0	50.0	74.0		40.0		40.0	40.0	34.0	34.0	27.1	(32.0)
2013	4.0	43.8	31.18	24.0	50.0	74.0		40.0	11.3	51.3	51.3	22.8	22.8	16.2	(9.3)
2014	4.0	43.8	27.84	24.0	50.0	74.0		40.0		40.0	40.0	34.0	34.0	21.6	24.8
2015	4.0	43.8	24.85	24.0	50.0	74.0			11.3	11.3	11.3	62.8	62.8	35.6	87.5
2016	4.0	43.8	22.19	24.0	50.0	74.0				-	-	74.0	74.0	37.5	161.5
2017	4.0	43.8	19.81	24.0	50.0	74.0			11.3	11.3	11.3	62.8	62.8	28.4	224.3
2018	4.0	43.8	17.69	24.0	50.0	74.0				-	-	74.0	74.0	29.9	298.3
2019	4.0	43.8	15.79	24.0	50.0	74.0			11.3	11.3	11.3	62.8	62.8	22.6	361.0
2020	4.0	43.8	14.10	24.0	50.0	74.0				-	-	74.0	74.0	23.8	435.0
2021	4.0	43.8	12.59	24.0	50.0	74.0			11.3	11.3	11.3	62.8	62.8	18.0	497.8
			260.1											**291.1**	

1 x 50 WP Systems

Levelized cost ($/kWh)	**0.68**
Levelized cost to end users ($/kWh)	**0.47**
EIRR	**71.8%**
NPV	**$366.3**

Discount rate (EOCK) **12%**

	Use per day	Energy output	PV of energy output	HH avoided costs	HH add. benefit	Total benefit	Subsidy	System cost to end user	O&M cost	Cost to end-user	Total cost	Net benefit to end-user	Total benefit	PV of end-user benefit	PV of accumul. end-user benefit
	(hr.)	(kWh)	(kWh)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	(US$)	benefit
2011	4.0	73.0	65.2	36.0	60.0	96.0	100.0	58.3		58.3	158.3	37.8	(62.3)	33.7	(62.3)
2012	4.0	73.0	58.20	36.0	60.0	96.0		58.3		58.3	58.3	37.8	37.8	30.1	(24.5)
2013	4.0	73.0	51.96	36.0	60.0	96.0		58.3	11.3	69.5	69.5	26.5	26.5	18.9	2.0
2014	4.0	73.0	46.39	36.0	60.0	96.0		58.3		58.3	58.3	37.8	37.8	24.0	39.8
2015	4.0	73.0	41.42	36.0	60.0	96.0			11.3	11.3	11.3	84.8	84.8	48.1	124.5
2016	4.0	73.0	36.98	36.0	60.0	96.0				-	-	96.0	96.0	48.6	220.5
2017	4.0	73.0	33.02	36.0	60.0	96.0			11.3	11.3	11.3	84.8	84.8	38.3	305.3
2018	4.0	73.0	29.48	36.0	60.0	96.0				-	-	96.0	96.0	38.8	401.3
2019	4.0	73.0	26.32	36.0	60.0	96.0			11.3	11.3	11.3	84.8	84.8	30.6	486.0
2020	4.0	73.0	23.50	36.0	60.0	96.0				-	-	96.0	96.0	30.9	582.0
2021	4.0	73.0	20.99	36.0	60.0	96.0			11.3	11.3	11.3	84.8	84.8	24.4	666.8
			433.5											**366.3**	



EDC Financial Performance

At appraisal, the financial viability of EDC was assessed. Several issues that might jeopardize the company's financial position were highlighted. They include i) insufficient tariff to recover costs of supply; ii) high costs of production; iii) outstanding government arrears; and iv) high distribution losses. Based on a set of assumptions made, the financial projections for the period 2001-10 demonstrated that EDC's financial outlook would remain fragile unless the following measures would be taken i) procuring fuel on the basis of competitive bids; ii) convert one of its power plants to running on cheaper fuels; iii) negotiating with IPPs for lower tariff and reduced level of off-take; iv) reducing staffing costs; v) shutting down older plants to reduce O&M costs; vi) reduce system losses; and vii) update company bad debt provisions and write-offs.

To promote continued prudent financial management, the following financial covenants were agreed: (a) sufficient cash flow cover operating expenses and the amount by which debt service requirements exceed the provision for depreciation; (b) debt service coverage ratio no less than 1.3 times from 2007 onward; (c) long-term debt to equity ratio less than 1.5 times.

Financial Performance of EDC

All covenants were met, except for the break-even covenant in 2007 when EDC's cost of supply was around Riel 1,012 per kWh and the average tariff around Riel 996 per kWh. In that year, the Cambodia Utility and Private Limited provided EDC with a Riel 54 million refund for liquidated damages, which helped made up for the shortfall in the company's cash flow.

	Target	2006	2007	2008	2009	2010
Debt Service Coverage Ratio(times)	>1.3	2.5	2.7	1.6	15.2	8.7
Minimum Cash Requirement	> 0	Yes	No	Yes	Yes	Yes
Long Term Debt Equity Ratio (times)	<1.5	0.9	1.1	0.6	0.7	0.5

See next page for the latest financial projections for the six year period 2011-2016. Key financial indicators of the recent past and projected period, the main assumptions used for the financial forecast are summarized below. According to the projection, EdC is expected to continue to remain financially viable, and all financial covenants are expected to be met in the foreseeable future.

Main Assumptions Used for the Five-year Financial Projections, 2011-2016

- *Sales growth*: 10%
- *Inflation rate*: 2%
- *Tariff and cost of supply*: move in the same direction and at the same pace
- *Interest rate, finance charges and amortization*: per loan agreements
- *Depreciation*: 30 year straight line depreciation
- *Income Taxes*: 20% on profit

EdC Financial Performance (2008-2010) and Project 2011-16

		2008 Audited	2009 Audited	2010 Audited	2011 Projected	2012 Projected	2013 Projected	2014 Projected	2015 Projected	2016 Projected
I	**Profit and Loss Statement**									
1	Operating revenue	1,303	1,231	1,598	1,916	2,101	2,304	2,527	2,772	3,041
2	Operating expenses	(1,243)	(1,048)	(1,340)	(1,715)	(1,881)	(2,062)	(2,259)	(2,478)	(2,719)
3	**Operating income**	**60**	**183**	**258**	**200**	**220**	**241**	**267**	**293**	**322**
4	Other income (expenses)	(19)	(20)	(31)	(35)	(16)	(13)	(16)	(19)	(25)
5	**Net income before tax**	**41**	**164**	**228**	**166**	**204**	**228**	**251**	**275**	**297**
6	Taxes	(12)	(34)	(45)	(35)	(41)	(46)	(50)	(55)	(59)
7	**Net income after tax**	**29**	**129**	**183**	**131**	**164**	**183**	**201**	**220**	**238**
II	**Balance Sheet**									
1	Current assets	394	587	787	983	1,183	1,350	1,584	1,847	2,146
2	Non-current assets	671	791	970	1,030	1,107	1,361	1,477	1,586	1,684
3	**Total Assets**	**1,065**	**1,378**	**1,758**	**2,014**	**2,290**	**2,711**	**3,060**	**3,433**	**3,830**
4	Current liabilities	318	395	503	441	477	516	559	607	660
5	Non-current liabilities	294	391	432	620	696	896	1,001	1,107	1,212
6	Equity	453	591	822	953	1,116	1,299	1,500	1,720	1,957
7	**Total Liabilities & Equity**	**1,065**	**1,378**	**1,758**	**2,014**	**2,290**	**2,711**	**3,060**	**3,433**	**3,830**
III	**Statement of Cash Flows**									
1	Cash flows from operations	20	116	216	182	239	265	288	315	343
2	Cash flows from investment	(24)	(15)	(88)	(117)	(138)	(322)	(188)	(189)	(186)
3	Cash flows from financing	(12)	7	8	64	67	191	96	96	96
4	**Net increase (decrease) in cash**	**(15)**	**108**	**136**	**128**	**169**	**134**	**196**	**223**	**253**
IV	**Financial ratios**									
1	*Break-even*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
2	*L-T debt to equity ratio*	*0.65*	*0.66*	*0.53*	*0.65*	*0.62*	*0.69*	*0.67*	*0.64*	*0.62*
3	*Debt service coverage ratio*	*1.65*	*15.17*	*8.66*	*3.47*	*4.36*	*5.14*	*5.24*	*5.46*	*5.23*

Table A: Weighted average supply cost of EDC in 2011

Descriptions	Unit	Energy Mix in 2011	Percentage of Supply (%)	Feed-in tariff, excl. VAT (US$/kWh)	Feed-in tariff + VAT+ import tax (US$/kWh)
Total EDC Energy mix	**GWh**	**2,564.07**	**100**		
Domestic generation (EDC, IPPs)	**GWh**	**901.88**	**35.17**		
Diesel (HFO and DO)	GWh	794.43	30.98	0.2	0.220
Biomass	GWh	0			
Thermal Wood	GWh	14.15	0.55	0.2	0.220
Biogas	GWh	0			
Charcoal	GWh	46.50	1.81	0.15	0.165
Hydro	GWh	46.80	1.83	0.07	0.077
Import from neighboring countries	**GWh**	**1,662,20**	**64.83**		
From Vietnam -Total	GWh	1346.70	52.52	0.07	0.081
From Thailand-Total	GWh	308.9	12.05	0.11	0.129
From Laos-Total	GWh	6.6	0.26	0.07	0.082
Weighted average feed-in tariff, generation (without loss)	US$/kWh			0.117	0.132
Weighted average feed-in tariff (supply cost), with loss 9.8%	US$/kWh			**0.128**	**0.145**
Import from Vietnam through REPT's 230kV line (ADB-finance)	GWh	**1,120.96**	**43.7**	**0.070**	**0.082**

Source: EDC data 2011.

ANNEX 4

BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION PROCESSES

(a) Task Team members

Names	Title	Unit	Responsibility/ Specialty
Lending			
Rebecca Sekse	Financial Analysis	EASTE	Task Team Leader
Chandrasekar Govindarajalu	Rural and Renewable Energy Specialist	MNSEG	Energy Development
Jon Exel	Rural and Renewable Energy Specialist	MNSEG	Energy Development
Enrique Crousillat	Consultant	LCSEG	Economist
Yuling Zhou	Operations Officer	EAPPR	Procurement
Kurt Schenk	Consultant	EASEG	Engineering and Procurement
Glenn Morgan	Regional Safeguards Adviser	LCSDE	Environmental Safeguards
Bernie Baratz	Consultant	EASTE	Environmental Safeguards
Youxuan Zhu	Social Scientist	EASTS	Social Safeguards
Lanfranco Blanchetti-Revelli	Social Scientist	EASTS	Social Safeguards
Teck Ghee Lim	Social Scientist	EASTS	Social Safeguards
Fernando Lecaros	Power Economist	LCSEG	Energy and Mining
Morten Larsen	Power Economist	SEGOM	Energy and Mining
Kannathee Danaisawat	Financial Management Specialist	EAPFM	Financial Management
Wijaya Wickrema	Financial Management Specialist	EAPFM	Financial Management
Mei Wang	Legal Counsel	LEGES	Legal
Robert P. Taylor	Energy Specialist	EASCS	Energy Development
Rosa Muleta	Consultant	CTRLA	Disbursement
Omowunmi Ladipo	Disbursement Officer	CTRLA	Disbursement
Soudalath Silaphet	Project Assistant	EACLF	Project Support
John Besant-Jones	Consultant	MNSEG	Peer Reviewer
Mac Cosgrove-Davies	Sector Manager, Energy	LCSEG	Peer Reviewer
Peter Cordukes	Consultant	EASEG	Peer Reviewer
Supervision/ICR			
Rebecca C. Sekse	Senior Financial Analyst	EASTE - HIS	Task Team Leader
Jie Tang	Senior Energy Specialist	EASIN	Task Team Leader
Veasna Bun	Senior Infrastructure Specialist	EASTS	Task Team Leader/ICR primary Author
Alfredo Bano-Leal	Consultant	EASTS	Operation Analyst
Bernard Baratz	Consultant	EASCS	Environmental

			Safeguards
Bunlong Leng	Environmental Specialist	EASTS	Environmental Safeguards
Chandrasekar Govindarajalu	Senior Energy Specialist	MNSEG	Energy Development
China Chhun	Program Assistant	EACSF	Project Support
Clive H.J. Mason	Consultant	CESI2	Energy Planing
Darayes Bahadur Mehta	Consultant	EASTE - HIS	Power Engineer
James Orehmie Monday	Senior Environmental Engineer	EASTS	Social Safeguards
Jason Steele	Consultant	EASER	Energy Analysis
John Richardson	Consultant	EASTS	Governance Framework
Kannathee Danaisawat	Financial Management Specialist	EAPFM	Financial Management
Latharo Lor	Procurement Specialist	EAPPR	Procurement
Maria Lourdes Pardo De La Pena	Senior Counsel	LEGCF	Legal
Roch Levesque	Senior Counsel	LEGEA	Legal
Melissa Ortega Sanchez	Temporary	EASIN	Project Support
Mohinder P. Gulati	Country Sector Coordinator	ECSSD	Energy and Mining
Oithip Mongkolsawat	Senior Procurement Specialist	EAPPR	Procurement
Panos Vlahakis	Consultant	EASTS	Power Engineer
Peng Seng Tan	Program Assistant	EACSF	Project Support
Ratha Sann	Infrastructure Operations Officer	EASTS	Transport
Kim Sidet	Program Assistant	EACTF	Project Support
Rohit Khanna	Program Manager	SEGES	Energy and Mining
Seida Heng	Consultant	EAPFM	Financial Management
Sirirat Sirijaratwong	Procurement Analyst	EAPPR	Procurement
Vanna Nil	Social Development Specialist	EASTS	Social Safeguards
Youxuan Zhu	Consultant	EASCS	Environmental and Social Safeguards
Vachraras Pasuksuwan	Program Assistant	EACTF	Project Support
Patricia Ramo Peinado	Consultant	EASTS	Infrastructure Analyst
Sophear Khiev	Program Assistant	EACSF	Project Support
Sok Keo Reaksmey	Consultant	EAPFM	Financial Management
Jun Zeng	Social Development Specialist	EASCS	Social Safeguards
Yan Li	Consultant	EASIN	Financial Management
Defne Gencer	Energy Specialist	EASIN	Energy Development

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD (including travel and consultant costs)
Lending		
FY00	25.16	202,432.44
FY01	30.72	186,315.38
FY02	14.57	78,193.30
FY03	37.6	156,924.87
FY04	33.14	182,507.60
Total:	141.19	806,373.59
Supervision/ICR		
FY00	0.05	120.52
FY02	0.00	-
FY03	0.10	315.36
FY04	6.58	39,051.68
FY05	11.65	46,767.32
FY06	13.06	65,766.10
FY07	11.07	67,384.74
FY08	13.14	82,011.21
FY09	25.71	66,652.50
FY10	25.42	104,673.48*
FY11 *	21.75	57,375.18**
FY12	26.80	94,381.01
Total:	155.33	624,499.10

Note: (*) including safeguards implementation review mission by HQ-based staff
(**) Excluding staff time and cost charged AusAID TF of US$4,902.87

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	USD (including travel and consultant costs)
FY11	2.00	4,902.87

ANNEX 5

BENEFICIARY SURVEY RESULTS

(if any)

NA

ANNEX 6

STAKEHOLDER WORKSHOP REPORT AND RESULTS

The stakeholder workshop was organized in Phnom Penh on March 23, 2012. The Workshop provided an opportunity to primary and secondary beneficiaries to share project outputs and outcomes, challenges, lessons learned and to express their views and recommendations for better project preparation and implementation. Participants were mainly the secondary beneficiaries who were officials of MIME, EAC, EDC and REF. Consultant, contractor and co-financier representative (ADB) also attended the workshop.

Presentation by IAs:

Each of the four project managers from the implementing agencies delivered a presentation on the project achievements, challenges and lessons learnt under their respective components, after a general introduction by the project Task Team Leader on RETP project time frame, structure and expected outputs and outcomes.

In summary, all activities under EDC components were completed, except the safeguards training for which EDC will use another source of financing (ADB) while continuing implementing the ADB's financed project. The outputs expected under the EDC component were also achieved: (i) completion all physical investment on TL, substations, the NCC, the MV expansion and equipment/goods purchased; and (ii) completion of TAs.

EAC reported their successful implementation progress including the (i) Operational Support to EAC - consultancy services; and (ii) Training to EAC staff on technical and financial regulation. As result, it helped EAC to discharge its responsibilities mandated in the Electricity Law to regulate the sector and to enhance EAC's operations.

REF presented achievements under its component including the completion of off-grid connection of 50,000 new households in the REE coverage areas; the completion of SHS installation of 12,093 systems, completion of construction of the REF office building and completion of all TAs assigned to them, plus new activities added during the restructuring in 2010.

MIME indicated that beside TAs which were completed on the closing date of the project, 27 staff of MIME benefited from the project.

Success factors:

- The key of the success of the project under REF component was flexibility that allowed the adaptation of the SHS program based on affordability of the household in rural areas to purchase the SHS with several payments (up to four years)
- Project support the REF sustainability by reallocating resources for construction of the REF office building and some technical assistances that were added during the restructuring.
- New delivery model of the SHS was found effective with participation of private companies.
- IAs were delegated to do procurement by themselves (within the authorized threshold) and their knowledge and capacity have been enhanced.

- Implementation support from the Bank was beneficial to all IAs especially on the FM (REF case), procurement and safeguards (EDC case).

Challenges to overcome:

- Continue support to IAs in different areas of project management will be appreciated.
- Simple project design with less procurement packages should be considered.
- Feasibility studies for investments under project should be done in advance.
- Separate bank account for each implementing agency is important for improving accountability.
- IPA performance was not fully satisfactory for all IAs. Reduce IPA involvement, strengthen the IA staff on procurement.

Other specific issues:

- One regulation was not finalized by EAC at the time of the Workshop.
- The sustainable charcoal production program under MIME could not materialize since the current Forestry Law does not allow to build the kilns within the community forest zone. It had to be at least five kilometers away from the community forest, which makes it difficult and expensive to transport supplies and workers.
- REF indicated that the FS of the five hydropower sites could not be completed since they were wrongly targeted.
- The import of power at full scale from EDC from Vietnam could not take place due to the increase in the domestic demand in Vietnam.
- The National Control Centre was not fully connected with all remote terminal units (RTUs), by the closing date, due to the late kick off of construction of the building and installation of SCADA system.

Lesson Learned:

- Close follow-up and support are needed in the implementation stage in order to reach the project objectives and build the implementing agencies' delivery capacity by mentoring and guidance.
- Future efforts should provide low interest loans to the REEs in order to benefit their potential customers in remote areas.
- End-user preference surveys should be conducted in the targeted areas a few months before the procurement of SHS in order to best estimate the preferences of the end users on capacity of SHS for more accurate procurement and ensure faster installation.
- Review and ensure the proposed hydropower sites are likely feasible before undertaking detailed FS for investment.
- Design less and bigger procurement packages in the future, which allow national and international companies to equally participate in the bidding.
- To avoid delays, compensation for tree pruning, removal of temporary structures should be completed before building power lines.
- Delegate implementing agencies (using the utility budget) for speeding the land acquisition process, instead of requesting for (land resettlement) budget directly from the Government.

- If possible, avoid upgrading (project) as it is more complex and time-consuming than building new ones (e.g. for substations)

The workshop was adjourned on the same day with closing remarks of TTL which underlined valued contributions and efforts of the IAs staff during the project implementation period, whose collaboration was critical for the success of the project and thanked them for their sincere cooperation and hospitality extended to the Bank team during project design and implementation.

List of Participants

Name	Agency	Functional Title
Mr. Kong Puthy	Electricité Du Cambodge (EDC)	Project Manager
Mr. Duong Phinithya	Electricité Du Cambodge (EDC)	Staff, Project Management Office 2
Mr. Hul Kunnak Vuth	Electricity of Cambodia (EAC)	Vice Chairman
Mr. Loeung Keosela	Rural Electrification Fund Secretariat (REF)	Executive Director
Mr. San Viryan	Rural Electrification Fund Secretariat (REF)	Chief of Technical Department
Ms. Chhoem Sopheak	Rural Electrification Fund Secretariat (REF)	Senior Accountant
Dr. Behera Manaranjan	Rural Electrification Fund Secretariat (REF)	Government RETP ICR Individual Consultant
Mr. Heng Kunleang	Ministry of Industry, Mines and Energy (MIME)	Director, Department of Energy Development
Mr. Yong Sy	Ministry of Economy and Finance (MEF)	Deputy Chief of World Bank Division
Mr. Ouk Nida	Asian Development Bank (ADB)	Senior Program Officer
Mr. Alfredo Bano Leal	Asian Development Bank (ADB)	Consultant
Mr. Bun Veasna	The World Bank	Task Team Leader
Mr. Lor Latharo	The World Bank	Procurement Specialist
Mr. Leng Bunlong	The World Bank	Environmental Safeguard Specialist
Ms. Yan Li	The World Bank	Consultant
Ms. Defne Gencer	The World Bank	Energy Specialist
Mr. Panos Vlahakis	The World Bank	Consultant
Ms. Patricia Ramo Peinado	The World Bank	Infrastructure Intern
Ms. Oithip Mongkolsawat	The World Bank	Senior Procurement Specialist
Ms. Chhun China	The World Bank	Program Assistant

ANNEX 7

SUMMARY OF BORROWER'S ICR AND/OR COMMENTS ON DRAFT ICR

I. The Borrower's ICR:

The Borrower's ICR was submitted to the Bank in January 2012[13]. Following are summaries of the Borrower's implementation completion report:

The RETP funded by the WB and the ADB aimed at helping the RGC to achieve the targets by implementing a wide range of activities including strengthening of Cambodia's existing generation, distribution and transmission capacity; technical assistance for capacity building, institutional strengthening and operational support; and rural electrification.

The PDOs are assessed to be clear and realistic. The overall rating for achievement of the PDOs of RETP is assessed as *satisfactory*. Similarly, the rating of GEO is also *satisfactory*. The ratings of PDOs and GEO are supported by the project outcomes, which are measured by the key performance indicators. The achievement of objectives and outputs of different components of the implementing agencies are mentioned below:

- To achieve the objectives of improving power sector efficiency and reliability and reducing electricity supply costs, and improving standard of living and fostering economic growth in rural areas by expanding rural electricity supplies, the 220 kV line from Vietnam border to Phnom Penh with substations at Takeo and West Phnom Penh have been completed and commissioned by EDC. This has enabled import of comparatively cheaper power and has improved operational efficiency and reliability.

- Construction of double circuit 14 km of 115 kV line from WPP substation to GS3 substation and stringing of conductors for about 22 km of 115 kV line to complete the second circuit between the three existing substations GS1, GS2 and GS3 have been completed by EDC. This has improved the capacity of the transmission system in and around Phnom Penh and has made power supply more reliable. The sub-component can be rated as highly successful.

- Up-grading of 115 kV grid substations GS1, GS2 and GS3 have been completed. This has increased the capacity at GS1, GS2 and GS3, reduced system losses by improving the power factor of the system, and has improved the efficiency of the system. The sub-component can be rated as highly successful.

- SCADA interface commissioning and testing is also completed except in two power plants. This is a small work and needs shut down of the existing power plants; and needs to be completed to complete the testing work at National Control Center. It was expected that this activity will be completed within January 2012.

- Extension of 22 kV lines from WPP substation along roads NR3 and NR4 and from Takeo substation to Samroang and Kampong Chrey is completed by EDC. MV line

[13] At time of its submission, some activities were still in progress such as installation of SHS, construction of REF office building, and testing SCADA system.

work in the provinces of Sihanouk, Battambang, Kampot, Takeo and Kampong Speu is also completed. Out of a target of 50, 000 new connections, by November 2011 more than 45, 000 new connections were connected to the system and it is expected that the target of 50,000 new connections can be achieved shortly. The sub-component can be rated as highly successful.

- Environmental and resettlement issues for the RETP project were small or negligible as the lines are pole mounted and does not involve major land acquisition. Some tree cutting and pruning were involved. EDC estimated the number of trees affected to be around 15,000. EDC has provided compensation to the private tree owners.

- To accelerate and encourage the REEs to invest on and extend their electric power facilities for providing new connection, as per the plan, 135 sub-grants were executed by REF during the project operation period and the direct benefit had reached to 50,000 rural households. The sub-component was successful in meeting its objective of providing grant assistance to REEs for 50,000 new household connections in the rural areas throughout the country.

- In order to encourage the solar firms and to reduce their per unit capital cost of SHS, the grant assistance of USD 100 was given for each SHS, so that, the price of SHS would be affordable to rural households, and this would facilitate access to electricity where the electricity network has not reached. For the installation of SHS, REF had signed the contract with Sunlabob, a private firm. Until January 24, 2012, Sunlabob could install 10,505 SHS (87.54 per cent of the target number of 12,000 SHS). It expected that, by January 31, 2012, installation of all the 12,000 SHS will be completed. The sub-component can be considered successful in meeting its objective by installing SHS for 12,000 non-electrified rural households.

- To promote the development of power plants by using renewable energy technology and providing electricity to the rural HHs, REF planned to provide the grant assistance for mini/micro hydro and renewable energy plant. For this, REF had signed the contract with a consulting firm for proving the consultancy service for Renewable Energy Business Development, including the feasibility study on the mini/micro hydro power projects. In November, 2011, the firm intimated its inability to complete the feasibility study on mini/micro hydro projects within the contract period with conclusion that sites chosen for the study were not feasible or bankable project that investors would be willing to invest in.

- The construction of REF new office building. Up to January 25, 2012, the construction firm achieved the construction of 95 per cent. By looking to the progress of construction of REF new office building, it was expected that the building construction would be completed by January 31, 2012. Therefore, the sub-component is considered as successful.

- To assist in the set-up and day-to-day operation of the REF Secretariat contract was signed in two phases with two individual international consultants. The consultants provided assistance and facilitation for the set-up and day-to-day operation of the REF Secretariat. The above TA was achieved and closed.

- For the implementation of SHS program, REF made the contract with a private firm, for installation supervision, collection of payment and maintenance of SHS. The above technical activities would ensure the sustainability of the sub-component, and the sub-component can be considered as successful.

- For rural income generation promotion, REF had signed contract with an individual international consultant. From this TA, about 1,200 villagers, including business owners, prospective business owners and other villagers, of the selected target electrified areas were directly benefitted. The above TA was achieved, and closed.

- Conducting Renewable Energy Promotion, and generating awareness. REF had signed contract with an international firm, who submitted the draft of final report to REF on January 13, 2012. The TA was closed on January 31, 2012.

- Provision of basic and advanced training to REEs: REF had signed contract with a specialized NGO. The TA was concluded successfully.

- Improvement and association building of REEs: a contract was signed between REF and Individual Local Consultant. The above TA was completed successfully in January 2012.

- Building capacity of financial institutions: REF had signed contract with an international consulting firm to train the officials of financial institutions in renewable energy business. The TA was achieved, and closed.

- An individual consultant provided operational support to EAC (from June 2005 to December 2009) to issue licenses to electricity providers and monitor their services. In the 5 year period from 2005 to 2009, the number of valid licenses has become almost 2.5 times and in the 7 year period from 2005 to 2011 the same has become almost 3 times. A number of revisions were made to the licenses during each of the years from 2005 to 2011. The large numbers of revisions each year show that EAC is regularly monitoring the service provided by the licensees. The project is highly successful in achieving the objective of issuing licenses to electricity service providers and monitoring their services. Three officers from Finance and Pricing Department (of EAC), and 17 officers from EAC took different types of training.

- A contract was signed with an individual consultant to study on sustainable wood and biomass supplies at reasonable prices from community forests, woodlots and energy plantation, alongside biomass residues from rice husks, animal dung and agri-business processing plants and rubber plantations; and to improve the efficiency and introduce improved technologies into all aspects of wood and biomass energy supply and demand. The consultant has submitted the final report on January 30, 2012.

- Quality training in Management and the English language to complement the engineering qualification of MIME's General Department of Energy Staff: a contract was signed between MIME and a local university. An evaluation was made on the participants on the quality of the training, which was rated between Very Good and Good. The above TA was achieved.

- One Advisor has provided very good support to MIME in specifying and implementing the Rural Energy Strategy Program and also more generally in supporting MIME in sector development activities. The TA was found to be achieved.

- A master plan for Power Sector Development was carried out by the international consulting firm in 2006. The above activity is completed and closed.

- Before the RETP, the sources of energy used by the beneficiary households were car battery, generator, kerosene lamp and candle, and use of car battery as energy source was more popular among the beneficiary households.

- The rapid beneficiary survey found that the average money spent by the beneficiary households was USD 14.35 per month before the RETP, whereas, it was USD 20.03 per month after the RETP. Though the average money spent by the beneficiary household increased after the project, but the extent of use of electricity by the beneficiary households was considerably more after the RETP compared to that before the RETP. All the beneficiary households expressed that before the project they were spending comparatively more in terms of the extent of the use of electricity. Those who were using diesel generator as the source of energy before the project told that, before the RETP project, they paid 2200 Riels/kWh (US$0.53/kWh) to 3000 Riels/kWh (US$0.73/kWh). But after the project, they were paying 993 Riels/kWh (US$0.24/kWh) on an average. So, there was significant reduction in the unit cost of electricity after the project. Further, the beneficiary households who were buying electricity from REEs were paying more per kW compared to those who were directly buying from EDC.

- After the project, the beneficiary households received many kinds of benefits such as: better light, better communication, watching TV, use of fan, food processing, study of children, safety and security of the house in the night, listening to radio, etc.

- Significant increase in the income of the beneficiary households was found after the implementation of RETP as compared to that before the implementation of RETP. The average monthly income of the 40 beneficiary households (interviewed) after the implementation of the RETP was estimated as USD 311.38 as against USD 202.50 per month before the implementation of the project, indicating the increase of 53.77 per cent in the average monthly income of the beneficiary households.

- The REEs expressed that the individuals and different organizations used the electricity for food and agriculture processing, carpentry shops, welding shops, vehicle repairs, street light, education in schools, health clinics, etc. in their network areas. Seventy per cent surveyed beneficiary households complained that there were frequent power cuts in their area. All the beneficiary households expressed that the project was environment friendly.

- Among the 10 surveyed beneficiary SHS, the percentage female household members (52.94 per cent), including one female disabled member, was more than that of male members (47.06 per cent). Before the installation of SHS, all the surveyed SHS households were using car battery as source of energy for light. After the installation of SHS in their houses, the beneficiaries were getting better light, and able to watch TV (black and white). Before the installation of SHS, the households were spending USD 1.50 to USD 5.00 per month on car battery, and the average monthly spending on car battery per household was estimated at USD 2.7. The average spending per month per household increased to USD 4.5 after the installation of SHS, and this ranged from USD 3.85 to USD 4.80 per month. Though the average spending of the SHS households on energy increased after the installation SHS, but the households were using the energy to get light and watch TV for long time.

- The average monthly incomes of the SHS households before and after the installation of SHS were estimated at USD 57.20 and USD 86.50 respectively. The above increase in the monthly income of SHS households was partly due to SHS and partly due to the effort of the households. All the surveyed SHS beneficiaries were very happy with SHS, and according to them, SHS was environment friendly.

It is concluded from the above findings that almost all the objectives of the project have been achieved by the implementing agencies. The project activities have helped in raising the incomes of the beneficiary households. It has helped to some household to do their

business. The household members have used the electricity for a number of purposes such as food and other products, agriculture processing, carpentry works, welding works, vehicle repairs, street light, education in schools, health clinics, etc. The SHS households got the benefits like better light, and watching TV. Female household members were found to be more benefitted from the project compared to male members. The project was found to be environment friendly. So the achievement of the objectives of the project is considered as satisfactory.

Key lessons learnt were:

Selection of Households for Installation of SHS and the Need of Additional SHS: It is observed that many rural households had less interest to take 30Wp SHS. Therefore, before the procurement of SHS, proper survey should be conducted in the target area, and the rural households should be explained clearly about the merits and demerits of 50Wp and 30Wp SHS. On the basis of the survey, final list of households requiring SHS of different capacities should be prepared.

Some surveyed households having one SHS need one more additional SHS of 50 Wp. For this, one survey should be conducted, and if possible one more SHS need to be provided to those households.

Generation of Mini and Micro-hydro Power: There was problem in the selection of sites for the generation of mini and micro-hydro power under the project. The study found that the sites selected were not feasible or bankable projects. So, in future, proper care should be taken for the selection of sites for mini and micro-hydro projects, so that, the investors will be willing to invest in those projects.

Frequent Power Cut remained: 80 per cent beneficiary households out of 40 surveyed households in Kampong Speu, Kandal and Takeo provinces complained about frequent power cuts. EDC should look to this matter seriously, and try to solve the problem immediately.

Reduction of REE Tariff Rate: Many beneficiary households, particularly those who were buying electricity from REEs, complained about high tariff rate. In this regard, necessary efforts should be taken to provide electricity at low tariff rate, so that, the rural poor households will benefited much.

Fund to REEs for the Extension of Power Supply to the Remote Areas: Because of the financial benefits given by REF to the REEs under the project, connection of electricity could take place to 50,000 new rural households. During the rapid beneficiary survey, the REEs suggested to provide them fund like interest free loan or loan with very low interest rate, so that, they can extend their grid lines to the remote areas. In this regard, necessary efforts should be taken to provide interest free loan or loan with very low interest rate to the REEs who can supply the electricity to the remote areas, and this will benefit to the people who are living in the remote areas of the country.

Income Generation through Electricity: Generation of income through electricity is strongly related to electricity tariff, access to reliable electricity supply, availability and access to electric appliances and electrical equipment as well as sufficient knowledge to choose, operate, and maintain them, access to row material and market, access to credits, and education. The stakeholders should look into the above factors, which will provide them proper guidance in future for the generation of rural income through use of electricity.

Sustainability of the Project: Infrastructure built under EDC component including high voltage lines, medium voltage lines and National Control Centre will become a part of EDC's supply system. It will generate sufficient revenue from sale of electricity to cover the operation and maintenance costs of these assets. It is expected that the project assets will be sustained for 25 years to 30 years.

The assets built by REEs for providing new connections to 50, 000 households will benefit the households as well as the REEs. These assets also will be sustained for 25 years to 30 years. The sustenance of SHS will depend on proper maintenance of the SHS and the battery by the rural households. As there is no previous experience of operation of SHS in the rural areas of Cambodia, it is difficult to ascertain the final sustainability of the SHS. However, REF is providing maintenance for four years under the hired purchase contract. Hence, it is expected that SHS will work for at least four years.

The TA components of the project have provided capacity building to the officials of EDC, EAC, MIME and the REEs. This has improved their working and capacities.

Relevance of the Project

The project has improved the power sector efficiency and reliability, and reduced electricity supply costs, and improved the standard of living of the people in the rural areas through the extension of grid lines by EDC and REEs, and installation of SHS. Through the extension of grid lines of EDC, 50,000 new connections can take place in the rural areas by January 31, 2012, and another 50,000 new household connections have already been completed through the grid lines of REEs who have got fund from REF under the project.

Thanks to the project, the economic standard of living of the people has improved in the rural area. The tariff rate per unit has decreased considerably. Because of the use of electricity after the project, the beneficiary households received many kinds of benefits such as: better light, better communication, watching TV, use of fan, food processing, study of children, safety and security of the house in the night, listening to radio, etc. The individuals and different organizations could use the electricity for agriculture processing, carpentry shops, welding shops, vehicle repairs, street light, education in schools, health clinics, etc. in the network areas of REEs and EDC.

The SHS sub component benefited the 12,000 rural households living in the remote areas. Because of installation of SHS in the remote, the beneficiary household members were getting better light and watching TV (black and white). The standard of living of SHS households also to some extent could increase because of the project. The female household members were found to be more benefitted from the project compared to male household members. All the activities under the project were found to be environment friendly with very negligible effect on the environment.

The project has also helped to build the capacities of the officials of EDC, REF, EAC and MIME, and REEs. These officials and REEs are helping, and will help in future for rural electrification effectively in the country.

The project has provided immense social and economic benefits to the rural people living in the country. So, the activities of the project are very much relevant for the country like Cambodia. Because the two decades of war and conflict, along with human resources huge destruction of physical infrastructure had brought the country to a very low base. However, Cambodia is of a country in the process of making itself. The growth of the Cambodian economy over the last decade is an important backdrop for the project under examination. According to the 2006 World Bank Report on poverty, "Cambodia has

consolidated peace and achieved economic growth of about 7 per cent per annum. These gains reflect the development, both social and economic upon which Cambodia has embarked, since transitioning from civil war to peace, and from one-party to multi-party politics. The country's peace and economic openings have made rapid growth and relatively rapid poverty reduction. Cambodia's economic growth; peace and political stability has contributed to an environment conductive to project support and interventions, in particular those aimed to improve power sector efficiency and reliability and reduce electricity supply costs, as well as to improve standards of living and foster economic growth in rural areas by expanding rural electricity supplies in order to achieve the Millennium Development Goals. The Rural Electrification and Transmission Project has improved the electricity infrastructure in the country along with strengthening electricity institutions, the regulatory framework and the 'enabling environment' for leading to both urban and rural economic growth.

II. Draft (Bank's) ICR

Draft ICR was circulated on August 6, 2012 to Borrower and Implementing Agencies for comments. Following are summaries of comments from the Borrower and Implementing Agencies:

A. Comments from the Borrower (MEF):

Comments from the Borrower were received on August 14, 2012. The comments were mainly editorial.

B. Comments from the Implementing Agencies:

- **Comments from the EAC:**

  Comments from the EAC were received on August 9, 2012. The main comment was on the reported numbers of licensees. It was suggested that, despite the fact that total licenses of 297 issued by the EAC by the closing date of January 31, 2012, it will be best represented if the number 297 in the report is replaced by 276. (to count only REE doing generation and/or distribution function as on 31-1 2012). It cited that the number of licenses valid at the end of 2011 were 297, out of which one (1) license was issued to EDC, five (5) licenses for transmission, seventeen (17) licenses for Generation which are not involved directly in supply to consumers.

  Team viewed that since the indicator counts "licenses to all IPPs and RREs", it should keep the number 297 as reported earlier.

  Licensees by types of services (source: EAC data August 2012)

EDC (Consolidated Gen + Distr + Trans)	1
Special Purpose Transmission License (SPTL)	5
Generation	17
Consolidated (SPTL + Distribution)	6
Consolidated (Gen + Distribution)	228
Retail (Distribution)	1
Distribution	41
Total	299

- **Comments from the MIME:**

Response without comments was received from MIME on August 10, 2012

- **Comments from the REF:**

Response without comments was received from REF on August 14, 2012

- **Comments from EDC**

Two comments were received from EDC on August 15, 2012. They sought clarification of two statements in the section 2.1 of the ICR which states that (i) "*RGC and EDC not honoring their financial commitments and lack of transparency in implementation of regulatory rulings and EAC decisions*" and (ii) in Section 2.2 which cited that "*Delays in appointing key PMU staff. Even though two Project Management Units (PMUs) were formally established prior to Credit effectiveness, the implementation of the EDC*".

The task team clarified that the section 2.1 of the ICR refers to PAD, Section 2 under Chapter F: "Sustainability and Risks", page 29. It was to reassess those critical risks identified during preparation stage if they were properly rated. Section 2.2 of the ICR reflects the critical delays identified by Bank's super vision mission in October 2005 which were documented and communicated with the RGC in the Bank's management letter dated December 1, 2005. EDC confirmed it was satisfaction with the clarification provided.

ANNEX 8

COMMENTS OF COFINANCIERS AND OTHER PARTNERS/STAKEHOLDERS

Minor comments in writing from the ADB (co-financier) were received on August 15, 2012. The comments included that:

- Is it necessary to reflect the change of the transmission line capacity is from 220kV at appraisal to 230 kV as constructed;
- The ADB report at project completion is called Project Completion Report (PCR), but not ICR, and
- The actual total cost financed by ADB is $38.90 million and the actual total cost financed by NDF is 12.91 million

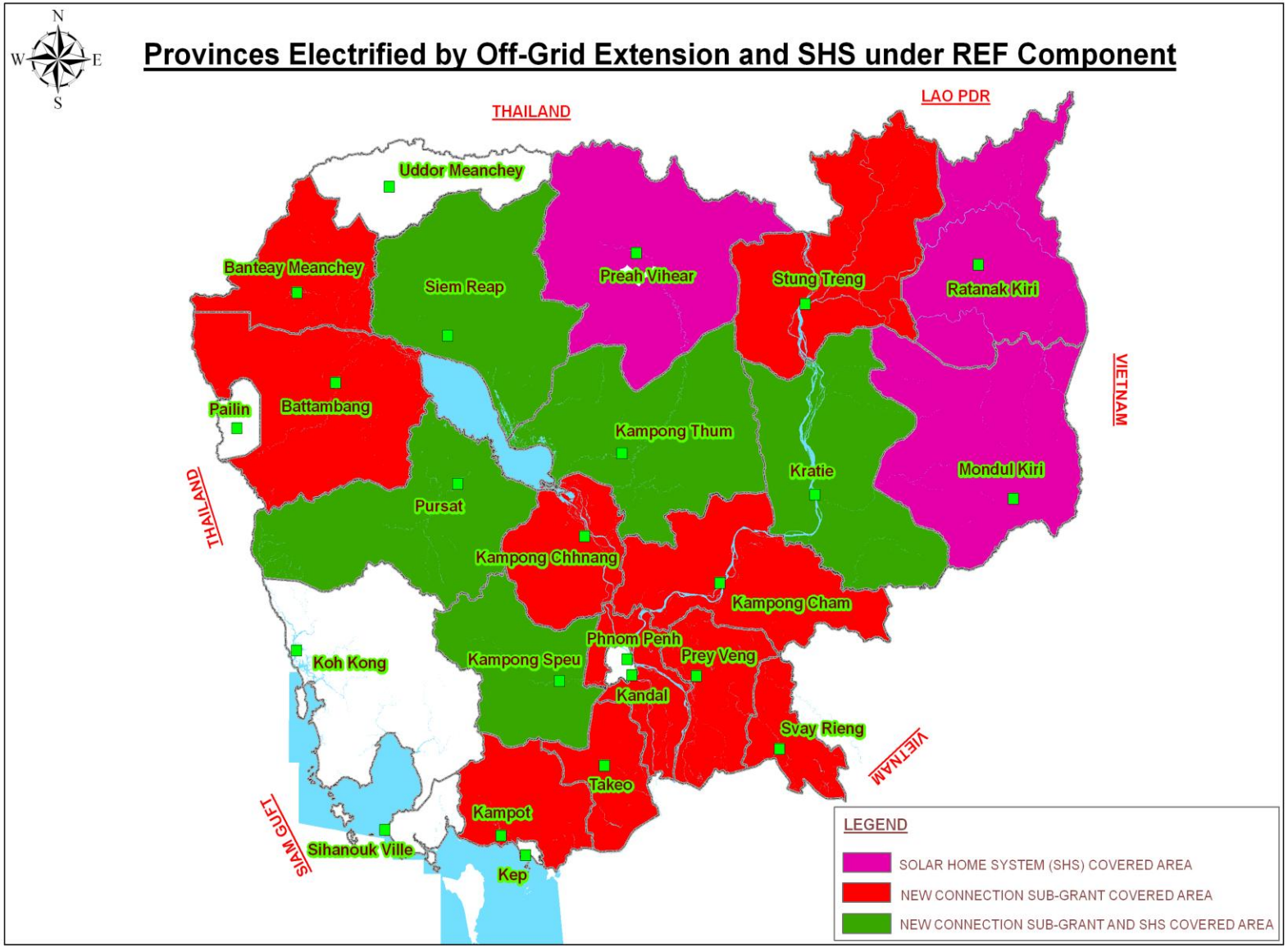
All ADB comments were incorporated.

ANNEX 9

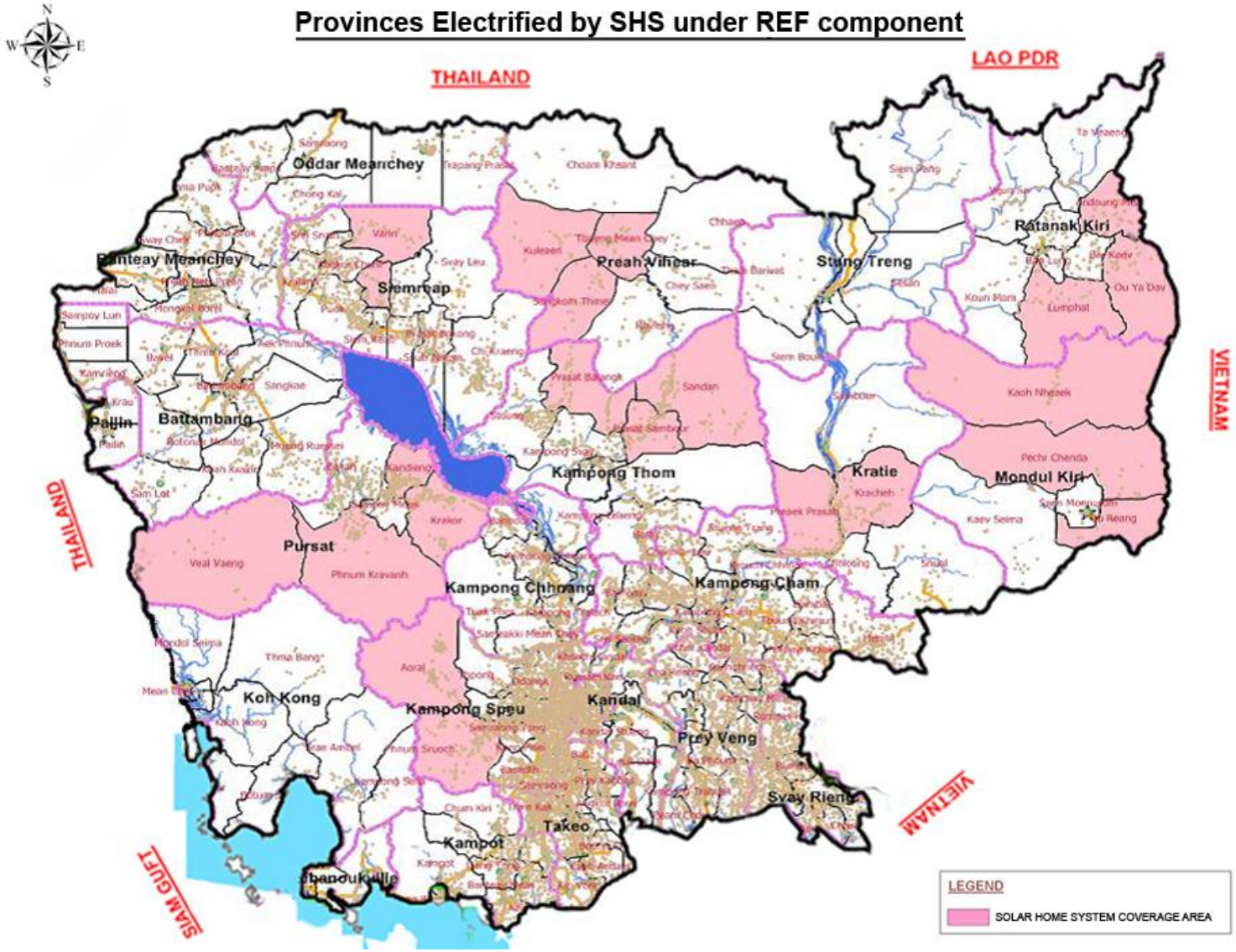
LIST OF SUPPORTING DOCUMENTS

1. Country Assistance Strategy (CAS), 2000
2. Project Implementation Plan, March 2003
3. Project Appraisal Document, November 21, 2003
4. Environmental Management Plan (EMP), March 1, 2004
5. Project Agreement, November 15, 2004
6. Resettlement Action Plan (RAP), January 2005
7. Power Master Plan, 2006
8. Energy Sector Review Strategy, 2006
9. Financing Agreement, August 14, 2007
10. Cambodia General Census 2008
11. Safeguards Implementation Review, 2009
12. Cambodia Rural Electrification Strategy and Implementation Plan – Final Report, December 31, 2009
13. Cambodia Regulatory Strategies for the Development of the Electricity Distribution Market – Final Report, April 2010
14. EDC Annual Report 2005 – 2010
15. EAC Annual Report 2005 – 2010
16. Project Paper for Restructuring, February 2010
17. Borrower Implementation Completion Report, 2011
18. Supervision of Installation, Collection of Payments and Maintenance of Solar Home System (SHS) - Completion Report, March 26, 2012
19. Aide Memoires, Back-to-Office Report
20. Project Progress Reports

MAP 1: PROVINCES ELECTRIFIED BY OFF-GRID AND SHS UNDER REF COMPONENT



MAP 2: PROVINCES ELECTRIFIED BY SHS UNDER REF COMPONENT



MAP 3: PROVINCES ELECTRIFIED BY GRID EXTENSION UNDER EDC COMPONENT