Document of
The World Bank

Report No: ICR3582

IMPLEMENTATION COMPLETION AND RESULTS REPORT

(IDA-H5380 TF-98662)

ON AN

INTERNATIONAL DEVELOPMENT ASSOCIATION GRANT

IN THE AMOUNT OF SDR 12.6 MILLION

(US$20 MILLION EQUIVALENT)

AND A

GLOBAL ENVIRONMENTAL FACILITY GRANT

IN THE AMOUNT OF US$1.818 MILLION

TO THE

LAO PEOPLE'S DEMOCRATIC REPUBLIC

FOR THE

RURAL ELECTRIFICATION PHASE II PROJECT

December 17, 2015

Energy and Extractives Global Practice
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective September 30, 2015)

Currency Unit = LAK

LAK 8150.5 = US$1

US$1.40374 = SDR 1

FISCAL YEAR

January 1 – December 31

ABBREVIATIONS AND ACRONYMS

APL	Adaptable Program Loan
DSM	Demand-side Management
DSCR	Debt-Service Coverage Ratio
CFL	Compact Fluorescent Lightbulb
EdL	*Electricité du Laos*
EdL-Gen	EdL Generation Company
EE	Energy Efficiency
EIRR	Economic Internal Rate of Return
ESMAP	Energy Sector Management Assistance Program
FAP1	2005–2011 Action Plan for Financial Sustainability of the Power Sector in Lao PDR
FAP2	2013–2017 Action Plan for Financial Sustainability of the Power Sector in Lao PDR
FIRR	Financial Internal Rate of Return
GEF	Global Environment Facility
GEO	Global Environmental Objective
GHG	Greenhouse Gas
ICR	Implementation Completion and Results Report
IDA	International Development Association
IEG	Independent Evaluation Group
IFC	International Finance Corporation
ISR	Implementation Status and Results Report
IT	Information Technology
Lao PDR	Lao People's Democratic Republic
M&E	Monitoring and Evaluation
MEM	Ministry of Energy and Mines
MoF	Ministry of Finance
NORAD	Norwegian Agency for Development Cooperation
NPV	Net Present Value
P2P	'Power to the Poor' program
PAD	Project Appraisal Document
PDO	Project Development Objective
PESCOs	Provincial Electrification Service Companies
PGIP	Power Grid Improvement Project
PRSO	Poverty Reduction Support Operation

RE	Rural Electrification
REF	Rural Electrification Fund
REP I/II	Rural Electrification Phase I/II Project
SHS	Solar Photovoltaic Home System
SPRE	Southern Provinces Rural Electrification Project
T&D	Transmission and Distribution
TA	Technical Assistance/Advisory Services

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LAO PEOPLE'S DEMOCRATIC REPUBLIC
Lao PDR Rural Electrification Phase II Project Implementation Completion and Results Report

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A. Basic Information

Country:	Lao People's Democratic Republic	Project Name:	Rural Electrification Phase II Project
Project ID:	P110978, P117177	L/C/TF Number(s):	IDA-H5380,TF-98662
ICR Date:	December 17, 2015	ICR Type:	Core ICR
Lending Instrument:	Adaptable Program Loan (APL)	Borrower:	Lao People's Democratic Republic
Original Total Commitment:	SDR 12.6 million, US$1.82 million	Disbursed Amount:	SDR 11.45 million, US$1.82 million
	Environmental Category: B	**Focal Area**: Multi-focal area	
	Implementing Agencies: *Electricité du Laos* (EdL); Ministry of Energy and Mines (MEM)		
	Co-financiers and Other External Partners: Consumers, the EdL, Energy Sector Management Assistance Program (ESMAP), International Finance Corporation (IFC), the MEM, Norwegian Agency for Development Cooperation (NORAD),		

B. Key Dates

Process	IDA P110978		GEF P117177	
	Original Date	Revised / Actual Date	Original Date	Revised / Actual Date
Concept Review:	Aug 14, 2009	Aug 14, 2009	Apr 27, 2006	Aug 14, 2009
Appraisal:	Oct 07, 2009	Oct 07, 2009	Jul 6, 2009	Oct 21, 2009
Approval:	Jan 12, 2010	Jan 12, 2010	Sep 29, 2009	Feb 22, 2011
Effectiveness:	Feb 28, 2010	Aug 09, 2010	May 5, 2011	Aug 17, 2011

Process	IDA P110978 and GEF P117177	
	Original Date	Revised / Actual Date
Midterm Review:	Mar 25, 2013	May 22, 2013
Restructuring:	Dec 24, 2013	Dec 24, 2013
Implementation End:	Dec 31, 2013	Jun 30, 2015
Closing:	Jun 30, 2014	Jun 30, 2015

C. Ratings Summary

C.1 Performance Rating by ICR	
Development Outcome:	Moderately Satisfactory
Risk to Development Outcome:	Moderate

C.2 Ratings of Bank and Borrower Performance (by ICR)			
Bank Performance		Borrower Performance	
Overall:	Moderately Satisfactory	Overall:	Moderately Satisfactory
Quality at Entry:	Satisfactory	Government:	Satisfactory

Quality of Supervision:	Moderately Satisfactory	Implementing Agencies:	Moderately Satisfactory

C.3 Quality at Entry and Implementation Performance Indicators

Implementation Performance		Quality Assurance Group Assessments	
Potential Problem Project at any time:	Yes	Quality at Entry Assessment:	None
Problem Project at any time:	Yes	Quality of Supervision Assessment:	None

Development Outcome Rating before Closing:	Moderately Satisfactory

D. Sector and Theme Codes

	IDA P110978		GEF P117177	
	Original	Actual	Original	Actual
Sector Code (as % of total Bank financing)				
Energy efficiency in Heat and Power	7	9	44	67
Other Renewable Energy	20	10	–	29
Public administration - Energy and mining	–	7	2	–
Transmission and Distribution of Electricity	73	74	54	4
Theme Code (as % of total Bank financing)				
Climate change	18	19	67	96
Regulation and competition policy	–	–	5	–
Rural services and infrastructure	82	81	28	4

E. Bank Staff

Position	At ICR	At Approval
Regional Vice President:	Axel van Trotsenburg	James W. Adams
Country Director:	Ulrich Zachau	Annette Dixon
Manager:	Julia M. Fraser (Practice Manager, Energy & Extractives)	Narasimham Vijay Jagannathan (Sustainable Development Leader) at IDA approval; Jeeva A. Perumalpillai-Essex (Sustainable Development Leader) at GEF approval.
Task Team Leader:	Rome Chavapricha	Jie Tang
ICR Team Leader:	Rome Chavapricha	
ICR Primary Author:	Alan David Lee	

F. Results Framework Analysis

Project Development Objective

The project development objectives (PDOs), according to both the Project Appraisal Document (PAD) and IDA Financing Agreement, were to (a) increase access to electricity of rural households

in villages of the project provinces and (b) further improve the financial performance of *Electricité du Laos* (EdL).

Revised Project Development Objectives

The PDOs remained unchanged throughout the project.

Global Environment Objectives

The global environment objectives (GEOs), according to the GEF Project Paper, were to (a) increase efficiency of energy supply by the EdL and consumption by consumers and (b) adopt substantial renewable energy in the government's rural electrification program. The GEF Grant Agreement restates the PDOs, identical to the PAD and IDA Financing Agreement, and does not state the GEOs.

Revised Global Environment Objectives

The GEOs remained unchanged throughout the project.

Project Development Objective Indicators

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Value at Completion or Target Years
PDO Indicator 1. Households electrified				
Number	0	37,700	n.a.	47,255
Date Achieved	31-Dec-2009	31-Dec-2013	–	30-Jun-2015
Comments (including % achievement): This target outcome has been exceeded. The indicator is the sum of grid and off-grid connections (Intermediate Outcome Indicators 1 and 5). The value at completion is 126% of the 37,700 target value approved with the IDA grant. The target value was not formally revised but would be 47,000 accounting for subsequent IFC co-financing. The value at completion still exceeds this higher target by 0.5%. The outcome corresponds to an estimated 248,000 people provided with electricity.				
PDO Indicator 2. Rate of return on revalued assets				
Months	< 1%	4%	Dropped	n.a.
Date Achieved	31-Dec-2009	31-Dec-2013	24-Dec-2013	–
This indicator was dropped at restructuring in 2013 because it was no longer meaningful at the EdL level, as the EdL Generation Company (a subsidiary established in 2010) accrues most profits.				
PDO Indicator 3. Debt-service coverage ratio				
Ratio	> 1.3	> 1.3	> 1.1	1.9
Date Achieved	31-Dec-2009	31-Dec-2013	24-Dec-2013	31-Dec-2014

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Value at Completion or Target Years
This target outcome has been exceeded. The value at completion is 173% of the target's minimum value. Debt-service coverage ratio is defined as EdL Group's net revenues divided by debt service requirements for a given fiscal year.				
PDO Indicator 4. Self-financing ratio				
Percent	> 15%	> 15%	Dropped	n.a.
Date Achieved	31-Dec-2009	31-Dec-2013	24-Dec-2013	-
This indicator was dropped at restructuring in 2013 as EdL Group was substantially increasing investments in assets such that the target may not have been met.				
PDO Indicator 5. Account receivables from government agencies				
Months	20	< 3	n.a.	18
Date Achieved	31-Dec-2009	31-Dec-2013	-	30-Jun-2015
This target outcome had not yet been achieved by completion due to factors outside project activities, in particular the budget allocations of government agencies.				

Intermediate Outcome (IO) Indicators

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Value at Completion or Target Years
IO Indicator 1: Households electrified—grid				
Number	0	27,700	n.a.	37,614
Date Achieved	31-Dec-2009	31-Dec-2013	-	30-Jun-2015
This target outcome has been exceeded. The value at completion is 136% of the 27,700 target value approved with the IDA grant. The target value was not formally revised but would be 37,000, accounting for subsequent IFC co-financing. The value at completion still exceeds this higher target by 1.7%. The outcome corresponds to an estimated 196,000 people provided with grid electricity. This includes 16,010 households (twice the 8,000 expected at appraisal) under the 'Power to the Poor' program (P2P).				
IO Indicator 2: Distribution lines constructed under the project				
Kilometers	0	1,209	n.a.	2,232
Date Achieved	31-Dec-2009	31-Dec-2013	-	30-Jun-2015

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Value at Completion or Target Years
Comment: This target outcome has been exceeded. The value at completion is 185% of the target.				
IO Indicator 3: EdL distribution system loss				
Percent	> 13%	< 13%	11%	13.1%
Date Achieved	31-Dec-2009	31-Dec-2013	24-Dec-2013	31-Dec-2014
This target outcome was not yet achieved at completion. The value at completion, measured per year, is 0.1 percentage points above the original 13% maximum target value approved with the IDA grant, and 2.1 percentage points above the revised 11% target value subsequently approved with the GEF additional grant. The project enhanced the EdL's capacity to measure and reduce distribution system loss. The value at completion, however, is largely attributable to factors outside project activities.				
IO Indicator 4: Measurable increase in awareness and adoption of energy efficiency technologies & practices by consumers				
Number or share of consumers	10 government agencies under REP I	80% of central government agencies	(a) Awareness: 100% central government agencies, 100 large consumers including 50 industrial and commercial consumers in Vientiane (b) Adoption: 50 agencies, 4 hospitals, 4 large commercial consumers	(a) Awareness: 100% agencies in Vientiane. At least 9 other large consumers. (b) Adoption: 24 government, 3 hospital, and 23 other public buildings in Vientiane. Thousands of residents and shops nationally.
Date Achieved	31-Dec-2009	31-Dec-2013	24-Dec-2013	7-Feb-2015
This outcome has been achieved, with a broader scope of energy efficiency (EE) technology and practice adoption than the target value and a narrower scope of EE awareness activities. The original target was approved with the IDA grant, and a revised target was approved with the GEF additional grant. Awareness campaigns and posters were provided to all government buildings in Vientiane. Fifty public sector buildings in Vientiane were retrofitted, saving equivalent to at least 200 MWh/year. Efficient lamps distributed to households and shops nationally are saving around 9 GWh/year.				

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Value at Completion or Target Years
IO Indicator 5: Households electrified—off-grid				
Number	0	10,000	n.a.	9,641
Date Achieved	2009	31-Dec-2013	-	30-Jun-2015
This target outcome has been achieved. The value at completion is 96% of the target value. The outcome corresponds to an estimated 52,000 people provided with off-grid electricity. The indicator counts the proportion of 10,000 solar home systems attributed to REP II finance, which are in use or being installed at completion (9,601), plus households connected to the village hydropower installed (40).				
IO Indicator 6: Rural electrification projects with financial support of the Rural Electrification Fund				
Number	0	3	n.a.	3
Date Achieved	31-Dec-2009	31-Dec-2013	-	30-Jun-2015
This target outcome has been achieved 100%, counting the biogas turbine, village hydro stations, and solar home systems, as one project each.				

G. Ratings of Project Performance in Implementation Status and Results Reports

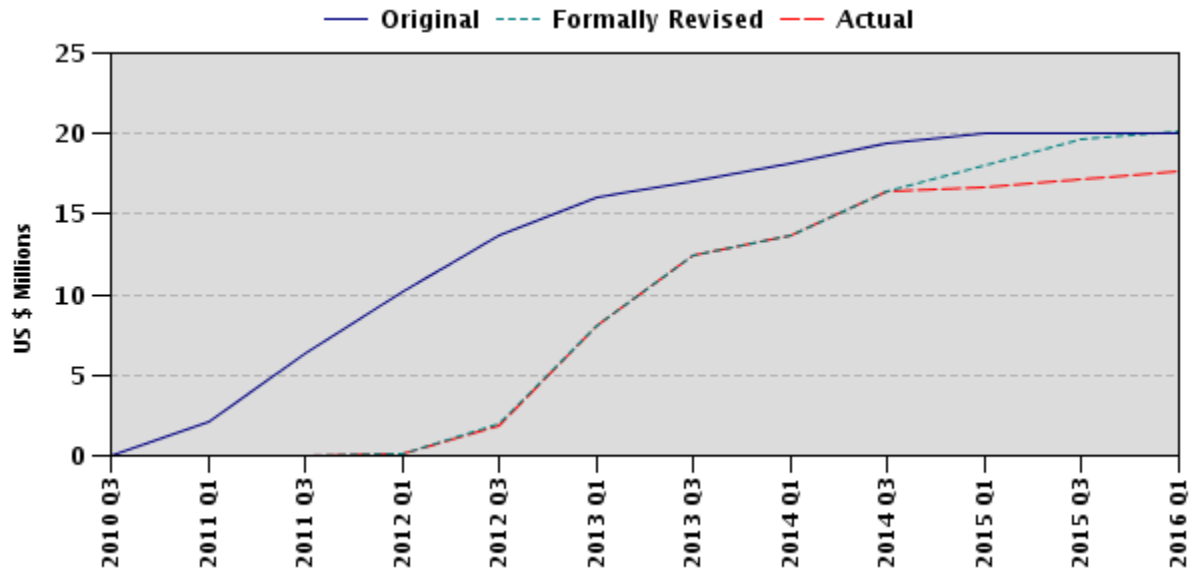
No.	Date ISR Archived	Project Development Objectives	Global Environment Objectives	Implementation Progress	Actual Disbursements (US$, millions)	
					IDA	GEF
1	06/13/2011	S	S	S	0.07	0.00
2	09/28/2011	S	S	MS	0.07	0.00
3	12/10/2012	MS	MS	MS	12.00	0.05
4	10/22/2013	MS	MU	MU	13.66	0.61
5	06/14/2014	MS	MU	MU	16.35	0.65
6	12/05/2014	MS	MS	MS	16.96	0.84
7	06/15/2015	MS	MU	MS	17.18	1.05

H. Restructuring

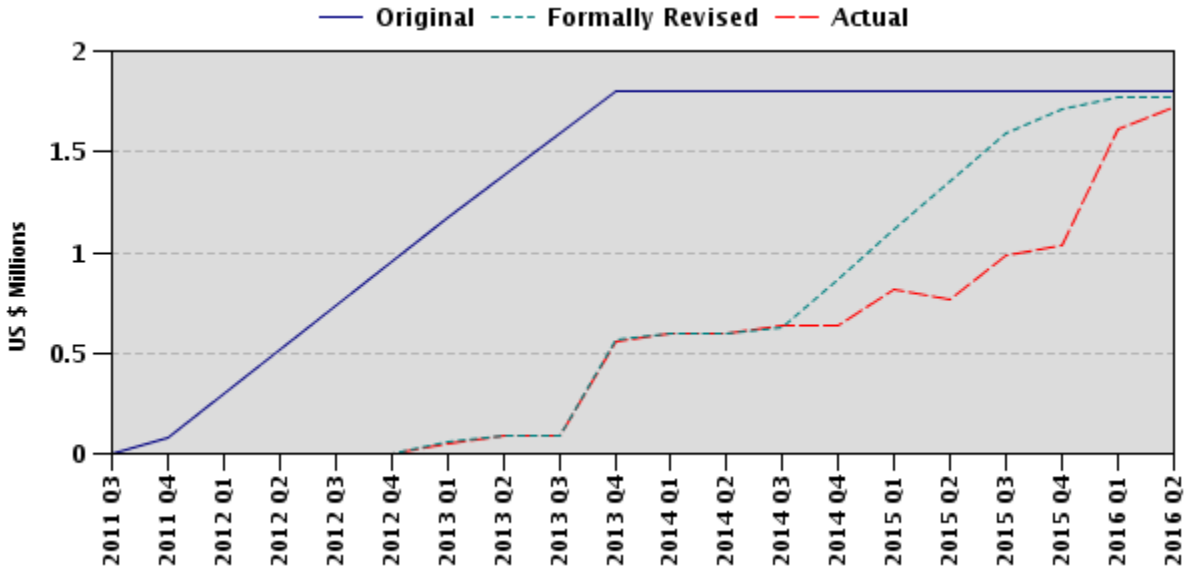
	Restructuring Date(s)	Board Approved		ISR Ratings at Restructuring			Amount Disbursed at Restructuring in US$, millions	
		PDO Change	GEO Change	DO	GEO	IP	IDA	GEF
	12/24/2013	No change	No change	MS	MU	MU	15.79	0.61
Reason for Restructuring and Key Changes Made	(a) Financial performance indicators changed (debt-service coverage ratio minimum revised from 1.3 to 1.1; rate of return on revalued assets dropped; self-financing ratio dropped) to account for the spin-off of the EdL Generation Company from the EdL; (b) private-public partnerships added to the procurement method for biogas and village hydro stations; (c) Disbursement category 'Incremental Operating Costs' definition expanded to include contract staff salaries and bank account charges; (d) Closing date extended 12 months to ensure adequate time to complete grid, village hydro, and biogas activities; (e) Minor changes to component descriptions and finance allocations among components to reflect evolving needs.							

I. Disbursement Profile

IDA (P110978)



GEF (P117177)


Original
Formally Revised
Actual
US $ Millions
2
1.5
1
0.5
0
2011 Q3
2011 Q4
2012 Q1
2012 Q2
2012 Q3
2012 Q4
2013 Q1
2013 Q2
2013 Q3
2013 Q4
2014 Q1
2014 Q2
2014 Q3
2014 Q4
2015 Q1
2015 Q2
2015 Q3
2015 Q4
2016 Q1
2016 Q2

1. Project Context, Development Objectives, and Design

1.1 Context at Appraisal

1. The Lao People's Democratic Republic (Lao PDR) in 2008 had 5.9 million people (growing around 2 percent per year), with 73 percent in rural areas and 27 percent below the poverty line. The share of households with electricity was 69 percent in 2009, up from 16 percent in 1995. Building on this success, and in the context of the development of significant hydropower resources, the government's long-term goals were to electrify 80 percent of all households by 2015 and 90 percent by 2020. The government also sought to promote off-grid solar and other renewable energy options in rural areas where grid extension would be prohibitively costly, recognizing that increased access to electricity improves living standards and helps reduce poverty, especially for women who spend time gathering fuelwood and on other chores at the expense of other more productive activities.[1] The World Bank Group Country Assistance Strategy 2005–2008 (still effective in 2009) is aligned with the government's plans by designating support to targeted investments for rural electrification (RE) infrastructure and improving the financing and management of infrastructure assets.

2. A key commitment of the government, and state-owned utility *Electricité du Laos* (EdL) under the Ministry of Energy and Mines (MEM), was the 2005–2011 Action Plan for Financial Sustainability of the Power Sector (FAP1). FAP1 sought to balance the government's social objective of affordable electricity with the EdL's commercial profitability. Its measures included tariff reforms, settlement of government arrears, efficiency improvements, and institutional restructuring. Developed with the World Bank Group's assistance, through the 1998–2004 Southern Provinces Rural Electrification (SPRE) Project, FAP1 was explicitly designed to ensure that the government and the EdL could comply with agreed financial covenants of anticipated, further World Bank assistance.

3. International Development Association (IDA) and Global Environment Facility (GEF) finance was subsequently agreed in 2006 for an RE Adaptable Program Loan (APL).[2] The overall APL objectives were to (a) increase access to electricity of rural households in villages of targeted provinces and (b) achieve sustainability of power sector development.[3] The APL began with a Phase I Project (REP I) that defined 24 triggers of satisfactory progress when finance could be committed to a Phase II Project (REP II). By 2009, 20 of the triggers were met, one had been dropped, and the other three (concerning electrification) were expected to be met by REP I's extended completion date in 2012.[4] REP II was thus prepared on this basis.

4. The rationale of World Bank assistance through the Rural Electrification Phase II Project ('REP II' or 'the project') was to provide (a) concessional finance for capital subsidies that are

[1] 2003 National Growth and Poverty Eradication Strategy; 2006 National Socio-Economic Development Plan.
[2] APLs were an instrument (no longer active) for long-term flexible support, in which phases would continue until goals were achieved or parameters no longer held. For REP I and II, IDA and GEF finance was grants (not loans).
[3] Specifically, the APL aimed to "provide access to electricity to some 106,000 rural households; achieve financial sustainability of EdL; promote development of legal, regulatory, and institutional framework; encourage other participants in sector development; provide a sound planning basis for electrification; and increase the efficiency of electricity delivery and consumption" (REP I Project Appraisal Document 2006, 4).
[4] All three remaining triggers were later met as expected. After completion in 2012, REP I outcomes, risk, and performance were all rated satisfactory or moderately satisfactory (Independent Evaluation Group (IEG) 2015).

vital to electrify rural areas; (b) a means to attract and leverage other finance including from the private sector; and (c) global knowledge to inform policy reform and capacity building, combined with local knowledge from support to electrification in Lao PDR since 1987. While REP II was prepared as a blend of IDA and GEF finance, each was processed separately due to a delay in GEF allocations. The IDA US$20 million grant agreement was signed in February 2010, and the GEF US$1.818 million additional grant was signed in May 2011. A total of US$15.8 million in co-financing from the consumers, the EdL, Energy Sector Management Assistance Program (ESMAP), International Finance Corporation (IFC), Norwegian Agency for Development Cooperation (NORAD), and the MEM was estimated at appraisal (see annex 1 for details).

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

5. The project objectives, according to both the Project Appraisal Document (PAD) and Financing Agreement, were to (a) increase access to electricity of rural households in villages of the project provinces and (b) further improve the financial performance of the EdL. Results indicators to measure achievement of these objectives, according to the PAD, were as follows:

Result indicators for development objectives

a) Household*s electrified.* Baseline: 0; Target 37,700
b) *Debt-service coverage ratio (DSCR).* Baseline: 1.3; Target: > 1.3
c) *Months of accounts receivable from government agencies.* Baseline: 20 months; Target: < 3 months
d) *Rate of return on revalued assets.* Baseline: < 1 percent; Target: 4 percent
e) *Self-financing ratio.* Baseline: > 15 percent; Target > 15 percent

Result indicators for each component

Electricité du Laos Component

a) *Households electrified—grid*. Baseline: 0; Target 27,700.
b) *Distribution lines constructed.* Baseline: zero; Target: 1,209 km.
c) *EdL distribution system loss*. Baseline: > 13 percent; Target < 13 percent.
d) *Measurable increase in awareness and adoption of energy efficiency (EE) technologies.* Baseline: 10 government agencies under REP I. Target: 80 percent of central government agencies.

Ministry of Electricity and Mines Component

a) Households electrified—off-grid. Baseline: 0; Target: 10,000.
b) RE projects with financial support of the Rural Electrification Fund (REF). Baseline: 0; Target: 3

1.3 Original Global Environment Objectives (GEOs) and Key Indicators

6. The GEF additional grant supports the PDOs as stated above. The GEOs of the GEF grant, according to the GEF Project Paper, were to (a) increase efficiency of energy supply by the EdL

and consumption by consumers and (b) adopt substantial renewable energy in the government's RE program. The GEF Project Paper specifies four outcome indicators as follows:

(a) *Measureable increase in awareness and adoption of EE technologies and practices by consumers.*

(i) *Awareness.* Baseline: 50 government agencies; Target: 100 percent central government agencies, 100 large consumers, including 50 industrial and commercial consumers in Vientiane

(ii) *Adoption.* Baseline: 4 central government agency buildings; Target: 50 government agencies, 4 hospitals, 4 large commercial consumers

(b) *Reduction of the EdL's distribution system loss.* Baseline: > 13 percent; Target: 11 percent

(c) *Newly installed renewable energy generation capacity.* Baseline: 0; Target: 0.3 MW.

(d) *Cumulative greenhouse gas (GHG) emissions reduction.* Baseline: 0; Target: about 300 kt CO_2 equivalent

1.4 Revised PDO (as Approved by Original Approving Authority) and Key Indicators, and Reasons/Justification

7. The PDOs remained unchanged throughout the project.

8. Project restructuring in 2013 revised one financial performance indicator and dropped two others, as shown in section 1.8, to retain relevance as external circumstances changed and to rationalize the number of financial indicators to one key indicator. In December 2010, four months after IDA credit effectiveness, the government created the EdL Generation Company (EdL-Gen) as a separate business, owned 75 percent by the EdL and 25 percent listed on Lao PDR's stock exchange.

- PDO Indicator 2 'Rate of return on revalue assets': Dropped, as it was no longer meaningful at the EdL level as EdL- Gen level accrues most profits.

- PDO Indicator 3 'Debt service coverage ratio': Target value reduced from minimum 1.3 to 1.1 to account for lower expected profits at the EdL level.

- PDO Indicator 4 'Self-financing ratio': Dropped, as the EdL and the EdL-Gen were substantially increasing new investment in generation and transmission and distribution (T&D) assets. During this investment ramp-up period, the 15 percent self-financing ratio (after debt repayments) may not have been met.

1.5 Revised GEO and Key Indicators

9. The GEOs and associated indicators remained unchanged during the project.

1.6 Main Beneficiaries

10. The main beneficiaries comprised 47,000 rural households across all provinces of Lao PDR, to be provided with access to grid or off-grid electricity.[5] The design anticipated 8,000 low-income households would receive zero-interest loans to finance grid connection costs under the 'Power to the Poor (P2P) program. Surveys indicated that female-headed households and people with disabilities made up a significant share of P2P beneficiaries. The EdL itself was to benefit from improved financial performance including from reduced power system losses and EE measures. Demand-side management (DSM) would also reduce the power bills of customers.

1.7 Original Components (as approved)

11. The project had two components, each with five parts, as follows.

- **A. *Electricité du Laos* Component**

  A.1. Grid Extension: (a) Install and commission medium and low-voltage lines, transformers, and house wiring to cover about 27,700 households and (b) provide technical advisory services (TA) to the EdL in (i) project implementation and supervision and (ii) building capacity for economic and financial evaluation, project management, and procurement.

  A.2. Loss Reduction: (a) Enhance loss reduction efforts through the provision of goods to support the implementation of prioritized investment projects recommended by the Loss Reduction Master Plan and (b) provide TA for nontechnical loss reduction activities.

  A.3. Information Technology System and Financial Management: TA to (a) integrate EdL headquarters and branch offices in the project provinces by making the existing information technology (IT) system fully operational and (b) strengthen the EdL's financial management capacity.

  A.4. Safeguards Capacity Building: Equipment and training to the EdL and its provincial branch offices to strengthen their capacity in environmental and social impacts assessment and impact management.

  A.5. Demand-Side Management and Energy Efficiency Program: (a) Financial resources to purchase goods, including computers, office equipment, testing instruments, and meters, needed to support the implementation of the actions as recommended in the DSM and EE Master Plan and (b) TA to support the implementation of the actions.

- **B. Ministry of Energy and Mines Component**

[5] Seven project provinces benefited from both grid and off-grid electrification: Bolikhamxay, Khammouane, Savannakhet, Salavan, Xekong, Champasak, and Attapeu. Nine others benefited from off-grid electrification only: Vientiane, Oudomxai, Luangnamtha, Luangprabang, Xaignabouly, Xiengkhuang, Houaphan, Phongsaly, and Bokeo.

B.1. Off-Grid Investment Program: Provide electricity to about 10,000 households by developing off-grid renewable technologies including solar photovoltaic home systems (SHSs) and pico hydro.

B.2. Institutional Strengthening: TA for (a) implementation of the MEM's program of management outsourcing and (b) monitoring performance of the MEM's outsourced management and Off-Grid Investment Program.

B.3. Alternative RE Delivery Models: TA to (a) promote alternative renewable energy development and develop associated delivery models and financing mechanisms and (b) support small and medium enterprises in income generation linked to the use of the renewable energy.

B.4. RE Master Plan and Database: TA to (a) maintain the MEM's RE database and (b) update the RE Master Plan.

B.5. Organizational strengthening of the MEM: (a) Goods and incremental operating costs to support implementation of the project and (b) TA to (i) support implementation of the project and (ii) support the operation of an REF secretariat.

1.8 Revised Components

12. At project restructuring, minor changes were made to component descriptions and IDA/GEF finance allocations among components to account for, among others, savings in the price of SHSs and public-private partnerships for biogas and village hydro activities (see annex 2 for details).

1.9 Other Significant Changes

13. **Electrification targets.** When the IDA grant was approved on January 12, 2010, the target number of households to be electrified was 27,700 by grid, 10,000 off-grid, and 37,700 in total. The grid target value was based in part on availability of co-financing for grid extension, which the PAD estimated would be US$3.88 million from IFC and US$7.06 million from the EdL and consumers. On January 26, 2010, IFC approved US$15 million co-financing for REP II, with an estimated US$9.50 million co-financing from the EdL and consumers, and a target of 37,000 household grid connections (IFC Board Paper 2010). While IDA targets were not formally revised, the availability of additional financing for 9,300 household grid connections suggests that the project was expected to electrify 47,000 households in total (that is, 37,000 grid plus 10,000 off-grid).

14. **EE indicators.** The GEF approved new target values for EE indicators with the GEF additional grant in 2011, compared to the original target values with the IDA grant in 2010, as follows:

- **EdL distribution system loss (PDO Intermediate Outcome Indicator 3).** Original target: < 13 percent. Target approved with GEF additional grant: 11 percent.

- **Measurable increase in awareness and adoption of EE technologies & practices by consumer (PDO Intermediate Outcome Indicator 4).** Original target: 80 percent of

central government agencies. Target approved with the GEF additional grant: awareness among 100 percent central government agencies and 100 large consumers and adoption by 50 government agencies, 4 hospitals, and 4 large commercial consumers.

15. **Restructuring.** Besides changes to indicators and components as sections 1.4 and 1.8 describe, the project's restructuring in 2013 (a) added public-private partnerships to procurement methods for the village hydro station and biogas investments; (b) expanded the disbursement category definition of Incremental Operating Costs to include contract staff salaries and charges for opening and operating project bank accounts; and (c) extended the closing date from June 30, 2014, to June 30, 2015, to ensure adequate time to complete grid, village hydro, and biogas activities.

2. Key Factors Affecting Implementation and Outcomes

2.1 Project Preparation, Design, and Quality at Entry

16. **Background analysis.** The project built on cumulative experience and long-term engagement of the Bank in the power sector of Lao PDR, including the SPRE and REP I projects, as well as associated studies and socioeconomic surveys, and similar projects in other countries.[6] The triggers for Phase II of the APL were thorough and reflected the implementation progress needed for preparing Phase II.

17. Key lessons that the project incorporated are as follows:

- Sustaining grid electrification to rural areas is costly and requires sound financial performance of the power sector. In response, the project included a focus on improving the EdL's financial performance as an integral part of the World Bank Group efforts to support sectorwide reform, in particular through FAP1.

- About 30 percent of households in villages are generally unable to afford up-front grid connection costs. In response, the project scaled up the P2P with zero-interest financing for households that remained without electricity in villages connected to the grid.

- The MEM needed enhanced staff and capacity to manage off-grid investments. In response the project supported the MEM through TA.

18. **Project objectives and components**. The objectives were clear and simple and advanced the government's commitment to electrify 80 percent of all households by 2015. Grid and off-grid electrification components were realistic and reasonable to achieve the PDOs centered on covenants in the project agreement for the EdL to maintain debt-service coverage, self-financing, and debt-to-equity ratios consistent with FAP1. Project components supported FAP1 measures to improve EE and the financial management system of the EdL. Full implementation of FAP1,

[6] The Bank's Quality Assurance Group in 2007 rated the quality at entry of REP I as satisfactory, with highly satisfactory ratings for strategic relevance, approach, poverty, policy, and institutional aspects. These findings remain broadly relevant given the continuity of design from Phase I to II. See also: IEG 2008 *Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits* and IEG 2008 *Project Performance Assessment Report for Laos SPRE*.

however, depended on tariff reforms and budget allocation to government agencies, which were outside the operation's direct scope.

19. The division of components and associated responsibilities between the EdL and the MEM was clear and simple. The project successfully integrated eight sources of finance across ten subcomponents, which neatly dovetailed with the REP I activities by design, including during the two-year period of concurrent implementation of REP I and REP II. This required sophisticated accounting and coordination to track the combination of financing sources and activities and avoid double counting, which was within the EdL's capabilities. For the MEM, the project recognized the need to supplement internal capacity with external consultants.

20. **Government commitment** to the project was demonstrated by its adoption of FAP1, as well as estimated government co-financing of US$4.05 million for grid extension, loss reduction, and off-grid investment (see annex 1 for details).

21. **Risk.** At appraisal, the project's overall risk was rated substantial before mitigation and moderate with mitigation measures. The Implementation Completion and Results Report (ICR) supports this rating. The PAD appropriately identified seven critical risks (and mitigation measures) related to grid and off-grid electrification, safeguards, procurement, and financial management. A low rating was given to the risk that budget shortfall would delay settlement of government accounts receivable, on the basis of two mitigation measures: (a) implementation and monitoring of FAP1 and (b) coordinated review with all key government agencies under various Bank- and donor-funded projects. This risk was arguably still substantial in hindsight, however, as implementation of FAP1 and associated measures depended on fiscal and political conditions outside project-level controls. Imminent restructuring of the EdL was an additional, moderate risk to the EdL's financial performance, which may have been foreseeable at appraisal since the EdL had been assessing the feasibility of restructure since 2008.[7]

2.2 Implementation

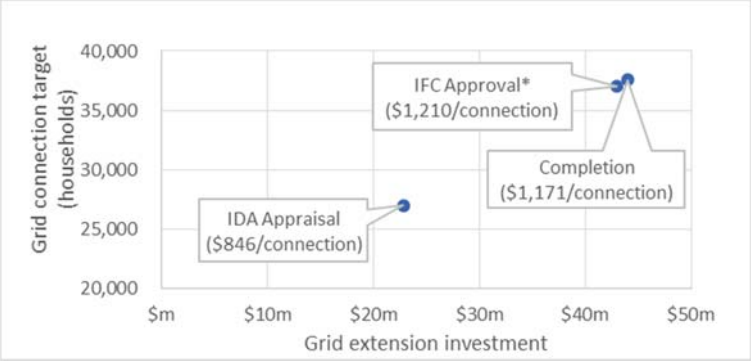
22. Overall implementation was moderately satisfactory, with moderate shortcomings, taking into account progress toward the electrification and financial performance objectives.

23. **The EdL was unequivocally successful electrifying 37,614 households by completion, which was above the target value and double the expected 8,000 households to benefit from the P2P.** A key factor toward this success was the time spent from 2010 to 2012 preparing for implementation of grid extension contracts. The pre-implementation period was longer than planned (the IDA grant became effective five months later than scheduled, and the EdL took 10 months to meet conditions for disbursement of IFC co-financing). Yet the additional time was well spent with the EdL preparing connection contracts with households and identifying households eligible to participate in the P2P. As a result, once grid extension contracts began, implementation swiftly caught up to schedule and led to more households participating in the P2P during the REP II time frame. Technical optimization of grid extension design achieved large cost savings, though the cost per connection inevitably rose as the grid reached more remote villages. Average cost per connection was an estimated US$846 at IDA appraisal and US$1171 at completion (figure 1). The

[7] See Background of EDL-Generation Public Company http://www.edlgen.com.la/en/page.php?post_id=1.

EdL's strong capacity to absorb additional financing to cover costs and increase the grid's reach was underpinned by effective management, adequate quality staffing, and an unwavering commitment for RE from the government.

Figure 1. Grid Extension Connections by Households and Costs from Appraisal to Completion



Note: *Estimates at IFC approval include an unspecified share of IFC finance planned for EE.

24. **The MEM overcame numerous challenges to achieve almost all the target value of 10,000 households with off-grid electricity by completion.** The 'lease-to-own' model for SHSs was an ambitious and commendable effort to provide rural households with a minimum level of electrification in a sustainable manner. Importantly, the design provided for low-cost financing with monthly installments and after-sales service for operation and maintenance (O&M). The model relied on regular visits to every village by contractors to collect household fees and provide O&M support, as well as rigorous monitoring of the contractors. Engaging staff to manage the contractors suffered a two-year delay at the beginning of the project. User payment collections fell from 90 percent before December 2009, to only 3 percent in 2012, prompting the Bank to request suspension of SHS installation in October 2012. Installation resumed in April 2013 after the MEM took remedial measures, including to restructure the business model. Faster than expected grid extension resulted in withdrawals of some of the SHSs from newly electrified areas, often in poor condition and with missing component parts. Contractors had no special incentive to reach the most remote villages that would be electrified later, and redefining off-grid target villages to account for grid extension progress also proved difficult, as authorities and private sector participants did not always follow the RE Master Plan. Nevertheless, the project successfully collected and reused returned systems, and 96 percent of SHSs were in use or installed by closure. At closure, customer payments were 65 percent, and contractors' debts to the MEM were around US$350,000.

25. **One biogas turbine and two mini-hydro stations were commissioned by completion.** Early studies identified up to 15 potential village hydro projects and 7 biogas projects, but several factors contributed to many projects proving unviable. These factors include (a) the unexpectedly high speed of grid extension; (b) pressure to maintain uniform national tariffs for social objectives and the absence of a particular government policy or subsidy for renewable-based electrification delivery schemes (some off-grid projects would have been viable only with higher tariffs or subsidies); and (c) insufficient income-generating activity at village hydro sites. Those projects pursued were successful, with delays (associated with construction and import of parts) successfully accommodated by restructuring in 2013 to extend the project closure to June 2015. Key factors for the viability of the two 25 kW village hydro stations include that the site is

sufficiently remote that grid connection is unlikely in the foreseeable future and the availability of a willing and qualified company to invest through a public-private partnership.

26. **Implementation of measures to improve the EdL's financial performance was mixed, due largely to factors outside the project's control**. Tariff levels are a key factor in the EdL's financial position. In 2010, the government approved tariff reforms in line with FAP1 and implemented them in March 2012 followed by incremental increases each year thereafter. This raised the EdL's revenues substantially. The World Bank's second series of Poverty Reduction Support Operations (PRSOs) (numbers 4–7, 2008–2012) also supported government efforts to eliminate electricity payment arrears between government agencies and the EdL and establish a sustainable mechanism for electricity consumption (annex 10). In 2010, the Ministry of Finance (MoF) established a committee with the EdL to oversee this issue, and in 2011, the ministry confirmed it had fully settled arrears, provided adequate budgetary allocations to government agencies for current electricity consumption for FY2010–11, and agreed with the EdL on a sustainable mechanism for electricity bill payment to ensure no new arrears were accumulated. The 2013–2018 Power Sector Financial Sustainability Action Plan (FAP2) was also developed with the World Bank Group's assistance as a complement to the project and advanced further reforms building on FAP1. By project closure, the EdL Group's financial performance was complete. However, the target to limit accounts receivable from government agencies to less than 3 months was not met due to insufficient budget allocations for relevant agencies to pay power bills. The EdL did not exercise the mechanism agreed under FAP1 to disconnect government customers with excessive arrears.

27. On EE, contracts for DSM measures were implemented successfully, building on planning and pilots undertaken in REP I and enhanced by the contractor's efficient performance and the cooperation between government agencies and other consumers. Loss reduction was on target up to 2012, but several factors adversely affected prospects of meeting the loss reduction target from 2013: (a) disbursement on loss reduction activities was a third of the amount expected (see annex 1 for details) and (b) extension of the grid to serve increasingly remote villages increased system loss over longer lines. The length of distribution lines that the EdL constructed under the project was 85 percent above the target value; 248,000 grid connections that were not financed by REP II were also added to the system from 2010 to 2014.

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

28. **M&E design.** The Results Framework was satisfactory, with some shortcomings at entry. The relevance of indicators to components and objectives is clear and self-evident for electrification. The indicators for financial performance measure outcomes expected to result from compliance with FAP1 rather than outputs of project activities or outcomes directly attributable to projects activities. The loss reduction indicator lacked details of its methodology (for example, it was not clear whether it was measured by month or year and how to account for factors beyond project activities).

29. **M&E implementation was satisfactory, with minor shortcomings.** Data for most indicators were updated once or twice per year, including through seven ISRs completed for the project. For financial performance indicators, statements were audited externally to ensure data quality. EdL-Gen's creation and listing on the Lao stock exchange in 2010 caused concerns that

the EdL (the holding company) might not meet the project's financial performance targets. Restructuring of the project in 2013 revised the financial performance indicators to accommodate these changed circumstances. The loss reduction indicator and its target values would have benefited from review to account for two developments in 2013: (a) a study improved measurement of 'non-technical' (that is, commercial) losses[8] and (b) several large customers served by low-voltage distribution lines switched to medium voltage lines, which caused an extraordinary shift in distribution loss data.

30. **M&E utilization.** Appropriate data were used to evaluate and inform decision making and resource allocation with respect to grid and off-grid electrification. M&E arrangements are sustainable beyond the project to the extent that they use the existing, ongoing systems, which is high for the EdL but not for the MEM due to lack of capacity and unclear arrangements for the ongoing program management.

2.4 Safeguard and Fiduciary Compliance

31. **Safeguards.** The project, categorized 'B,' triggered three policies: OP 4.01 - Environmental Assessment; OP 4.10 - Indigenous Peoples; and OP 4.12 - Involuntary Resettlement. This categorization remains relevant in retrospect. The project complied with Bank safeguards policy without deviations or waivers. Visits to beneficiaries found that issues were explained and understood, and mitigation measures were applied. No severe adverse impacts were reported.[9]

32. **Financial management** was rated Moderately Satisfactory at completion. Satisfactory ratings in the early stages of implementation went to Moderately Unsatisfactory from 2012 to 2013 due to unresolved internal control weaknesses identified by the auditors. After support, the project addressed some of the issues and concerns resulting in an upgrade to Moderately Satisfactory. The EdL and the MEM submitted all required audit reports and interim financial reports (IFRs), but many were late. All project audit reports were unqualified (clean opinion). All EdL entity audit reports were also unqualified except for the year end 2011 when a disclaimer opinion was given. The quality of variance analysis in the IFR improved for the MEM but not for the EdL. Reporting of eligible expenditure paid from the designated accounts for both financing sources was not made on a monthly basis for both implementing entities, resulting in inactive designated accounts status at various stages of implementation.

33. **Procurement was rated Moderately Satisfactory at closing.** The EdL and the MEM managed procurement of goods, works and consultants. All major works, equipment and materials were procured through International Competitive Bidding or National Competitive Bidding (NCB). There were no major issues regarding compliance with Bank procurement guidelines. Procurement activities under each EdL subcomponent were carried out by staff of different EdL departments, which led to some delays in procurement due to lack of procurement experience. In addition, a frequent turnover of the EdL staff (every 2 years) negatively affected procurement performance.

[8] Mercado 2013. The study was supported by REP I financing.

[9] EDL reported unavoidable damage valued at LAK 304 billion (~US$37,900) to an estimated 0.7 ha of land and 10,300 trees from installation of poles and wires across 51 subprojects in 586 villages. Most impacts were "discussed with owners and considered not to be severe and were acceptable" as villagers were compensated through the improvement of community facilities.

All procurement activities under the MEM component were carried out with the assistance of an international procurement specialist.

2.5 Post-completion Operation/Next Phase

34. The World Bank Group 2012–2016 Country Partnership Strategy identifies the EdL's keen interest to continue collaboration with the Bank to increase electricity access in poor rural areas and the need to invest up to US$70 million per year by 2021 as costs increase at the fringes of the grid. Yet, due to the major success of electrification and fast growth of electricity demand, development of Lao PDR's power sector has entered a new 'post-electrification' phase. For this reason, an IDA credit of US$30 million for a Power Grid Improvement Project (PGIP), approved in June 2015, shifts the focus from RE access to improvement of efficiency and reliability of electricity supply. The PGIP nevertheless continues the REP II focal areas of distribution loss reduction (for Xaithany District of Vientiane Province, which has one of the highest loss rates of any district) and upgrading corporate financial management, billing, and collection systems. These will serve to strengthen the EdL's financial performance. The PGIP also aims to help create a favorable environment for scaling up private sector participation in the power sector. The TA for capacity building in the Hydropower and Mining Sectors Project will also help create market and regulatory conditions to strengthen the EdL's financial position and role as a major power operator in the region.

3. Assessment of Outcomes

3.1 Relevance of Objectives, Design, and Implementation

Relevance of Objectives

35. **Rating: High**. The PDO to increase rural electricity access aligns well with government plans and the World Bank Group strategy at both appraisal and completion. The National Socio-Economic Development Plan for 2006–2010 and 2011–2015, respectively, include goals to provide electricity to 70 percent and 80 percent of households. The World Bank Group's 2005–2008 Country Assistance Strategy and 2012–2016 Country Partnership Strategy include support for RE infrastructure investments and for improved management of financing and revenues. The National Socio-Economic Development Plan for 2011–2015 includes a commitment to reform state enterprises (including the EdL), particularly on finance. In addition, the PDO to improve the EdL's financial performance aligns directly with the government's FAP1 and its successor FAP2.

Relevance of design

36. **Rating: Substantial.** The relevance of design, together with the causal chain of components to objectives, was high for electrification and modest for financial performance.

37. The **PDO to electrify households** was supported by finance for goods and TA for grid extension and for SHSs and village hydropower. Effective implementation of these activities was further supported by subcomponents to (a) build the EdL's capacity to manage environmental and social impacts for grid extension; (b) strengthen the MEM's institution and organization of management for the off-grid program; and (c) update the RE Master Plan and database. Targeted

off-grid solutions for remote communities remain relevant at completion for areas still beyond the reach of the grid for the foreseeable future.

38. The **PDO to further improve the EdL's financial performance** was supported by several subcomponents directly and indirectly, as follows: (a) the grid extension component increased customers and therefore potential revenue for the EdL; (b) the component to reduce distribution system losses would allow the EdL to earn more revenue from each unit of power generated; (c) measures to increase consumer EE would reduce their demand at peak times when the EdL had to import costly power from Thailand; and (d) training staff to operate and maintain computerized billing and accounting would allow the EdL to integrate headquarter and branch office systems and strengthen the information it uses to manage finances. At the same time, some of these activities also potentially weaken the EdL's financial position, because (a) grid extension increases system loss since longer lines result in larger technical losses and (b) connecting low-income households under the P2P is not financially rewarding for the EdL. Improving EE was supported by finance for goods and TA to implement the government's 2008 Loss Reduction Master Plan and 2009 DSM and EE Master Plan. The design was not explicit about the scale or direction of effects, or the net effect, of project activities on the EdL's financial performance.

3.2 Achievement of Project Development Objectives

39. **The efficacy of PDOs is rated as Substantial**. The project's Moderately Satisfactory rating before restructuring combines with a Satisfactory rating at completion, weighted according to the 71:29 share of project disbursements before and after restructuring, to give a Moderately Satisfactory rating overall, as shown in table 1. The Moderately Satisfactory rating corresponds to Substantial' on a four-point scale for achievement of the objectives. PDO (a) and PDO (b) are treated as equally important in the absence of an explicit basis to do otherwise.

Table 1. Rating of Achievement of PDOs, Accounting for Restructure

	Before Restructuring	After Restructuring	Overall
1. Rating	Moderately Satisfactory	Satisfactory	–
2. Rating value	4 (out of 6)	5 (out of 6)	–
3. Disbursement before/after restructure[10]	US$37.62 million	US$15.14 million	US$52.76 million
4. Weight (% disbursed before/after restructure)	71.3	28.7	100
5. Weighted value (row 2 x 4)	2.85	1.43	4.29
6. Final PDO rating (rounded)	–	–	Moderately Satisfactory

40. **PDO (a) to increase access to electricity of rural households in villages of project provinces**. **The project exceeded this objective and intended outcomes.** The target approved with the IDA grant was to electrify 37,700 households: 27,700 by grid—including an estimated

[10] World Bank operational policy staff (personal communication, November 19, 2015) advise to use all project financing for this purpose.

8,000 households through the P2P—and 10,000 by off-grid. A grid target of 37,000 households was subsequently approved with IFC co-financing, so 47,000 total connections (37,000 grid and 10,000 off-grid) were expected by completion. At completion, the number of connections was 47,255, corresponding to an estimated 248,000 people with access to electricity.[11] A total of 37,614 households (196,000 people) were connected to the grid—including 16,010 households (75,000 people) through the P2P—and 9,641 households (52,000 people) were connected to off-grid sources. The P2P connection target was exceeded twofold. This is particularly significant as the P2P reached those people otherwise unable to afford connection costs and for whom grid power brings the most welfare benefits (as section 3.5 elaborates). Attribution of grid connections to the project is supported by the intermediate indicator of distribution lines constructed, which was exceeded 85 percent (target: 1,209 km, actual value: 2,232 km). The total number of grid connections achieved through the project is equivalent to around 13 percent of all new grid connections in Lao PDR from 2010 to 2014 (see table 2). REP II thus represents a major contribution to the early achievement of Lao PDR's goal to electrify 80 percent of all households by 2015—a rate already met in 2012. The further goal to electrify 90 percent by 2020 is on track to be met in 2015.

Table 2. Lao PDR Grid Electrification Rates 2006–2014 and RE Project Connections

Year	Total households (HH)	Grid-electrified HHs	Grid-electrified HHs: share of total HHs (%)	Grid-electrified HHs: change from year before
2006	967,420	492,100	51	8,967
2007	954,345	536,727	56	44,627
2008	967,340	597,428	62	60,701
2009	1,011,623	700,547	69	103,119
2010	1,036,773	756,604	73	56,057
2011	1,045,825	821,295	79	64,691
2012	1,066,017	876,762	82	55,467
2013	1,080,342	943,599	87	66,837
2014	1,112,046	986,435	89	42,836
New connections in the period 2006–2014				503,302
REP I grid connections (and as share of new grid connections 2006–2012)				57,039 (14%)
REP II grid connections (and as share of new grid connections 2010–2014)				37,614 (13%)
REP I + II grid connections (as share of new grid connections 2006–2014)				94,653 (19%)

Source: EdL Statistic Yearbooks; REP I ICR; EdL Progress Reports.
Note: Data of total households and grid-electrified households for 2015 are not included in the table as they are not reported until 2016.

41. Off-grid connections include the following:

- **SHSs** for 9,601 households (52,000 people) in use or being installed as of June 2015. About 10,000 SHSs were purchased and up to 100 percent installed during the project lifetime. The number in use or being installed was 96 percent at completion as some

[11] Average number of persons/household is 5.6 for standard grid connections, 4.7 for P2P, and 5.4 for SHSs, from field surveys (Voravate 2013). Population figures for village hydro stations are from the MEM's progress report (2015).

users returned systems once the grid arrived or due to O&M issues. The MEM hopes to install remaining systems in the future.

- **Village hydropower** for about 40 households (226 people) in Houaphanh Province. Two 25 kW pico hydro stations, commissioned in June 2015, serve two villages (Pao Neua and Pao Tai) which have 5.7 people/house on average.

42. **PDO (b) to further improve the financial performance of the EdL. The project partially achieved this objective and intended outcome.** This assessment is based on the key associated indicators: (a) debt-service coverage ratio, which was achieved, and (b) months of accounts receivable rfrom government agencies, which was not achieved. Attribution of the project's impact is stronger for the former indicator than the latter, based on evidence as follows.

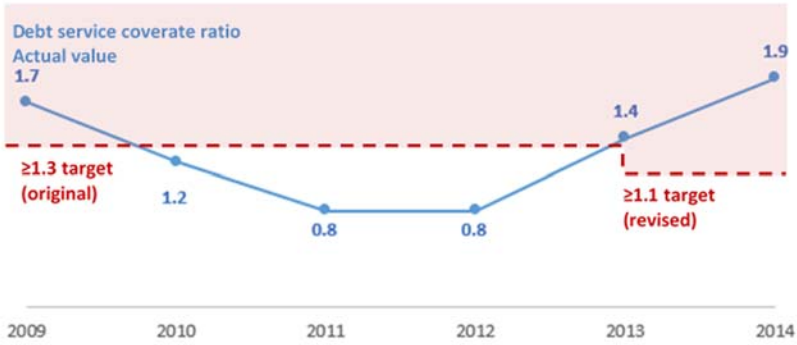
43. DSCR is one of two financial performance indicators in the results framework. It is defined as the ratio of net revenues to their debts service requirements in a given fiscal year. The EdL Group's DSCR in 2014 was 1.9 and thus exceeded the minimum 1.1 target by 72 percent (figure 2)[12].

44. The EdL's revenue and debts are largely attributable to factors, such as tariff reforms, which go beyond specific project activities. Nevertheless, the project is inferred to have contributed positively to EdL finances in general terms. The grid extension, EE, and TA activities under the project align explicitly with FAP1 and FAP2 and thus serve as complementary measures to tariff reform. The fact that FAP2 cites the project's financial performance covenants demonstrates the project's strong influence on the government and the EdL's approach to financial viability of the power sector at large. The impact of the project's TA to improve the EdL's financial management system is not quantifiable but contributes to financial performance by having trained staff to integrate computerized billing and accounting nationwide. The loss reduction target was not met, while the consumer EE target was achieved. However, the impact on EdL finances from these EE activities is imperceptible according to the available evidence (see paragraph 51 for a summary of EE outcomes and annex 11 for details).

45. **Accounts receivable from government agencies** is the other indicator of financial performance in the Result Framework.[13] The target value was not achieved. The value was 18 months at closing, two months better than the 20-month baseline value of 2009 but six times the maximum 3-month target value (figure 3). The project's impact on this indicator derives from alignment with FAP1 and FAP2, which contain specific measures to meet the accounts receivable target. The MoF's decision to centralize billing and payment of government agency electricity accounts, effective from 2015, may help settle the arrears, though an impact of this on accounts receivable was not apparent by project completion.

[12] The EdL stand alone DSCR was about 1.4 (non-consolidated basis).
[13] This is defined as the number of months of sales of electricity needed to recover the amount of money government agencies owe in unpaid bills.

Figure 2. Debt Service Coverage Ratio of the EdL Group 2009–2014*



Note: *DSCR data are from audited financial statements for fiscal years January to December: 2014 is the last before project closing in June 2015. The EdL Group comprises the EdL and subsidiaries, including 75 percent ownership of the EdL-Gen, spun off in December 2010. Source: EDL audited financial statements.

Figure 3. Months of Accounts Receivable from Government Agencies to the EdL, 2009–2014 (December)

Global Environment Objectives

46. The outcome for the GEOs is rated Moderately Satisfactory, based on partial achievement of associated indicators as below.

47. **GEO (a) to increase efficiency of energy supply by the EdL and consumption by consumers,** was partially achieved, as demonstrated by the following two indicators. (For further details of EE outcomes, see annex 11).

- 'Measurable increase in awareness and adoption of EE technologies and practices by consumers' (GEO Indicator 1) was achieved, with a narrower scope of outcome for awareness activities and a broader scope for adoption of EE technology and practices than the approved target values. Retrofitting of public buildings and distribution of efficient lamps to households and small businesses led to an estimated 9.2 GWh/year in energy savings (~0.3 percent of the 3,275 GWh sold to EdL customers in 2013).

- 'Reduction of the EdL's distribution system loss' (GEO Indicator 2) was not yet achieved by completion. The value at completion (measured per year) was 13.1 percent. This is higher than the original 13 percent maximum target value and the 11

percent target value subsequently approved with the GEF additional grant. The value at completion, however, is largely attributable to factors outside project activities.

48. **GEO (b) to adopt substantial renewable energy in RE** was exceeded, as demonstrated by 'newly installed generation capacity' (GEO Indicator 3). The value at completion was 310 kW, which exceeds the target value of 300 kW by 3 percent. The value at completion includes the single 260 kW biogas turbine on a pig farm in Vientiane Province and two 25 kW hydro stations for villages in Houaphanh Province.

49. **Cumulative GHG emissions reductions** (GEO Indicator 4) are not used to evaluate outcome ratings. This is because emissions reductions are a corollary outcome of achieving the GEOs to increase EE and adopt renewable energy. The reduction target of about 30,000 kt CO_2e was not fully achieved, based on the available evidence, though significant emissions reductions can nevertheless be attributed to project activities, as annex 11 details.

3.3 Efficiency

50. **Efficiency rating: High.** Economic and financial analyses were conducted at appraisal for two subcomponents: A.1 Grid Extension and B.1 Off-Grid Investment Program. These subcomponents together represent the bulk of project investment (76 percent as estimated at appraisal or 87 percent of actual investment at completion). The analyses reestimated at completion confirmed that the economic and financial values of A.1 and B.1 were mostly as good as, if not better than, expected, as summarized below (see annex 7).

Table 3. Project Economic Assessment

Component	Economic					
	NPV in 2010		Internal Rate of Return		Benefit Cost Ratio	
	Appraisal	Completion	Appraisal	Completion	Appraisal	Completion
A.1	US$84.5 million	US$137.3	81%	39%	2.8	3.2
B.1	US$209 to US$314 per SHS	US$572/SHS (US$5.5 million total)	22 to 41% per SHS	60%	1.6–1.8	5.1

Note: NPV = Net Present Value.

Table 4. Project Financial Assessment

Component	Financial					
	NPV in 2010		Internal Rate of Return		Benefit Cost Ratio	
	Appraisal	Completion	Appraisal	Completion	Appraisal	Completion
A.1	US$4.5 million	US$2.6 million	15%	5.1	1.1	1.3
B.1	US$44 to US$200 per SHS	US$126/SHS (US$1.2 million total)	−14 to −62% per SHS	−62%	1.5–3.3	2.1

3.4 Justification of Overall Outcome Rating

51. **Overall outcome rating**: **Moderately Satisfactory.** This rating is based on the combination of the aforementioned ratings: (a) high relevance of objectives; (b) substantial relevance of design;

(c) substantial efficacy of PDOs—the intended outcome for RE was exceeded and the intended outcome for improving the EdL's financial performance was partially achieved; and (d) high efficiency.

3.5 Overarching Themes, Other Outcomes, and Impacts

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

52. Evaluation in 2013 found strong benefits from grid connections including income-generation opportunities, reduced time spent by women on chores (from more than 60 minutes down to 23 minutes per night on average), and reduced air pollution exposure, which benefits women and children who spend most time indoors. Compared to a baseline study in 2004, household incomes were three times higher on average, and households owned more assets and spent less share of their income on energy. There was a positive association between grid connections and business activities. P2P participants (16,010 households by completion) particularly benefited from these changes as they tended to be newly formed families with less means (land, education, capital, and assets) to earn income (Tuntivate 2013). About 93 percent of P2P recipients agree that work undertaken by women is easier with electricity. About 90 percent of retail businesses undertaken by P2P recipient households are operated by women.

(b) Institutional Change/Strengthening

53. The project made a lasting institutional impact by having (a) an improved policy environment and regulatory framework, including cost-recovery tariff, reduced cross subsidies, power sector financing strategy, and the 2013–2017 Power Sector Financial Sustainability Action Plan; (b) an RE master plan in place; and (c) strengthened human capacities in the EdL and the MEM in project management, environmental and social impact management, renewable technologies, and English language (see annex 3 for details).

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

54. The 2013 evaluation found that with better lighting from grid connections, children in P2P households do not appear to significantly increase their study time in the evening but like elsewhere, prefer to spend more time watching televisions. Television was the most important appliance after lighting for households who connected to the grid. In contrast to grid connections, the 2013 evaluation found fewer benefits from SHSs due to the small size of systems and unaffordability or unavailability of goods and services to maintain or upgrade systems and for suitable electric appliances. There was no evidence that the SHSs contributed to income-generating activities. However, 95 percent of users were satisfied with their SHS and all agreed that electricity from the SHS is better than just using kerosene wick lamps, as they can work more easily at night and the lease purchase payment is affordable.

55. Contrary to expectations, 4 out of 27 public sector buildings, for which data were available at completion, increased energy consumption after installation of EE technologies. The increase of up to 3 percent (compared to a reduction of 10 to 25 percent for most buildings) is presumed to be independent of the project intervention.

4. Assessment of Risk to Development Outcomes

Rating: Moderate

56. **The risk that the project's achievement of access to electricity might not be maintained is moderate overall, low for grid connections, and high for off-grid connections.** The EdL has proven its strong technical capacity to manage the distribution network and its commitment to expand the grid further. Grid electricity tariffs should increase over time, in part to cover investments to maintain and expand the power system and ensure quality of supply. Yet the risk of tariffs becoming unaffordable for households connected under the project is low given the strong association of grid connections with income-generating activities, including for P2P participants (as section 3 and annex 5 describe). SHS connections have a high risk of not being maintained, despite the affordable monthly payments and a high rate of user satisfaction, due to the substantial rate of returns expected after arrival of the grid and unclear arrangements for ongoing collection of fees, provision of O&M services, and associated program management. SHSs are thus a form of 'pre-electrification' that allows households to enjoy limited access to electricity before the grid arrives. Less accessible off-grid connections are most at risk of losing access if the grid takes too long to arrive and thus should be a focus for ongoing efforts. Electrification overall, however, is only advancing nationally with no signs of retreat.

57. **The risk that the project's achievement of improving the EdL's financial performance might not be maintained is moderate.** In 2014, the EdL achieved an overall substantial net profit of 8.9 percent of revenue from generation, transmission, and distribution. A notable improvement was seen in the T&D business with a profit margin before depreciation of 2 percent of operating revenue, compared with a deficit of 4 percent in 2012. Altogether, the EdL's profitability and cash flow continues to improve, particularly for the T&D business. Collection performance from nongovernment customers continues to be satisfactory (outstanding receivables averaged 1.5 months of total revenue). The key financial risk facing the EdL is the rising level of debt to finance the continued rising capital spending/investment. Experience shows that EdL companies may take on new debt financing for unplanned projects that arise without necessarily aligning to the Power Development Plan. This makes it challenging for EdL companies to manage their finance and prevailing financial contracts with existing creditors. Government agency receivables continued to rise, with outstanding receivables averaged 1 month of total revenue (or 18-month worth of sales to this group only). However, the MoF has addressed this issue by centralizing government agency billing effective from 2015. Building on FAP2, the MoF, the MEM, and the EdL have established a joint working group to propose and undertake actions to ensure financial sustainability of the power sector. Lao PDR authorities are also working to mitigate financial and liquidity risks with World Bank Group assistance including through the PGIP.

5. Assessment of Bank and Borrower Performance

5.1 Bank Performance

(a) Bank Performance Ensuring Quality at Entry

Rating**:** Satisfactory

58. There were minor shortcomings in the extent to which the Bank prepared and appraised the operation such that it was most likely to achieve planned development outcomes. The project was

strong in strategic relevance, economic justification, poverty and social development aspects, safeguards policy compliance, and fiduciary and policy institutional arrangements, especially in relation to electrification and the EdL component more specifically. Risks associated with coordination of grid and off-grid electrification, design and management of the SHS program, and the technical and economic challenges of village off-grid electrification were, in hindsight, underestimated. For the objective of improving the EdL's financial performance, the project's design and results framework would have benefited from more explicit consideration of the causal chain between project activities and objectives, the attribution of indicator targets to factors in or outside of the project's control, and associated risks (as sections 2.1 and 2.3 discuss).

(b) Quality of Supervision

Rating**:** Moderately Satisfactory

59. There were moderate shortcomings in the extent to which the Bank proactively identified and resolved threats to the achievement of relevant outcomes. Several factors gave rise to implementation problems which were mostly, but not completely, resolved by completion (as detailed in section 2.2) and with respect to M&E implementation (section 2.3). The reduction of the DSCR target from a minimum 1.3 to 1.1 at restructuring could have been reflected in the amendment of a covenant at 1.3 in the Project Agreement and in FAP2, as agreed in 2013. Loss reduction and consumer EE activities would have benefited from attention to maintain alignment between planned activities, costs, and related results framework indicators appropriately defined. Otherwise, supervision was strong. The Task Team Leader (TTL) changed four times during supervision which contributed to the delay in formally restructuring the project. However, the project benefited from all TTLs, as well as all of the fiduciary/safeguard staff, being based in the field which allowed frequent follow-up and support to the Client. Formal Bank missions took place 2–3 times per year. During field visits, the team was able to monitor and verify social and environmental impacts, meet with contractors, clients and other relevant authorities, as well as beneficiaries to listen and discuss possible adverse impacts. The World Bank Group's joint implementation support contributed to enhanced discussion/dialogue on financial aspects as evidenced by a joint support to the Lao PDR authorities, including officials from the MoF, the MEM, and the EdL in developing FAP2.

(c) Justification of Rating for Overall Bank Performance

Rating: Moderately Satisfactory

60. This rating is based on the ratings of the previous two dimensions.

5.2 Borrower Performance

(a) Government Performance

Rating: Satisfactory

61. The government showed steadfast support for electrification and provided the EdL in particular with a strong mandate and enabling environment—including an 18 percent tariff increase in 2013—to achieve the impressive outcome of electrifying 248,000 households in rural villages of Lao PDR. There were shortcomings in compliance with covenants directly under the government's control: (a) government agencies' budget allocations were inadequate to cover

power bills and (b) the government did not maintain the EdL's debt-to-equity ratio to less than 1.5. The MoF's decision to centralize government agency billing from 2015 is a step to address the latter concern.

(b) Implementing Agencies' Performance
Rating: Moderately Satisfactory

62. **Rating for the EdL: Satisfactory.** Strong institutional and staff commitment and availability to the project at the EdL have been instrumental to the overall success of the electrification components and the resolution of problems during implementation. Nevertheless, there were shortcomings in compliance with covenants and agreements toward improving the EdL's financial performance that were not in direct control of the EdL. In 2014, the EdL met the PDO financial target DSCR (1.9 versus target of minimum 1.1) but breached the IDA grant covenant debt-to-equity ratio (2.3 versus covenant of maximum 1.5).

63. The EdL could also have more proactively reported on the project's loss reduction activities, to explain the impact in the context of developments to methodology, the shift in large customer connections, and difference between planned and actual expenditure (the EdL reported no expenditure on loss reduction activities, whereas their contribution was expected to be US$3.2 million).

64. **Rating for the MEM: Moderately Satisfactory**. The MEM was a champion in implementing EE measures in its buildings. The rating reflects the fact that the MEM (including staff in the Institute for Rural Electricity Promotion under the MEM) substantially relied on external consultants and Bank teams in project implementation. There is a large capacity gap between different levels of MEM staff, which hindered project administration and implementation. After closure, the arrangements for the REF Secretariat to manage the REF need to be reviewed by MEM for future operations.

(c) Overall Borrower Performance
Rating: Moderately Satisfactory

65. This rating was due to the moderate shortcomings as identified above

6. Lessons Learned

66. The World Bank in 2011 reviewed lessons learned and key factors contributing to the extraordinary progress in national electrification in Lao PDR were reviewed.[14] These high-level lessons are applicable to this project as part of the national electrification program and include the following:

- Clear electricity access targets, institutional framework, financing, monitoring mechanisms, sound planning, and efficient operations can ensure the achievement of targets in a timely and effective manner.

[14] World Bank. 2011. *Lao PDR Power to the People: Twenty Years of National Electrification.* World Bank Asia Sustainable and Alternative Energy Program, Washington DC.

- A workable balance must be struck among financing, subsidy, and tariff policies by providing necessary state subsidies to RE and at the same time maintaining the commercial viability of the power sector with cost-recovery tariffs.

- A 'P2P, with low-cost financing that targets unelectrified households in villages previously electrified, is a simple and effective means to provide grid connections with strong benefits for women, children, income generation , health, and social inclusion.

67. The key element of success for Lao PDR to increase access to electricity was long-term national commitment to electrification which was broad-based, driven by the public utility (rather than private sector for whom RE is not profitable) and not unduly affected by normal political and economic changes during this period. Second, establishing appropriate technical codes and introducing recent technical innovations can lower the cost and accelerate electrification program. Lao PDR adopted low-cost options for low-demand areas, such as 'single-phase supply and single-wire earth return'. Lao PDR also deployed shield wire technology with significant savings in the mountainous regions.

68. Additional lessons include the importance of regularly updated data from multiple sources including on private sector investments to coordinate grid extension with off-grid electrification and avoid 'stranded' off-grid assets by earlier than expected arrival of the grid. SHSs must have a sustainable business model that does not depend on heavy government oversight. Careful consideration is warranted before including financial indicators as PDO outcome indicators or covenants given the sociopolitical risks associated with reform necessary to meet them, especially adjustments to tariffs, and the time required to bring about financial improvement, which often may exceed the life of one project. These lessons have already been incorporated, for example, into the design of IDA support to Myanmar's National Electrification Project.

69. **Safeguards**

- Free, prior, and informed consultation carried out from the beginning of the project can result in establishment of community broad support for the project. As impacts were either minor or avoidable in comparison to the longer-term benefit from the project investment, neither complaints nor negative feedback was received from project-affected people.

- Local office support in monitoring and reporting was instrumental to allow EdL headquarters to respond quickly to issues such as complaints from residents. The Safeguards Operational Manual was and will continue to be a key instrument for future installation and substation work of the EdL. Effective and timely transfer of information from local to national level and the availability of documentation (for example, compensation records and/or voluntary donation evidences) to the agencies and beneficiaries are also vital.

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

(a) Borrower/Implementing Agencies

70. The EdL's completion report (annex 7) rates all parameters highly satisfactory and risks to outcomes low or negligible, with lessons learned similar to REP I, while also noting that the change of Bank team leaders caused some delays. The MEM did not provide a completion. The EdL and the MEM had no comments on the draft ICR.

(b) Co-financiers

71. NORAD noted the positive results on the electrification side and that the reporting requirements on the government's side have been challenging. IFC had no comments on the draft ICR.

(c) Other Partners and Stakeholders

72. The team spoke with a representative from a consultancy firm engaged for Village Off-grid Promotion and Support under REP II, responsible for overseeing the Provincial Electricity Service Companies (PESCOs) and providing support to the MEM. The representative offered the following reflections, lessons, and recommendations:

- The off-grid SHS model relies heavily on collection of rental and purchase money, which is risky due to the high transaction cost of visiting sites in person. Implementation and enforcement of contracts between PESCOs and the MEM were lax due to several factors including the new experience of off-grid electricity in Lao PDR; lack of choice and of competition between PESCOs for a service area; and cultural hesitancies of parties to urge each other to comply with a contract. Individual leaders within the MEM can make a big difference to collection rates. MEM-PESCO contracts would also have benefited from provisions for interest on debt or some kind of penalty for delayed payment.

- One suggestion for similar future programs would be to have performance targets for PESCOs so that rebidding would not be necessary. Also, since the government and business owners have a close relationship in each province, the opportunities for winning contracts each round should be shared to maintain social harmony.

- Lao PDR could definitely benefit from ongoing work in rural off-grid electrification, building on the achievements of REP I and II.

Annex 1. Project Costs and Financing

(a) Project Cost by Component (in US$, millions)

Components	Estimate at appraisal (2009)	Estimate with GEF Grant (2011)		Estimate at Restructuring (2013)	Actual (June 2015)	Actual as share of estimate with GEF Grant (in %)
A: *Electricité du Laos* Component	**29.327**	**30.326**		**30.326**	**47.406**	**156**
A.1 Grid Extension	22.847	22.847		21.543	44.031	193
A.2 Loss Reduction	4.880	5.080		5.366	1.965	39
A.3 Information Technology System and Financial Management	0.300	0.300		1.318	0.393	131
A.4 Safeguard Capacity Building	0.250	0.250		0.250	0.245	98
A.5 Demand Side Management and Energy Efficiency Program	1.050	1.849		1.849	0.772	42
B: Ministry of Energy and Mines Component	**6.474**	**7.293**		**7.293**	**5.352**	**73**
B.1 Off-Grid Investment Program	4.354	4.354		3.561	1.622	37
B.2 Institutional Strengthening	0.500	0.500		0.882	1.951	390
B.3 Alternative Rural Electrification Delivery Models	0.700	1.499		1.700	0.711	47
B.4 Rural Electrification Master Plan and Database	0.100	0.100		0.100	0.106	106
B.5 Organizational Strengthening of Ministry of Energy and Mines	0.820	0.840		1.050	0.963	115
Total Financing Required	**35.801**	**37.619**		**37.619**	**52.758**	**140**

Data sources: PAD, GEF Project Paper, Restructuring Paper, Quarterly IFR ending June 2015.
Note: Data are for June 2015. IDA disbursement was US$17.59 million as of October 30, 2015. This includes money expected to be returned. Some financing sources (for example, NORAD) made disbursements after June 2015, which are not included here due to unavailability of data at the time of writing.

(b) Financing

Source of Funds	Type of Cofinancing	Original (US$, millions)	Actual at June 2015 (US$, millions)	Actual as share of original (in %)
Borrower	Counterpart	4.058	16.102	396
Local Communities	Counterpart	3.363	1.146	34
ESMAP	Grant	0.500	0.183	37
IDA	Grant	20.000	16.989	85
NORAD	Grant	4.000	2.421[18]	60
IFC	Loan	3.880	14.822	382
Global Environment Facility– Associated IDA Fund (GEF)	Grant	1.181	1.094[15]	93
Total		**37.619**	**52.758**	**140**

[15] Disbursement from GEF is US$1.73 million as of October 30, 2015.

(a) Project Cost by Component Estimated at Restructuring (US$, millions)

	IDA	NORAD	ESMAP	IFC	EdL	MEM	Consumers	Subtotal	GEF Additional Financing	Total
EdL Component										
A.1 Grid Extension	13.296	0.500	–	3.880	0.704	–	3.163	21.543	–	21.543
A.2 Loss Reduction	1.286	0.680	–	–	3.200	–	–	5.166	0.200	5.366
A.3 Information Technology System and Financial Management	1.018	0.300	–	–	–	–	–	1.318	–	1.318
A.4 Safeguard Capacity Building	–	0.250	–	–	–	–	–	0.250	–	0.250
A.5 Demand Side Management and Energy Efficiency Program	0.300	0.750	–	–	–	–	–	1.050	0.799	1.849
Subtotal	**15.900**	**2.480**	**–**	**3.880**	**3.904**	**–**	**3.163**	**29.327**	**0.999**	**30.326**
MEM Component										
B.1 Off-Grid Investment	2.408	–	–	–	–	0.154	0.200	2.762	0.799	3.561
B.2 Institutional Strengthening	0.382	0.500	–	–	–	–	–	0.882	–	0.882
B.3 Alternative Rural Electrification Delivery Models	1.000	0.200	0.500	–	–	–	–	1.700	–	1.700
B.4 Rural Electrification Master Plan and Database	–	0.100	–	–	–	–	–	0.100	–	0.100
B.5 Organizational Strengthening of MEM	0.310	0.720	–	–	–	–	–	1.030	0.020	1.050
Subtotal	**4.100**	**1.520**	**0.500**	**–**	**–**	**0.154**	**0.200**	**6.474**	**0.819**	**7.293**
Total	**20.000**	**4.000**	**0.500**	**3.880**	**3.904**	**0.154**	**3.363**	**35.801**	**1.818**	**37.619**

(b) Actual Project Cost by Component at June 2015 (US$, millions)

	IDA	NORAD	ESMAP	IFC	EdL	Consumers	Subtotal	GEF Additional Financing	Total
EdL Component									
A.1 Grid Extension	12.541	0.518	–	14.822	16.102	n.a.[16]	43.983	0.048	44.031
A.2 Loss Reduction	1.350	–	–	–	–	–	1.350	0.615	1.965
A.3 Information Technology System and Financial Management	0.338	0.055	–	–	–	–	0.393	–	0.393
A.4 Safeguard Capacity Building	–	0.245	–	–	–	–	0.245	–	0.245
A.5 Demand Side Management and Energy Efficiency Program	0.168	0.485	–	–	–	–	0.653	0.119	0.772
Subtotal	**14.397**	**1.303**	**–**	**14.822**	**16.102**	n.a.	**46.624**	**0.782**	**47.406**
MEM Component						**REF/MEM[17]**			
B.1 Off-Grid Investment	1.454	–	–	–	–	0.168	1.622	–	1.622
B.2 Institutional Strengthening	0.483	0.698	–	–	–	0.770	1.951	–	1.951

[16] EdL confirmed that there was a contribution from the consumers. However, the amount was not estimated.
[17] Rural Electricity Fund - Contribution from MEM and consumers

B.3 Alternative Rural Electrification Delivery Models	0.216	–	0.183	–	–	–	0.399	0.312	0.711
B.4 Rural Electrification Master Plan and Database	–	0.106	–	–	–	–	0.106	–	0.106
B.5 Organizational Strengthening of MEM	0.441	0.314	–	–	–	0.208	0.963	–	0.963
Subtotal	**2.592**	**1.118**	**0.183**	**–**	**–**	**1.146**	**5.040**	**0.312**	**5.352**
Total	**16.989**	**2.421**[18]	**0.183**	**14.822**	**16.102**	**1.146**	**51.664**	**1.094**	**52.758**

[18] By end of July 2015, NORAD disbursement increased to US$ 3.27 million, comprising US$ 2.1 million for EdL Components and US$ 1.17 miilion for MEM Components. Source: NORAD.

Annex 2. Outputs by Component

1. This annex provides detailed information on project outputs, further to the summary in section 3. Outputs are listed for each component, along with cost estimates at key stages of the project, and changes made to component descriptions at project restructuring. Table 2.2 on page **Error! Bookmark not defined.** shows the indicators associated with each component and their relationship to the objectives.

A. EdL Components

2. **A.1. Grid Extension:** Cost estimate at appraisal: US$22.847million; estimate with GEF funding: US$22.847 million; estimate at restructuring: US$21.543 million; and actual at completion: US$44.031 million. For this subcomponent, 11 procurement contracts were completed, covering 67 subprojects and extending the EdL's grid to 525 villages in seven central and southern provinces. The network extension comprised 1,880 km of 22 kV, 49 km of 12.7 kV, and 990 km of 0.4 kV lines and 552 sets of transformers of various types and capacities. In total, 37,614 households were connected and 2,879 km of lines were laid. At restructuring in 2013, training was added to improve the performance of the EdL's Project Management Unit; consultancy services were added for implementation supervision, production of modular specifications, and review of design standards; and US$1,304,000 of IDA funds were reallocated to Subcomponents A.2 and A.3.

3. **A.2. Loss Reduction:** Cost estimated at appraisal: US$4.880 million; estimated with GEF grant: US$5.080 million; estimate at restructuring: US$5.366 million; and actual at completion: US$1.965 million. Five contracts were completed. At restructuring, US$0.29 million of IDA funds were allocated to this subcomponent to purchase critical testing equipment needed to identify losses in the EdL's system and take appropriate actions.

Table 2.1. Completed Contracts

Contract Value	Source of Finance	Date of Signing	Purpose
US$155,883	IDA	2012–08	Capacitor banks
US$333,475	IDA	2012–06	Meters
US$305,500	IDA	2012–01	Meter testers
US$84,000	IDA	2014–03	Meter testers
US$305,500	IDA and GEF	2013–06	Meter testers

4. **A.3. Information Technology System and Financial Management:** Cost estimated at appraisal: US$0.300 million; estimated with GEF grant: US$0.300 million; appraisal estimated at restructuring: US$1.318 million; and actual at completion: US$0.393 million. At restructuring, funds of (a) US$0.34 million were allocated for the virtual private network and related computing and IT equipment and software, to facilitate the EdL's financial management and (b) US$0.68 million for TA, goods, and/or works, for upgrading the EdL's accounting system. A virtual private internet network with 17 servers was procured and installed under this subcomponent, through one contract awarded to the firm Cyberia, at the cost of US$337,625. The second phase of the contract was not executed.

5. **A.4 Safeguards Capacity Development:** Cost estimated at appraisal: US$0.250 million; estimated with GEF grant: US$0.250 million; estimate at restructuring: US$0.250 million; and actual at completion: US$0.245 million. This subcomponent provided goods and training to the EdL and its provincial counterparts to strengthen their capacity in environmental and social assessment and managing impacts associated with distribution and substation projects. During the project launch workshop, a safeguard training was provided for the EdL and the MEM by the Bank's task team to explain the principles and process provided in the Environement and Social Safeguard Framework. This was followed by a series of training and on-the-job training to ensure safeguard awareness and compliance by the project implementing agencies. The results of the training component included the following: (a) 2 staff received training at the Asian Institute of Technology in Thailand from June 17–25, 2015; (b) 64 staff from the EdL and from 7 provinces' branch offices participated in a technical training program from July 16–19, 2013; (c) office equipment was provided to branch offices; (d) 44 branch office staff in seven provinces completed training; and (e) staff of the EdL headquarters' Environment Office undertook an English language course. The safeguard capacity of headquarters staff, in particular, were enhanced and contributed to strengthen the human resources for the EdL's training center for newcomers.

6. **A.5**. **Demand-side Management and Energy Efficiency:** Cost estimated at appraisal: US$1.050 million; estimated with GEF grant: US$1.829 million; estimate at restructuring: US$1.829 million; and actual at completion: US$0.772 million. In total, 12 procurement contracts were completed in this subcomponent, with satisfactory results. Program management costs for the EdL's component were also accounted under this subcomponent.

- **Public Buildings.** The project was initially estimated to save 16–25 percent of energy consumption for 50 central government buildings, equivalent to 40–60 GWh per year by 2014.[19] The percentage reduction was roughly achieved, though absolute savings were an order of magnitude less, as the baseline consumption level of targeted buildings was smaller than expected. Potential savings for EE measures in 50 public buildings (including 24 government agencies and 3 hospitals) were estimated at 446 MWh per year in 2014. The project saved an estimated 200 MWh per year across 27 buildings for which data were available by project closure.[20] Most buildings reduced consumption by 10–25 percent. Surprisingly, four buildings increased consumption (up to 3 percent) and four reduced consumption by more than 25 percent (up to 40 percent). The MEM's two buildings were among the top five champions of energy reduction, reducing consumption by 23–30 percent. This subcomponent's final report notes that there is good potential to replicate measures across more than 8,200 public administrative buildings in Lao PDR with a potential energy saving estimated at 22 GWh per year (of which 13 GWh per year is in the capital Vientiane) assuming an

[19] Targeted government buildings were assumed to consume 168 GWh in 2011, growing 13 percent yearly, according to the GEF Project Paper (World Bank 2011, 18). Actual consumption was 149 GWh in 2011 (IIEC 2014, 7).

[20] Post-installation consumption data was not available for 13 buildings due to delays of up to three months in securing senior management permission to access buildings for installation (ICEE 2015, 11). Figure 3.1 shows an average 19 MWh per month per building, which implies ~114 GWh per year for 50 buildings or ~62 GWh per year for 27 buildings. The report did not include data to derive the weighted average of percentage energy reduction in total.

average saving of 15 percent in each building. Lessons learned, including those with regard to behavior, policies, and technology (page14 of IIED 2015), also propose a five-year replication plan starting with an audit and leading to public-private partnership investment in EE projects.

- **Efficient lighting:** The program was started in August 2013 and finalized in October 2014. The compact fluorescent lightbulb (CFL) replacement program reduced peak demand in the range of 8–39 percent according to studies conducted in five villages. This compares to the expected reduction of 15 percent. The EdL distributed 360,000 CFLs across Lao PDR's 17 provinces either for free or for a subsidized price.[21] This resulted in an estimated 9 GWh per year in power savings and increase in market for CFLs from 61 percent to 88 percent.[22] Most villagers interviewed were satisfied with the CFLs, with a noticeable decrease in electric bills, while some consumers such as food and jewelry vendors preferred warmer light. Some customers also wanted to have mini or twist cap CFLs that can fit with their existing recessed luminaires. (IIEC 2014a, 22).

- These were the subcomponent deliverables: a website (www.laodsm.net); consumer awareness and behavior campaign in urban areas; a roadmap for EE standards and labelling; an assessment of pilot program options for commercial and industrial demand management; an upgraded energy use database; and building the capacity of EdL staff including to conduct energy audits and monitor and verify EE activities such as the maintenance of the energy use database.[23]

B. MEM Component

7. **B.1. Off-Grid Investment Program:** Cost estimated at appraisal: US$4.354 million; estimated with GEF grant: US$1.829 million; estimate at restructuring: US$3.561 million; actual at completion: US$0.772 million). This subcomponent centered on 15,000 SHSs purchased under one contract in 2011 with US$2.0 million REP I and US$1.62 million REP II finance. REP II was originally expected to contribute US$4.0 million, so 5,000 units were attributed to REP I, and 10,000 to REP II. The unit price was ultimately lower than expected. At restructuring, savings of US$1.59 million were allocated to other subcomponents. The MEM and REP II ISRs reported implementation progress of 15,000 SHSs all together. The 2:1 ratio attributed to each phase is retained for evaluation purposes to ensure consistency with REP II targets and REP I ICR, and to avoid double counting.

8. According to the final MEM report, 11,992 SHSs were installed while withdrawals due to grid conversion of households and other operational maintenance reasons are reported as 234, bringing the total number of SHSs to 11,758. Considering the funding from the Australian Agency for International Development for 5,000 SHSs from REP I, the effective prorated target achievement for IDA and local contributions is 9,601 units or 96 percent. The MEM's final

[21] 86 percent free of charge and 14 percent for LAK 8,000 each (LAK 4,000 cheaper than the average market price) total of LAK 346 billion (~US$50,000) which the EdL will use to expand the program. Philips sent 1.5 percent of the total supply to replace lamps that failed; 40,000 were retained as spares (IIEC 2014)
[22] IIEC 2015, 2.
[23] The online database, www.laodsm.net/database, accessed in October 2015 includes data only up to May 2014.

progress showed that there were no clear plans to manage 3,008 SHSs from REP I and REP II which remain uninstalled. The MEM subsequently updated the number of remaining systems to 599 (out of 15,000).

9. **B.2. Institutional Strengthening:** Cost estimated at appraisal: US$0.500 million; estimated with GEF grant: US$0.500 million; estimate at restructuring: US$1.951million; and actual at completion: US$0.711 million. At restructuring, IDA funds were allocated to cover the costs of consultancy services to manage the village off-grid program and to monitor debt collection performance.

a. Under the implementation of its comprehensive program of management outsourcing, the village off-grid program management contract was executed at a total cost of US$1,281,297.07. Additionally, the definition of Incremental Operating Costs was expanded to include contract staff salaries and charges for opening and operating project bank accounts.

b. Under the monitoring of the performance of the outsourced management and the Off-Grid Investment Program, including PESCOs and village electricity managers, vehicles were purchased for a total of US$99,990.00. One procurement contract was issued and completed for this subcomponent.

10. **B.3. Alternative Rural Electrification Delivery Models:** Cost estimated at appraisal: US$0.700 million; estimated with GEF grant: US$1.499 million; estimate at restructuring: US$1.700 million; actual at completion: US$0.711 million). At restructuring, funds were allocated to design, supply, install, and supervise pilot projects for village hydropower in Houaphan Province, and biomass and/or biogas in Vientiane, to be developed under public-private partnership schemes. A total of four procurement contracts were completed and two were cancelled during the achievement of this output.

11. Two village hydro stations were commissioned in Houaphanh Province, Pao Neua and Pao Tai Village, each of 25 kW. The Pao Neua station provides electricity service to Pao Neua, which has 63 households and 376 people, and expected 396 W capacity of installation on average, according to MEM reports from early 2015. The Pao Tai station could provide electricity service to up to two villages, Pao Tai and Ban Pheing Pheau, with 90 households (36+54) and 454 people (184+270). The total potential households connected through the hydro project was 153, with each household having 277 W capacity on average. At completion, an estimated 40 households were connected. An amendment to the contract to extend the Pao Tai station's service to Ban Pheing Pheau Village could not be processed before closure.

12. Scoping for a number of potential sites for alternative models of renewable energy was undertaken. However, during the project lifetime, only one project was completed. The UD Farm Biogas Project is located in Phonehong District, Vientiane Province. It was invested by a pig farm owner to treat pig dung with anaerobic technology to reduce pollution to the local environment and to generate electricity. The installed power generation capacity is 260 kW. The project construction started in October 2014 and was completed by the end of May 2015.

13. **B.4 Rural Electrification Master Plan and Database:** Cost estimated at appraisal: US$0.100 million; estimated with GEF grant: US$0.100 million; estimate at restructuring: US$0.100 million; and actual at completion: US$0.106 million). One contract was issued and completed for this subcomponent. The June 2014 ISR reported that the assignment for this component came to a close in 2013. No further information was available on the contract output, or whether it was used or useful.

14. **B.5 Organizational Strengthening of the MEM:** Cost estimated at appraisal: US$0.820 million; estimated with GEF grant: US$0.820 million; estimate at restructuring: US$1.030 million; and actual at completion: US$0.701 million. In total, nine procurement subcontracts were completed, three cancelled, and one was annulled in this subcomponent. At restructuring, funds were allocated to enhance the MEM's supervision and monitoring capacities through the purchase of vehicles and office equipment. In addition to office equipment purchased, training was provided to staff.

Table 2.2. Key Indicators Associated with Each Component and Objectives

Components	PDOs		GEOs	
	(a) Increase access to electricity of rural households in villages of project provinces	(b) Further improve the EdL's financial performance	(a) Increase efficiency of energy supply by the EdL and consumption by consumers	(b) Adopt substantial renewable energy in the rural electrification program
EdL Component A.1 Grid Extension	IO Indicator 1: Households electrified—grid. ***Achieved 136%.*** IO Indicator 3: Distribution lines constructed. ***Achieved 185%.***	Indirect relation	No relation	No relation
A.2 Loss Reduction	Indirect relation	IO Indicator 5/GEO Indicator 1: Reduction of the EdL's distribution system loss. ***Not achieved but attribution is indiscernible.***		
A.3 Information Technology System	Indirect relation	GEO Indicators 3 and 5: The EdL financial performance. ***Achieved partially.***	Indirect relation	
A.4 Safeguard Capacity Building	Implementation support	No relation	No relation	
A.5 Demand-Side Management and Energy Efficiency	Indirect relation	IO Indicator 6/GEO Indicators 2 and 3: Increase in awareness and adoption of EE technologies and practices by consumers. Achieved with different scope.		
MEM Component B.1 Off-Grid Investment	IO Indicator 2: Households electrified—off-grid. ***Achieved 96%.***	No relation	No relation	Indirect relation
B.2 Institutional Strengthening	Implementation support			Implementation support

Components	PDOs		GEOs	
	(a) Increase access to electricity of rural households in villages of project provinces	(b) Further improve the EdL's financial performance	(a) Increase efficiency of energy supply by the EdL and consumption by consumers	(b) Adopt substantial renewable energy in the rural electrification program
B.3 Alternative Rural Electrification Delivery Models	Indirect relation			GEO Indicator 4: Newly installed renewable energy generation capacity. ***Achieved 103%.***
B.4 RE Master Plan and Database	Implementation support			Indirect relation
B.5 Organizational Strengthening of the MEM	Implementation support			Implementation support

Note: IO Indicator 4 (number of RE projects with financial support of the REF) and GEO Indicator 5 (cumulative GHG emission reduction) are not included as they do not contribute to achievement of objectives.

Annex 3. Economic and Financial Analyses

Subcomponent A.1: Grid Extension (EdL)

Appraisal

1. The economic analysis at appraisal for this subcomponent assessed the benefits of connecting 27,700 additional households and non-households to the grid. The economic benefit of connecting households to the grid was based on the consumer surplus of household demand for electric lighting, estimated to be US$412 per household per year, according to household survey data collected in 2004. The economic benefit of connecting non-households to the grid was assumed to equal the cost they pay for consuming electricity, as no other energy source is cheaper. The non-household consumption of electricity was estimated to be approximately twice as much as the household consumption based on empirical information from the EdL. The economic cost was taken as the total amount invested in the grid extension subcomponent, excluding commercial sources of financing, estimated at appraisal to be US$22.85 million. The analysis was built over a period of 30 years, used a discount rate of 10 percent, and assumed that benefits start accruing from the first year.

2. Based on the approach and assumptions, the NPV[24] estimated at appraisal was US$85 million, the economic internal rate of return (EIRR) 81 percent, and benefit-to-cost ratio 2.8.

Completion

3. The economic analysis at completion maintains the same approach and assumptions, but uses the latest available data and includes O&M costs, which were bundled into the cost of supply at appraisal. The consumer surplus of household demand for electric lighting was revised up to US$658 per household per year, based on data from an impact evaluation conducted in 2013.[25] Based on the impact evaluation, average consumption of electricity for households connected to the grid had also increased at a faster rate than assumed at appraisal,[26] which was reflected in the economic analysis at completion. In addition, the project eventually connected a higher number of households; specifically, it connected 37,614 households at completion compared to 27,700 household connections estimated at appraisal. The economic costs at completion comprise the total amount of finance invested in the subcomponent (including from IDA, IFC, NORAD, the EdL, and consumers), estimated to be US$38.7 million (refer annex 1). The economic costs also include O&M costs, assumed to be 2.5 percent of the capital cost for distribution projects. The assumed discount rate (10 percent) and project life (30 years) were kept the same as those at appraisal.

4. Based on the approach and assumptions, the project's NPV in 2010 is reestimated at completion to have been US$137 million, the EIRR 39 percent, and the benefit-to-cost ratio 3.2. The results at completion are different but still quite favorable, primarily due to the inclusion of total capital cost and a higher consumer surplus.

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[24] Throughout this analysis, NPV refers to the value in 2010, at the beginning of the project's first year.

[25] Tuntivate, V. 2013. *Welfare Benefits of Lao PDR: Rural Electrification Project, Phase I & II Grid Electrification Component*. The World Bank Group. (Data inflation adjusted to 2014).

[26] Specifically, the annual household consumption growth rate was 6.7 percent from 2010–2013, whereas at appraisal this was assumed to be static.

Table 3.1. Grid Extension Project Economic Analysis

Year	Cost (USD Million)				Benefits (USD Million)			Net Benefits (USD Million)
	Economic Capital Cost	O&M Cost	Cost of Incremental Supply	Total Cost	Value of Non HH Grid Connection @ Tariff	Value of HH Grid Connection @ Consumer Surplus	Total Benefits	
2010	9.27	0.00	0.00	9.27	0.00	0.00	0.00	-9.27
2011	23.12	0.20	0.00	23.32	0.00	0.00	0.00	-23.32
2012	0.00	0.27	1.09	1.36	1.22	4.45	5.68	4.32
2013	1.28	0.42	1.71	3.42	2.10	6.57	8.67	5.25
2014	1.15	0.87	3.95	5.97	4.87	13.75	18.62	12.65
2015	0.00	0.87	7.82	8.69	9.83	24.76	34.59	25.90
2016	0.00	0.87	8.60	9.47	11.03	24.76	35.79	26.32
2017	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2018	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2019	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2020	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2021	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2022	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2023	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2024	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2025	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2026	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2027	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2028	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2029	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2030	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2031	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2032	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2033	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2034	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2035	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2036	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2037	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2038	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
2039	0.00	0.87	9.46	10.34	12.38	24.76	37.14	26.80
							NPV @ 10%	$137.28
							EIRR	38.71%
							B/C Ratio	3.20

Subcomponent B.1: Off-Grid Investment (MEM)

Appraisal

5. The economic analysis for this component was performed for SHSs on a per system basis. Similar to Subcomponent A.1, the economic analysis for this component also assessed the benefits of providing households with electricity based on the consumer surplus of household demand for electric lighting. For SHSs, the consumer surplus was estimated according to the amount of lighting provided by different-sized systems ranging from 20–50 Wp; the corresponding consumer surplus ranged from US$90 to US$134 per month per household. The economic cost was taken as the capital cost of each system of different size and the O&M cost was assumed to increase by US$5 every two years.[27]

6. Based on the approach and assumptions, the NPV was estimated to range from US$209 to US$313 per SHS, the EIRR from 22–41 percent per SHS, and benefit-to-cost ratio from 1.6 to 1.8 per SHS.

[27] This assumption was built into the analytic model used at appraisal.

Completion

7. The economic analysis at completion maintains the same approach and assumptions; however, it assesses the SHS component in aggregate instead of on a per system basis. The consumer surplus of household demand for electric lighting from SHSs was revised to be on average US$139 per household per year, based on data available from an impact evaluation conducted in 2013.[28] The economic costs at completion comprise the total project investment for Subcomponent A.1—US$1.6 million.[29] Similar to the analysis at appraisal, the analysis at completion also assumes a 10-year repayment period from the year of installation.

8. Based on the approach and assumptions, the NPV in 2010 is reestimated at completion to have been US$5.5 million, the EIRR 60 percent, and the benefit-to-cost ratio 5.1. The results at completion are different but still quite favorable, primarily as the analysis was done at the component level and not at the system level.

Table 3.2. Off-Grid Project Economic Analysis

Year	Cost (USD Million)			Benefits (USD Million)		Net Benefits (USD Million)
	Economic Capital Cost	O&M Cost	Total Cost	Value of SHS @ Consumer Surplus	Total Benefits	
2010	0.00	0.00	0.00	0.00	0.00	0.00
2011	1.46	0.00	1.46	0.00	0.00	-1.46
2012	0.00	0.00	0.00	0.61	0.61	0.61
2013	0.00	0.00	0.00	0.68	0.68	0.68
2014	0.00	0.02	0.02	1.33	1.33	1.31
2015	0.00	0.02	0.02	1.33	1.33	1.31
2016	0.00	0.09	0.09	1.33	1.33	1.24
2017	0.00	0.12	0.12	1.33	1.33	1.21
2018	0.00	0.21	0.21	1.33	1.33	1.12
2019	0.00	0.24	0.24	1.33	1.33	1.09
2020	0.00	0.31	0.31	1.33	1.33	1.02
2021	0.00	0.31	0.31	1.33	1.33	1.02
2022	0.00	0.18	0.18	1.33	1.33	1.15
2023	0.00	0.16	0.16	1.33	1.33	1.17
2024	0.00	0.00	0.00	1.33	1.33	1.33
					NPV @ 10%	$5.50
					EIRR	60.02%
					B/C Ratio	5.07

[28] Tuntivate, V. 2013. *Welfare Benefits of Lao PDR Off-Grid Solar PV Home System.* The World Bank Group.
[29] Refer annex 1.

Table 3.3. Economic Analysis Summary Table

Subcomponent	Economic					
	NPV in 2010		EIRR		Benefit-to-cost Ratio	
	Appraisal	Completion	Appraisal (in %)	Completion (in %)	Appraisal	Completion
A.1	US$84.49 million	US$125.29 million	80.77	37.03	2.80	3.03
B.1	US$209–314 per SHS	US$5.50 million	22–41 per SHS	60.02	1.55–1.84	5.07

Financial Analysis

Subcomponent A.1: Grid Extension Component (EdL)

Appraisal

9. The financial analysis at appraisal for this component assessed the revenues for the distribution company at the average electricity tariff of U.S. cents 6.38 per kWh. The financial capital cost, estimated at US$25.77 million, took into account the subsidies received as a result of grant financing for the component and included commercial financing. The NPV, at a discount rate of 10 percent, was US$4.39 million, the financial internal rate of return (FIRR) was 14.76 percent, and the benefit-to-cost ratio was 1.14.

Completion

10. The financial analysis at completion maintains the same approach, in that it assesses the revenues earned as the electricity tariff. At appraisal, the average electricity tariff was used; however, the analysis at completion uses the latest available electricity tariff ranging from U.S. cents 3.3 to 4.4 per kWh for households and U. S. cents 7.4 to 9.7 per kWh for non-households. At completion, the capital cost was also revised to US$24.41 million. Additionally, similar to the economic analysis, the financial analysis at completion includes O&M costs. Based on the approach and assumptions, the NPV in 2010 is reestimated at completion to have been US$2.6 million, the FIRR 11.2 percent, and the benefit-to-cost ratio about 1.3. These results are less favorable than the financial analysis at appraisal due to the use of the latest available low-voltage household tariff, which is substantially less than as assumed at appraisal.

Table 3.4. Grid Extension Project Financial Analysis

Year	Cost (USD Million)				Revenue (USD Million)			Net Revenue (USD Million)
	Subsidized Capital Cost	O&M Cost	Cost of Incremental Supply	Total Cost	Revenue - Increase in Non-HH Sales @ Tariff	Revenue - Increase in HH Sales @ Tariff	Total Revenue	
2010	6.50	0.00	0.00	6.50	0.00	0.00	0.00	-6.50
2011	16.21	0.22	0.00	16.44	0.00	0.00	0.00	-16.44
2012	0.00	0.30	1.09	1.39	1.22	0.23	1.45	0.06
2013	0.90	0.47	1.71	3.08	2.10	0.38	2.49	-0.59
2014	0.80	0.97	3.95	5.72	4.87	0.88	5.75	0.03
2015	0.00	0.97	7.82	8.79	9.83	1.78	11.61	2.82
2016	0.00	0.97	8.60	9.57	11.03	2.00	13.03	3.46
2017	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2018	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2019	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2020	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2021	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2022	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2023	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2024	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2025	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2026	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2027	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2028	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2029	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2030	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2031	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2032	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2033	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2034	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2035	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2036	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2037	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2038	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
2039	0.00	0.97	9.46	10.43	12.38	2.24	14.62	4.19
							NPV @ 10%	$2.63
							FIRR	11.16%
							B/C Ratio	1.27

Component B-1: Off-Grid Investment Component (MEM)

Appraisal

11. The financial analysis at appraisal for this component assessed the revenues earned from SHS installation fees, which ranged from about US$18 to 30, and monthly fees over a 10-year repayment period, which ranged from about US$1.5 to 3.5 per month. There was no capital cost assessed for this component as it was subsidized by the project. The NPV, at a discount rate of 10 percent, ranged from US$44 to US$200 per SHS, the FIRR from −14 to −62 percent per SHS, and the benefit-to-cost ratio from 1.5 to 3.3 per SHS.

Completion

12. The financial analysis at completion maintains the same approach, but assesses the component holistically instead of on a per system basis. Similar to the analysis at appraisal, the analysis at completion also assumes a 10-year repayment period from the year of installation. As in the economic analysis, the financial analysis also uses data from an impact evaluation conducted in 2013, which yields an average installation fee of US$31 and monthly fee of US$2.83 per SHS. Based on the approach and assumptions, the NPV in 2010 is reestimated at completion to have

been US$1.21 million, the FIRR negative 62 percent, and the benefit-to-cost ratio about 2.1. These results are similar to those at appraisal.

Table 3.5. Off-Grid Project Financial Analysis

Year	Cost (USD Million)			Revenue (USD Million)			Net Revenue (USD Million)
	Subsidized Capital Cost	O&M Cost	Total Cost	Installation Fee	Service Fee	Total Revenue	
2010	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2011	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2012	0.00	0.00	0.00	0.14	0.15	0.29	0.29
2013	0.00	0.00	0.00	0.02	0.17	0.19	0.19
2014	0.00	0.02	0.02	0.14	0.33	0.47	0.45
2015	0.00	0.02	0.02	0.00	0.33	0.33	0.30
2016	0.00	0.09	0.09	0.00	0.33	0.33	0.23
2017	0.00	0.12	0.12	0.00	0.33	0.33	0.21
2018	0.00	0.21	0.21	0.00	0.33	0.33	0.11
2019	0.00	0.24	0.24	0.00	0.33	0.33	0.08
2020	0.00	0.31	0.31	0.00	0.33	0.33	0.02
2021	0.00	0.31	0.31	0.00	0.33	0.33	0.01
2022	0.00	0.18	0.18	0.00	0.18	0.18	-0.01
2023	0.00	0.16	0.16	0.00	0.16	0.16	0.00
2024	0.00	0.00	0.00	0.00	0.00	0.00	0.00
						NPV @ 10%	$1.21
						EIRR	-61.58%
						B/C Ratio	2.12

Table 3.6. Financial Analysis Summary Table

Subcomponent	Financial					
	NPV in 2010		FIRR		Benefit-to-cost Ratio	
	Appraisal	Completion	Appraisal	Completion	Appraisal	Completion
A.1	US$4.5 million	US$2.63 million	15%	11.16%	1.1	1.27
B.1	US$44–US$200 per SHS	US$1.21 million	−14 to −62% per SHS	−62%	1.5–3.3	2.1

Annex 4. Bank Lending and Implementation Support/Supervision Processes

(a) Task Team Members

Names	Title	Responsibility/ Specialty
Lending		
Alfredo Bano-Leal	Consultant	–
Boualamphanh Phouthavisouk	Team Assistant	Project support
Brahmanand Mohanty		–
Chanin Manopiniwes	Infrastructure Economist	–
Chrisantha Ratnayake	Consultant	–
Chutima Lowattanakarn	Team Assistant	Project support
Clive H.J. Mason	Consultant	–
Daniel R. Gibson	Consultant	–
Edouard Ereno Blanchet	Operations Officer	–
Enrique O. Crousillat	Consultant	–
Grayson Heffner	Consultant	–
Hanan G Jacoby	Lead Economist	–
Jason Steele	Information Specialist	–
Jian Xie	Senior Environmental Specialist	Environmental safeguards
Jie Tang	Program Leader	Task team leader (FY08–11)
Jin Li	Senior Environmental Specialist	Environmental safeguards
Joseph Daulat Marsangap Siagian	Information Assistant	–
Kannathee Danaisawat	Financial Management Specialist	Financial management
Manida Unkulvasapaul	Consultant	Environmental safeguards
Mara T Baranson	Consultant	–
Marieke Van Der Zon		–
Mette Kirstine Rohr Boatman	Consultant	–
Morten Larsen	Mining Specialist	–
Oithip Mongkolsawat	Senior Procurement Specialist	Procurement
Pajnapa Peamsilpakulchorn	Consultant	–
Panos Vlahakis	Senior Operations Officer	Power engineer
Pedro Olinto	Program Leader	–
Robert Vernstrom	Consultant	–
Roch Levesque	Senior Counsel	Legal
Sombath Southivong	Senior Infrastructure Specialist	–
Souridahak Sakonhninhom	Program Assistant	Project support
Teresita Ortega	Temporary	–

Names	Title	Responsibility/ Specialty
Thalavanh Vongsonephet	Program Assistant	Project support
Vachraras Pasuksuwan	Program Assistant	Project support
Vilaythong Chanthalinh		–
Vilayvanh Phonepraseuth	Operations Analyst	Project support
Voravate Tuntivate	Consultant	–
Yan Li		–
Supervision/ICR		
Alan David Lee	Energy Specialist	ICR lead author
Alfredo Bano-Leal	Consultant	–
Asad Ali Ahmed	Consultant	–
Syed Adeel Abbas	Extended Term Consultant	–
Bunlong Leng	Environmental Specialist	Environmental safeguards
Julia M Fraser	Practice Manager	Task team leader (FY11/12)
Jie Tang	Program Leader	Task team leader (FY08–11)
Kannathee Danaisawat	Financial Management Specialist	Financial management
Kaysone Vongthavilay	Program Assistant	Project support
Khamphet Chanvongnaraz	Procurement Specialist	Procurement
Makathy Tep	Consultant	Environmental safeguards
Makoto Takeuchi		–
Manida Unkulvasapaul	Consultant	Environmental safeguards
Oithip Mongkolsawat	Senior Procurement Specialist	Procurement
Pajnapa Peamsilpakulchorn	Consultant	–
Panos Vlahakis	Senior Operations Officer	Power engineer
Patricia Ramos Peinado	Consultant	Infrastructure analyst
Phaymany Philakone	Consultant	Financial management
Roch Levesque	Senior Counsel	Legal
Rome Chavapricha,	Senior Energy Specialist	Task team leader (FY14–16)
Satoshi Ishihara	Senior Social Development Specialist	Social safeguards
Siriphone Vanitsaveth	Financial Management Specialist	Financial management
Sombath Southivong	Senior Infrastructure Specialist	
Souksavanh Sombounkhan	Program Assistant	Project support
Thalavanh Vongsonephet	Program Assistant	Project support
Veasna Bun	Senior Infrastructure Specialist	Task team leader (FY12–14)
Vilayvanh Phonepraseuth	Operations Analyst	Project support
Voravate Tuntivate	Consultant	–
Yanqin Song	Senior Energy Specialist	–

(b) Staff Time and Cost

Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of Staff Weeks	US$ Thousands (including Travel and Consultant Costs)
Lending		
FY08	6.45	85.87
FY09	23.55	129.37
FY10	8.49	97.94
Total:	**38.49**	**313.18**
Supervision/ICR		
FY10	0.00	0.56
FY11	10.52	58.02
FY12	9.16	52.58
FY13	3.76	48.40
FY14	21.01	98.51
FY15	11.88	35.30
FY16	4.14	23.48
Total:	**60.47**	**316.85**

Annex 5. Beneficiary Survey Results

1. This annex summarizes a survey of 3,658 households conducted during February–March 2013 to evaluate welfare impacts of grid and off-grid electrification under REP I (2006–2012) and REP II (2010–2015), building on a baseline survey in 2004. The findings are inferred to apply broadly to both REP I and REP II, as the survey has a large sample size and does not report differences in impact between REP I and REP II beneficiaries.[30]

2. In broad terms, RE in Lao PDR improved livelihood; brought lights and television; and provided opportunities for income-generation activities. From 2004 to 2013, per capita household monthly income increased more than three times,[31] while household size declined by almost one person from 6.4 to 5.6. Besides income, households in the surveyed villages also accumulated more assets, such as equipment. While the vast majority of households connected remained subsistence rice farmers before and after electrification, their agricultural practices had improved and the share of households that own and use agricultural or farm equipment increased dramatically.

Welfare Benefits of Grid Electrification Component

3. For grid connections, the survey assessed 2,158 households across 148 villages in 11 provinces, based on the same villages chosen for a 2004 baseline survey. These included 635 households connected under the P2P, 1,305 households connected normally (not under the P2P), and 217 households waiting to be connected.

4. **Ownership of motorcycles and Tok, the more affordable means of transportation, increased dramatically.** Ownership of the very expensive means of transportation such as cars or pickup trucks has increased from less than 1 percent to 5 percent. Increasing the number of ownership of these means of transportation provides further evidence that during the past 9 years transportation has improved between these surveyed villages with main transportation routes and other villages. Good transportation also means that migration of labor force is easier as well and may have contributed to change in the socioeconomic characteristics of households in the surveyed villages. Baseline and follow-up household surveys conducted in 2004 and 2013 show that proportions of households with at least one family member working outside the village or country have increased from only 10 percent in 2004 to 29 percent in 2013, which may help explain why family size has declined and suggests that urban migration has increased.

5. A study confirms that television is the second most important electric appliance after electric lights. Close to three-quarter of the households acquire a television during the first year of electrification. About 86 percent of the households in the project-surveyed villages own a color television. Television ownership among electrified households in the surveyed villages does not

[30] At the time of the survey, REP I had already concluded and achieved 57,039 household grid connections and 4,908 SHS connections. REP II (2010–2015) was still under way but reported in May 2013 to have achieved 9,977 household grid connections and 6,518 SHS connections. REP II would subsequently connect an additional 27,637 households to the grid and 3,223 households with the SHS from 2013 to 2015.

[31] The 2004 and 2013 surveys align with a period of rapid economic growth for Lao PDR. Between 2004 and 2012, the average gross domestic product annual growth for Lao PDR is estimated to have been 7.6 percent, and gross domestic product per capita increased from US$362 in 2004 to US$1,320 in 2012.

appear to be positively associated with income. In fact, television ownership appears to be close to universal since majority of the households in the bottom income quintile can afford to own a television as well. This means that rural households—financially rich and poor—in the project area may begin to benefit equally from electricity. Comparison of video ownership among households that have electricity for only one year with those that have access to electricity for two, three, and more suggests that ownerships increase from 40 percent in the first year to 50 percent and over 60 percent in the fifth, sixth, and seventh year. The pattern of video player ownership is also similar to television. However, the ownership of video players is at a lower level than television.

6. The data confirm that refrigerators have become one of the most important appliances among households that first gain access to grid electricity. Despite a relatively high retail price, about 35 percent of households acquire a refrigerator within the first year of electrification; about half of rural households in the surveyed villages own a refrigerator. Ownership of other home appliances, including rice cooker and fan, is also very significant. Ownership of a fan, refrigerator, and rice cooker are positively associated with household income. It is important to note that the ownership of a refrigerator, which is the most expensive home appliance, is quite high among households in the fourth to the top income quintile, ranging from 56 percent to 72 percent, respectively. On the contrary, only 28 percent of the households in the bottom fifth income quintile own a refrigerator, suggesting that most households in the lower-income bracket still cannot afford to buy refrigerator. Regarding cooking appliances, the proportion of rural households that own a rice cooker is close to 40 percent.

7. **Unlike several decades ago, the cost of electric appliances has become much more affordable. Household income has also increased.** In addition, many households have family members working abroad, and as a result, gifts and remittances are common, which enables households to acquire electric appliances. A large number of households can afford electric appliances. Therefore, the opportunity to gain direct benefits from electricity is greater than the past few decades; data collected from these two surveys confirm this trend. Village-level data collected from village surveys in 2004 and in 2013 reveal that the rice milling business has been transformed from using a diesel motor to an electric motor. A village survey shows an average of three to four rice mills per village, and about 85 percent of these rice mills are powered by electric motors, with the remaining 15 percent still powered by diesel motors. The study conducted in 2011 and entitled 'Powering up Productivity in Rural Lao PDR: Stimulating Small and Medium Enterprises' provides further evidence. The study shows that the operating cost of an electric powered mill is significantly lower than a diesel powered mill. In addition, farmers have also benefitted from the electric-powered mill as well since the cost of milling rice using the electric powered mill is lower than the diesel-powered mill. Grid electricity has also provided opportunities for rural households to significantly improved agricultural processing business. Reducing the costs of post-harvest processing of key agricultural processing product such as rice milling is important to farmers.

8. Evidence from household surveys shows that after electrification retail business, including retail stores, convenient shops, and grocery stores, has replaced handicraft and is the dominant income-generation activity in all surveyed villages. Unlike commercial handicraft, which depends on markets outside the villages, retail businesses in the villages are usually set up to serve local clienteles within the village or community. The fact that there are more retail shops or retail

businesses in the villages means that the local economy has become more active than before. Although it is not clear whether electricity has directly stimulated business development in the village or only plays a supporting role, it is evident that these businesses can use electricity for their business.

9. Data from the 2004 and 2013 household surveys show positive association between household income and engagement in business activities. Besides retail shops in the village, public markets in the village also increased. In 2004, only four of all sampled villages had a public market, but in 2013, nine villages had a public market. All of these public markets used electricity.

10. Electricity has a direct influence on how men and women spend their time in their households. Women appear to receive significant benefits from electrification. Before electrification, women spend, on average, over one hour each night doing household chores, but after electrification, women spend only 23 minutes doing household chores in the evening.

11. **Electrification also has a direct positive impact on health and environment.** Before electrification, individuals living in the households that use a simple diesel wick lamp for lighting were exposed to dangerous particulate matters particles (PM2.5) concentration that are an order of magnitude greater than World Health Organization ambient health guidelines. Using a simple diesel wick lamp, individuals will unavoidably breathe in soot and smoke from incomplete combustion, which are unhealthful particles. Since lighting from the wick lamp is poor, it is quite likely that users must get very close to the wick lamp to be able to see better.

12. It is also expected that electric light from grid electricity will render more benefits to women and children than men in the households. This is because women and children spend more time inside than other household members. As a result, they are more likely to have more exposure to indoor air pollution. In particular, children usually need to stay close to the wick lamp to do their homework and read; thus they are likely to breathe in unhealthful particles. Data from the 2004 household survey show that the average diesel fuel consumption for lighting using the wick lamp per household is estimated to be 2.7 liter per month.

13. Electrification from REP I and II eliminates a total of 2.7 million liter of diesel fuel that would otherwise be consumed per year. A study focusing on black carbon and kerosene lighting conducted by Lam et al. (2012) shows that 7–9 percent of kerosene used for lighting with the simple wick lamp is converted to carbonaceous particulate matter that is nearly pure black carbon. It is believed that similar portions of diesel fuel are converted to black carbon particles.

14. With regard to public health services, the village surveys conducted in 2004 and 2103 show that public health services in the project villages have expanded somewhat but improved significantly. In 2004, only five villages had a public health center located within the village. All of these public health centers did not have access to electricity. At present, the public health service deliveries in the project area have changed. The 2013 village survey reveals that 12 villages have public health centers providing services to villagers within and in the nearby villages. All of these public health centers have access to electricity and are equipped with necessary medical equipment and refrigerators to store vaccine and medicine. In addition, all of these public health centers have a full-time nurse providing health services to the public.

15. **Electricity from the grid has significantly reduced the financial burden of households that were electrified under REP I and II.** Before electrification in 2004, the total household monthly spending for lighting, which included mostly diesel fuel for lamp lighting and battery charging fee for some households, was estimated at LAK 16,623. At an inflation rate of 6 percent per year, the monthly spending on lighting is estimated to be LAK 28,084 in 2013. The household survey conducted in 2013 shows that, on average, households spend LAK 27,312 on the electricity bill. The household survey reveals that the average monthly electricity consumption of households in the project area is about 77 kWh, of which around 25 percent is used for lighting. Therefore, the estimated monthly electricity bill that covers only lighting is estimated to be only LAK 6,681 per month. Other benefits and impact of the REP I and II electrification projects include telecommunication with mobile phone ownership and usage exceeding 80 percent in 2013. With electricity, people also feel safe inside and outside the house after sunset. The survey also confirms that life is better after the home is electrified.

Welfare Benefits of P2P

16. The study confirmed that the P2P improves livelihood, brings lights and television, and provides opportunities for income-generation activities of households that would otherwise be left behind without electricity. Typically, grid extension favors villages or communities that are located nearer to the grid network and have more economic activities. The main reason is to minimize investment cost and at the same time maximize economic return on investment. Once grid electricity arrives in the village or community, households that can afford to pay for the connection costs and house wiring can enjoy electricity. However, poorer households who cannot afford to pay for the connection costs and house wiring are left behind. To ensure that poorer households, including female-headed and disadvantage households in the village or community, are not left without electricity, the P2P is established as part of the main RE program. The program is designed to assist those who cannot afford to pay for the connection costs and house wiring in overcoming these up-front costs.

17. The study finds positive association between the status of electricity access and business activities at home, which seem to suggest that the P2P has opened up opportunity for the households to engage in business activities at home. The proportion of households that engage in business activities at home is higher among households with access to grid electricity. The household income of P2P recipients and applicants who engage in business activity is higher than that of P2P participants who do not engage in business activity.

18. **Electrification from the P2P appears to influence time use of household members. The** study confirms that useful evening hours of electrified program applicants and program recipients are significantly longer than unelectrified program applicants. Analysis of time use suggests that there is positive correlation between the status of electricity connection and evening hours of household members. Further analysis of time use in the evening shows that heads of the households and their spouses in P2P recipient households spend slightly more time in the evening on several key activities, including productive or income-generation activities, household chores, reading (or education), and watching television and/or video than their counterparts in P2P applicant households. On the contrary, heads of households and their spouses in unelectrified households spend the least time on these activities in comparison to electrified households (electrified program applicants and recipients). This finding suggests that these four major activities may be positively

correlated with electrification status of the households. Thus, electrification may influence people to spend more time on these activities.

19. Ownership and use of mobile phone is very high among P2P participants. Mobile phone ownership among P2P recipients is actually as high as other rural households that gain access to grid electricity through the normal electrification process under REP I and II. For P2P applicants who do not have access to electricity, ownership and usage reach 67 percent despite the fact that they have to go somewhere else to charge their phones. The apparent positive association between mobile phone ownership and electrification status of the households suggests that electricity is one of the many factors that have directly contributed to the high ownership and use of mobile phones, since it allows mobile phone users to conveniently charge their phones. Moreover, with the providion of grid electricity, phone companies could also conveniently set up mobile phone towers for services.

Welfare Benefits of Off-grid Electrification through the SHS

20. For off-grid electrification, a total of 1,500 households in 50 villages were surveyed, randomly selected from all of the provinces where solar PV home system projects under REP I and II were implemented. In each village, 15 households that adopted a solar PV home system were selected for interview. Since the off-grid solar PV home system program does not collect any baseline information before the program implementation, to compare the impact and benefits of the solar PV home system, the household survey also selected 15 households that did not adopt a solar PV home system in the same villages for interview. Additional data and information include project documents and literature reviews.

21. Rationale for the off-grid solar PV home system in Lao PDR is based on the belief that RE in the country will take a few decades to complete. As a result, an off-grid RE solution is introduced to be implemented alongside grid electrification. The main motivation is to allow households that would otherwise have to wait for decades to gain access to electrification. The off-grid program is considered as pre-electrification since it allows households to enjoy limited access to electricity beforehand.

22. The off-grid solar PV home system program in Lao PDR is supposed to focus on villages that are hard to reach at a reasonable cost by grid electrification and where grid electricity will not reach for at least 10 years. However, the off-grid electrification is based on a semi-private business model to be implemented by PESCOs. As a result, PESCOs' business model tends to only focus on villages with easy access and consumer ability to pay; this is to maximize sales at minimum cost. The combination of successful and quick expansion of grid electrification and selection of off-grid villages has resulted in several thousand off-grid villages gaining access to grid much sooner than anticipated.

23. Electricity cannot be consumed directly by consumers; to gain benefit from electricity, households must own and use electric appliances. Households must also be able to overcome the up-front installation fee of the solar PV home system and pay a monthly lease repayment. The size of the solar PV home system also determines the number and size of electric lighting and appliances that households can use. The off-grid solar PV home system program provides only 20,

30, and 50 Wp solar PV systems. Due to these constraints, benefits of electrification from the solar PV home system tend to be much smaller than from grid electrification.

24. However, in the case of the off-grid solar PV program in Lao PDR, benefits and impact are further reduced due to (a) the fact that most solar PV home system users cannot afford to buy replacement parts, including batteries and electric lamps, or add more solar PV panels when adding new electric appliances especially television; (b) unavailability of suitable replacement parts in the market; and (d) the combination of low after sales services and limited or no supply of suitable replacement parts.

25. The impact and benefits of solar PV home systems appears to be small. The study finds weak or no association between electricity and several aspects, including income-generation activity, time use, and education. However, the association appears to be more significant on health and indoor air pollution and feeling safe. This is because electricity supply from the solar PV home system is very limited and most of the impacts and benefits from solar PV home systems can be drawn from electric lights and small appliances, and electric lighting is the key for major activities in the households.

26. Analysis of time use reveals that electric lighting energized by the solar PV home system does not significantly extend evening hours of the surveyed households. There is a small difference on the average bedtime of household members for both groups. These differences are statistically insignificant, suggesting that electric lighting energized by the solar PV home system does not significantly extend evening hours of the households. This may be because the average size of the solar PV home system (about 30 Wp) provides a limited amount of energy. The constraint of electric power available in the evening may have been the major determining factors.

27. Individuals living in the households that use a simple diesel wick lamp for lighting at home could likely be exposed to dangerous particulate matters particles (PM2.5)concentration that are an order of magnitude greater than World Health Organization ambient health guidelines. The main reason for high risk of exposure is that unlike a hurricane lantern, a wick lamp is a crude lighting device with no protection for flame or glass shrouded. Individuals will unavoidably breathe in soot and smoke, which are unhealthful particles. Furthermore, since lighting from the wick lamp is poor, it is quite likely that users must get very close to the wick lamp to be able to see better.

28. It is also expected that electric light from the solar PV home system will render more benefits to women and children than men in the households. This is because women and children spend more time inside than other household members. As a result, they are more likely to have more exposure to indoor air pollution. In particular, children usually need to stay close to the wick lamp to do their homework and read; thus they are likely to breathe in unhealthful particles.

29. The solar PV home system not only increases perception of safety but also makes people feel safe. Lights provide people with a sense of safety and they feel safe at night. The household survey confirms that with electric light from the solar PV home system, households feel safe inside and outside the house after sunset.

30. Despite noticeable reduced and deteriorating performances of the SHS, the household survey shows that 95 percent of SHS users are satisfied with their system. All households agree that electricity from the SHS is better than just using diesel wick lamps, they can work at night, and the monthly lease purchase payment is not expensive.

Annex 6. Stakeholder Workshop Report and Results

A stakeholder workshop was not conducted for REP II.

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

EdL provided a completion report as below. MEM did not provide a completion report.

In response to the draft ICR, EdL and MEM had no comment.

LAO PEOPLE'S DEMOCRACTIC REPUBLIC

COMPLETION REPORT FOR RURAL ELECTRIFICATION PHASE II PROJECT

Submitted to the World Bank by
Electricité du Laos (EDL)
21 September 2015

Introduction

This report concerns the Rural Electrification Phase II Project (REP II) supported in part by International Development Association (IDA) Grant No. H538-LA, and Global Environment Facility (GEF) Grant No. TF098662. The report is submitted pursuant to the Project's Financing Agreement dated February 8, 2010 and its amendment agreed December 24, 2013, and GEF Grant Agreement dated May 5, 2011.

The Project's development objectives were to: (i) increase access to electricity of rural households in villages of targeted provinces; and (ii) further improve the financial performance of EdL.

Assessment of objective, design, implementation, and operational experience.

As a result of the Rural Electrification Project REP II, a total of 2,232 km (1,345 km of MV Lines and 886 km of LV) lines were installed against a target of 1,209 km. Some 42,291 concrete poles were erected and a number of 514 sets of transformers were installed.

The total numbers of households which were connected under REP II was 21,604 HHs, and (16,010 HHs under P2P), Total: 37,614 HH which is 36% over the outcome indicator target of 27,700 HH. A total of 513 villages have been connected which is less than the target of 525 villages.

The design and implementation works have been contracted with ECI a 100 % subsidiary of EDL. The network design has been performed according to good engineering practice. Implementation of the works was performed by the contractor under the supervision of EDL PIU's. After commissioning of the network in the villages the system is working properly

Assessment of outcome against the objectives.

Our overall assessment of the extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently, is:

Highly Satisfactory. There were no shortcomings in the operation's achievement of its objectives, in its efficiency, or in its relevance.

This rating is based on the following criteria.

3.1 Achievement of objectives. The objectives were fully achieved for all sub-components as follows.

The Project had two components, to be executed by EDL and MEM. These components are summarized below:

A. The EDL Component comprises the following sub-components:

A.1 Grid extension:

a) Installation and commission of MV and LV transmission Lines, Transformers and house connections to cover about 33,000 households in some 525 villages in the targeted seven central and southern provinces;

The objectives were fully achieved considering the target values have been exceeded.

b). Provision of Technical advisory services to EDL in Project Implementation and Supervision, and Capacity building for Economic and Financial Evaluation, Project management and procurement.

The objectives were fully achieved considering that EDL hired a qualified consultancy company (Fichtner) who provided technical advisory services in the project implementation and supervision as well as for capacity building for economic and financial evaluation and project implementation..

A.2 Loss Reduction:

a). Enhancement of EDL's loss reduction efforts through the provision of goods to support the implementation of prioritize of investment project recommend by the Loss Reduction master Plan; and

b). Provision of Technical advisory services to EDL for none technical Loss Reduction activities.

A.3 Information Technology System and Financial Management:

Provision of technical advisory services to EDL to:

a). Integrate the operation of EDL headquarters and branch offices in the project provinces by making the existing information technology system fully operational ; and

b). Strengthen its financial management through the information technology system, which includes computerized billing and accounting systems.

A.4 Safeguards Capacity Building:

Provide good and training to EDL and its provincial authority counterparts to strengthen their capacity in management of environmental and social assessment and impact associated with distribution and substation projects.

A.5 DSM and Energy Efficiency:

Provision to EDL of :

a). Goods to support the implementation of the action plan under the DSM and EE Master Plan; and

b). Technical assistance to implement the action plan.

The MEM Component comprised the following sub-components:

B.1 Off-grid Investment Program

B.2 Institutional Strengthening

B-3 Alternative RE Delivery Models
B.4 RE Master Plan and Database
B.5 Organization Strengthening of DoE of MEM.
This Implementation Completion Report concerns only the execution of the EDL's sub-components. A separate completion report will be submitted for the MEM component

1.2 Efficiency. The operation has achieved a return higher than the opportunity cost of capital, and is the least cost alternative.

For A1

The total numbers of households connected under REP II is 21,604 HHs, and (16,010 HHs under P2P), which is 36% over the outcome indicator target of 27,700 HH. A total 513 villages have been connected which is less than the target of 525 villages.

For A2 A3 A4 and A5

1.3 Relevance. The operation's objectives, design, and implementation are fully consistent with the country's current development priorities and with current country and sectorial assistance strategies and corporate goals.

For A1

A total number of 46,037 HHs have been connected to the grid, which contributes to the country's current development priority.

Evaluation of own performance during preparation and implementation, with special emphasis on lessons learned that may be helpful in the future.

Our assessment of the extent to which the Government and implementing agencies ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes, is as follows.

4.1 For the Government overall:

Highly Satisfactory. There were no shortcomings in Government performance.

4.2 For implementing agency EdL

Highly Satisfactory. There were no shortcomings in the implementing agency's performance.

The rating is based on

4.2.1 Achievement of objectives. The objectives were /partially achieved as follows.

- The quantity of distribution lines installed was completely achieved.
- The number of households connected was achieved too.
- The number villages electrified was less than the target number.

4.2.2 Efficiency. The operation has achieved a return higher than the opportunity cost of capital, and is the least cost alternative.

- The distribution lines installed constitute the basis for easy facilitating more households to be connected.
- Considering that the number of households connected exceed the target this will generate more revenue of EDL

4.2.3 Relevance. The operation's objectives, design, and implementation are <fully>consistent with the country's current development priorities and with current country and sectoral assistance strategies and corporate goals.

- The countries objective is that by 2020 90% of the household shall have electricity. Hence the implementations are consistent with the country's development strategy.

4.3 Lessons learned

The lessons learned and key factors contributing to the extraordinary progress in national electrification in Laos. These high-level lessons are applicable to this Project as part of the national electrification program and therefore summarized below:

• GoL has played an irreplaceable role in terms of making unwavering commitment, getting the policies right and staying the course. The government set clear targets for electricity access and developed an institutional framework and financing and monitoring mechanisms to ensure the achievement of the target in a timely and effective manner.

• EdL has been a key and keen facilitator and front line partner in implementing grid extension and roll-out programs, and makes them successful with effective leadership, sound planning, and efficient operations.

• Targeting the gender and extreme poverty dimension of rural electrification with the innovative P2P program.

• Complementing grid extension with off-grid options for remote rural areas where the grid cannot reach in the short term.

Other lessons germane to the Project include:

Continuous Bank engagement is essential to the lasting impact of Bank interventions. It takes much longer than one project cycle to influence sector policies and institutional capacity building. Bank support for the energy sector in Laos dates back to the late 1990s when EdL was still a relatively new company. Over the last two decades, the Bank has consistently engaged in the energy sector in Laos and provided financing and technical assistance for electrification as well as improving EdL's financial performance through five consecutive projects including the ongoing APL. The achievement made by the Project, with particular regards to the power sector financial performance, would not be possible and sustainable without such interventions.

- rethinking and evaluation for its suitability.

Evaluation of the performance of the World Bank, co-financiers, and other partners during preparation and implementation, including the effectiveness of their relationships, with special emphasis on lessons learned.

5.1 World Bank (IDA): Quality at entry. Our assessment of the extent to which services provided by the Bank ensured quality at entry of the operation is as follows.

Highly Satisfactory. There were no shortcomings in identification, preparation, or appraisal.

5.2 World Bank (IDA): Implementation. Our assessment of the extent to which the Bank supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan/g closing) is as follows.

Highly Satisfactory. There were no shortcomings in the proactive identification of opportunities and resolution of threats.

5.3 IFC

Highly Satisfactory. There were no shortcomings in the proactive identification of opportunities and resolution of threats.

5.4 NORAD

Highly Satisfactory. There were no shortcomings in the proactive identification of opportunities and resolution of threats.

5.5 Lessons learned

The importance of partnership cannot be overestimated for achieving the expected results of the Project and the national electrification program. Given limited IDA allocations for Laos, the Project drew partners of GEF, Norad, IFC during preparation and implementation. The resultant co-financing and parallel financing was almost four times the IDA grant amount, enabling the Project to exceed its original targets. Moreover, donor support is united in a single program and operated based on the same operational guidelines, enabling maximum efficiency.

The Donor had been changed of the Team Leader if each time is caused to the delay as:

- Delays for approval (no objection)
- Delays for disbursement
- Delays for main subject are not continues of agreement.
- Loss times if implementation

The WB and the co-financiers supported EDL and the GoL throughout the project period giving precious advice and guidance. Therefore in the future EDL hopes that the same support will be obtained from the banking partnerships.

Description of proposed arrangements for future operation.

6.1 Future arrangements.

Arrangements to achieve or maintain the same development outcome include:

For grid and the financial viability of EdL, EDL could be used as the financial owner to continue for developing the network in the future.

Similar arrangements for grid extension as for REP II could be used in the future

P2P, EDL and World bank were support for installation of the meters for connection to the poor consumers, Now EDL still supports this project by using the return funding to future arrangements.

For offgrid:

6.2 Risk to development outcome.

Our assessment of the risk, at present, that development outcomes will not be maintained is: Negligible to Low. Changes that may occur that would be detrimental to the ultimate achievement of the operation's development outcome include:

- The likelihood is negligible to low that some of these changes may occur.

(a) increase access to electricity of rural households in villages of project provinces; and

(b) further improve the financial performance of EDL. The global environmental objectives (GEO) of the GEF additional financing are to: (i) increase efficiency of energy supply by EDL and consumption by consumers; and (ii) adopt substantial renewable energy in the government's rural electrification program.

The impact on the operation's development outcomes of some or all of these changes materializing is negligible to low. No impact on operation's development outcomes base on criteria

Annex 8. Comments of Financiers and Other Partners/Stakeholders

1. The following comments were received in response to the draft ICR.

- *NORAD:* "NORAD has reviewed the report and noted the positive results on the electrification side. The reporting requirements on the government's side have been challenging." NORAD also noted that their record of disbursements differed from those recorded in annex 1 by around US$60,000, due to disbursements that took place in July 2015 and differences in the amounts reported by the MEM.

- IFC: No comments received.

Annex 9: Core Sector Indicators

1. Core sector indicators are included here further to the final ISR (archived June 2015). These were added to the ISRs mid-project for corporate reporting purposes, and are calculated ex post from other data. The indicators are not included in the Datasheet Results Framework Analysis and do not have target or baseline values because they are not part of the Results Framework agreed at approval and restructuring.

Table 9.1. Indicators and Value at Completion

Indicator	Value at Completion
People provided with access to electricity by household connections (Number, Core)	248,000
Date Achieved	June 30, 2015
Comment: This is the sum of grid and off-grid breakdown indicators.	
People provided with access to electricity by household connections—grid (Number, Core Breakdown	196,000
Date Achieved	June 30, 2015
Comment: This estimate is based on 21,604 standard household grid connections and 16,010 P2P household grid connections achieved, with the average number of persons/household being 5.6 for standard grid connections and 4.7 for P2P recipients, according to field surveys of beneficiaries (Voravate 2013), rounded to the nearest thousand.	
People provided with electricity by household connections—Off-grid/mini-grid–Only renewable sources (Number, Core Breakdown)	52,000
Date Achieved	June 30, 2015
Comment: This estimate is based on 9,601 SHSs installed or in use at completion, with the average number of persons/household being 5.4 according to field surveys of SHS recipients (Voravate 2013); and 40 households (226 people) connected to hydropower in Pao Tai and Pao Neua Villages, rounded to the nearest thousand.	
Electricity losses per year in the project area (Percentage, Core)	13.1
Date Achieved	December 31, 2015
Comment: This indicator is measured for the period January to December.	
Generation capacity of hydropower constructed under the project (Megawatt, Core breakdown)	0.05
Date Achieved	December 31, 2015
Comment: This indicator includes the two 25 kW stations constructed under the project.	

Annex 10. Poverty Reduction Support Operations for EdL Reform

1. PRSOs 4–7 influenced outcomes of greater commercial viability of the EdL.

PRSO 4 2008–09

Prior actions from Program Document	Status
4. Ministry of Finance (MOF), Ministry of Energy and Mining (MEM) and Electricite du Laos (EDL) agreed upon the quantum and a plan to settle arrears from government entities to EdL up to September 2006, within implementation of the Action Plan for Financial Sustainability of the power sector.	**Completed.** A plan to settle arrears of public entities to EDL was agreed. Measures to curb future arrears introduced by the government. This Prior Action was intended to continue repayments of government agencies' electricity arrears to the state-owned utility company Electricité du Laos (EDL), within an Action Plan that was to ensure that the EDL is financially sustainable in the future. The government agreed on a quantum and schedule of repayments. The MOF and EdL have agreed upon K38.4 billion in arrears for FY2005/06 and a schedule of repayment in three installments of K12.8 billion each in FY2008/09, FY2009/10, and FY2010/11. The government also introduced measures to curb future arrears, including more appropriate budget allocation for electricity payments.

PRSO 6 2010–11

Prior actions from Program Document	Status
3. The MOF (a) remains current on settlement of arrears for the period commencing FY 2004/05 and including FY2007/08, and reconcile arrears for FY2008/09; (b) provides	**Completed.** The purpose of this prior action was to; (i) reduce arrears on utilities; and (ii) ensure financial sustainability of EDL. The "Action
adequate budgetary allocations to government agencies for current electricity consumption for FY2009/10; and (c) together with EDL, clarify the financial arrangements for electricity provision to the irrigation sector in a letter sent by EDL to MOF on April 30, 2010 and at a following workshop held in Vientiane on May 4, 2010.	Plan for Financial Sustainability of the Power Sector" (Action Plan) comprises four main actions: (a) settle electricity arrears of government for the year ending September 2005; (b) implement an arrangement for ensuring that future government bills for electricity consumption are paid in full, and on time, so that the receivables from government departments do not exceed 90 days; (c) regular tariff adjustment for EDL to achieve financial performance targets; and (d) reduction of technical and commercial losses by EDL.

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Prior actions from Program Document	Status
3. MOF and EDL fully settle arrears of the government entities to EDL, up to September 2010 in FY 2010/11; MOF provides adequate budgetary allocation for current electricity consumption for FY2010/11; MOF and EDL agree on a sustainable mechanism for electricity bill payment to ensure no new arrears are accumulated	**Completed.** MOF confirmed in the PRSO 7 Letter of Development Policy dated April 21, 2011 that it fully settled arrears of government agencies to EDL up to September 2010 in FY2010/11; provided adequate budgetary allocations to government agencies for current electricity consumption for FY2010/11; and agreed with EDL on a sustainable mechanism for electricity bill payment to ensure no new arrears are accumulated. To ensure that no new arrears are accumulated, a sustainable mechanism for electricity consumption and payment by government agencies was discussed. It may involve three elements: (i) improving the way recurrent cost for electricity is budgeted by agencies and consolidated by MOF, to reflect expected actual consumption; and (ii) implementing efficiency measures (no-cost) endorsed by government and which MEM and EDL are working on; (ii) an effective monitoring mechanism of electricity consumption by agencies over time. By MOF's Decision No. 1760 of July 30, 2010 (on file) a Committee led by Mme Viengthong (Vice Minister for Finance) and comprised of the Budget Director, Treasury Director and EDL Director has been established to oversee this issue.

Annex 11: Global Environment Objectives Assessment Details

GEO Indicators

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Value at Completion or Target Years
GEO Indicator 1. Measureable increase in awareness and adoption of EE technologies and practices by consumers				
Number/percent of consumers	(a) Awareness: 50 government agencies. (b) Adoption: 4 central government agency buildings	(a) Awareness: 100% central government agencies, 100 large consumers including 50 industrial and commercial consumers in Vientiane (b) Adoption: 50 government agencies, 4 hospitals, 4 large commercial consumers	n.a.	(a) Awareness: 100% government agencies in Vientiane. At least 9 other large consumers. (b) Adoption: 24 government, 3 hospital, and 23 other public buildings in Vientiane. Thousands of residents and small shops in 17 provinces.
Date Achieved	November 31, 2008	December 31, 2013	–	May 31, 2013
Comment: This outcome has been achieved, with some changes in scope. EE awareness campaigns and circulation of posters were carried out for all government buildings in Vientiane (May 31, 2013). A report was completed on development and implementation framework for pilot DSM program options for commercial and industrial sectors. Fifty public sector buildings were retrofitted in Vientiane, saving equivalent to at least 200 MWh/year (February 7, 2015). Efficient lamps distribution to households and small retail stores nationally resulted in an estimated 9 GWh/year in energy savings.				
GEO Indicator 2: Reduction of the EdL's distribution system loss				
Percent	> 13%	11%	n.a.	13.1%
Date Achieved	December 31, 2008	December 31, 2013	–	December 31, 2014
Comments: This target outcome was not yet achieved at completion. While the project enhanced the EdL's capacity to measure and reduce distribution system loss, the value at completion is largely attributable to factors outside project activities. The value is measured per year.				
GEO Indicator 3: Newly installed renewable energy generation capacity				
MW	–	0.30	n.a.	0.31
Date Achieved	September 30, 2009	December 31, 2013	–	June 30, 2015
Comment: This target outcome has been exceeded. The value at completion is 103% of the target, counting one 260 kW biogas turbine on a pig farm in Vientiane province, and two 25 kW hydro stations for villages in Houaphanh Province.				
GEO Indicator 4: Cumulative GHG emissions reduction				
kt CO_2e	0	About 300	n.a.	< 300
Date Achieved	December 31, 2009	December 31, 2013	–	June 30, 2015

Indicator	Baseline Value	Original Target Values (from approval documents)	Formally Revised Target Values	Value at Completion or Target Years
Comment: The target outcome has been partially achieved. About 75% of the target was expected from distribution system loss reduction, which was not yet achieved at completion. The project nevertheless contributed positively to reduce emissions through other activities. The indicator refers to emissions reduction from EE, bioenergy, and hydropower activities over years 1 to 4 of the project relative to a baseline scenario without the project.				

GEOs Ratings

31. **GEO (a) to increase efficiency of energy supply by the EdL and consumption by consumers** was partially achieved. This is based on two, key associated indicators (a) measurable increase in awareness and adoption of EE technologies and practices by consumers, which was achieved and (b) reduction of the EdL's distribution system loss, which was not achieved. Both indicators are a requirement of the GEF Grant Agreement.

32. **Measurable increase in awareness and adoption of EE technologies and practices by consumers.** This outcome was achieved as evidenced by the project's DSM and EE activities, which saved an estimated total 9.2 GWh per year (around 0.3 percent of total power distributed by the EdL in 2014) from activities as follows.

- **Distribution of 360,000 CFLs** to households and small retail shops nationwide to replace less-efficient incandescent bulbs. Results include (a) an estimated **9 GWh per year** in energy savings; (b) an increase in CFL's share of the lighting market from 61 percent to 88 percent while the incandescent bulbs' share has decreased from 39 percent to 12 percent; and (c) reduced peak demand in the range of 8–39 percent according to studies of five villages (peak demand reduction was expected to be 15 percent). Most users asked were satisfied with the CFLs and noticed lower electricity bills, estimated to be equivalent to saving LAK 6 billion per year per CFL under current electricity tariffs.

- **Retrofitting and behavior change campaigns in 50 public buildings** in Vientiane to improve the efficiency of lighting and air conditioning. These included 24 government agencies and 3 hospitals. Results include **200 MWh per year** energy savings from the 27 buildings for which data were available at completion, most of which reduced consumption by 10–25 percent. The MEM's two buildings were among the top five 'champions' of energy reduction, reducing consumption by 23–30 percent. Annex 2 details further TA outputs that provide a solid foundation for large future energy savings including from scale-up of building retrofits

33. The PAD and GEF Project Paper elaborate 'sub-indicators' for consumer efficiency with target outcomes as follows.

- **Awareness of EE among central government agencies (target 100 percent) and among large consumers in Vientiane** (target: 100, including 50 industrial and

commercial consumers). The value at completion was 100 percent government agencies in Vientiane and at least 9 large consumers. Awareness campaigns and circulation of posters on EE were carried out for all government buildings, as reported in the Midterm Review, and not specifically for other large consumers.[32]

- **Adoption of EE technologies and practices by government agencies (baseline 0, target 50); by hospitals (baseline 0, target 4); and by large commercial consumers** *(*baseline 0, target 4). The value at completion was 24 government agencies, 3 hospitals, and 23 other public buildings as described above. In addition, a report was completed on development and implementation framework for pilot DSM program options for commercial and industrial sectors (IIEC 2015).

34. **Reduction of the EdL's distribution system loss.** The outcome target was to reduce loss from a starting baseline of greater than 13 percent to a target of 11 percent, according to the GEF Project Paper, or less than 13 percent according to the PAD. This outcome was not achieved. Distribution system loss was 13.1 percent for the 12 months to December 2014 while 2015 full data are not available at project closure. The relevant project activity comprised five contracts, between 2012 and 2014, for equipment with a total value of US$1.18 million. These enhanced the potential for the EdL to measure and reduce distribution system loss, but the impact on loss rates over time is indiscernible based on available evidence. This is because (a) progress reports and the M&E framework did not estimate the amount of loss reduction attributable to use of equipment purchased under the project and (b) loss and its change over time (figure 11.1) are attributable to factors besides the equipment contracts. Sections 2.2 and 2.3 detail the reasons for this, one of which is that extension of the grid to serve increasingly remote villages increases system loss over longer lines. The length of distribution lines that the EdL constructed under the project was 85 percent above the target value; 248,000 grid connections not financed by REP II were also added to the system from 2010 to 2014. In addition, several large customers served by low-voltage distribution lines switched to medium-voltage lines in 2013, which caused an extraordinary shift in distribution loss data.

[32] The November 2008 baseline survey found 76 percent of public sector and 66 percent of commercial and industrial consumers were aware of EE. The Midterm Review reports a value of 9 large consumers, as of May 2013, were aware of EE. In addition, 'some' of two large businesses and one small or medium enterprise interviewed in 2015 reported that they regularly received energy conservation information from the MEM and were aware of EE measures (IIEC 2015, 36). Further data to confirm a value for this indicator and its attribution to project activities were unavailable.

Figure 11.1. EdL Distribution System Net Injected Generation and Loss January 2012 to June 2015

Source: EdL.

35. **GEO (b) to adopt substantial renewable energy in RE. Efficacy Rating: High.** The project exceeded this objective and intended outcomes, based on the amount of newly installed generation capacity, an indicator required under the GEF Grant Agreement. The target of 300 kW was exceeded by 3 percent to be 310 kW at completion. This includes one 260 kW biogas turbine at a pig farm in Vientiane Province and the two 25 kW hydro stations serving villages in Houaphanh. The 260 kW biogas turbine has already proved so successful since commissioning in June 2015 that the pig farm hopes to install another. The farm has financial and technical capacity and strong incentives to operate and maintain the turbine as an integral part of the farm's operations, with the mutual benefits of reducing power bills by 10 percent as well as containing pig waste odors and pollution (and avoiding complaints from neighbors). The two 25 kW village hydro stations are likely to be maintained as the villages are sufficiently remote that the grid is unlikely to connect in the foreseeable future.

Greenhouse Gas Emissions Reduction

36. The GEF Project Paper results framework includes an indicator of cumulative GHG emissions reductions. The indicator is not used to evaluate outcome ratings because reducing emissions does not contribute to the GEOs. Rather, emissions reductions was anticipated as a corollary outcome of achieving the GEOs—to increase EE and adopt renewable energy.[33] The GEF Project Paper anticipated emissions reductions of about 300 kt CO_2e after four years from (a) savings from increased efficiency of energy supply by the EdL and consumption by consumers which would increase the EdL's hydropower exports to substitute thermal power generation in Thailand and (b) adoption of rural renewable energy, which would displace diesel that Lao PDR villages otherwise use to generate power.

37. Evidence suggests the reduction target was not fully achieved, though significant emissions reductions can still be attributed to project activities.

[33] The GEF Grant Agreement also did not include this indicator in the list of indicators required to be reported.

- Most (75 percent) of the emissions reductions were anticipated to result from grid distribution loss reduction, from a baseline of 13 percent to the target of 11 percent. Since losses were over 13 percent at closing, GHG emissions would have increased according to the methodology used in the Project Paper (assuming Thailand uses thermal sources to generate the power that would otherwise have been available to import from Lao PDR). However, as section 3.2 describes, it is difficult to attribute any impact from project activities on the EdL's loss rates (and therefore associated GHG emissions).

- In addition to loss reduction, which was expected to reduce emissions by 75 percent, GHG reductions were expected from saving 40–60 GWh per year in government agencies' energy demand, plus 300 kW in added renewable energy capacity. Actual efficiency savings in public sector buildings were around 0.2 GWh per year (IIEC 2015). Nevertheless, the addition of 310 kW in village hydro and biogas is still expected to have reduced GHG emissions.

38. CFL replacement achieved estimated emissions reductions of 3.5 kt CO_2 per year with a lifetime reduction of 24.6 kt. Substantial reduction is inferred to result from grid connections and SHSs displacing power generated from diesel and other GHG-emitting sources. The GEF Project Paper and Restructuring Paper could usefully have accounted for emissions reductions from these activities and revised the indicator target accordingly.

39. The **risk to the GEO is rated low** based on assessment of both GEOs. **The risk that the project's achievement to increase EE will not be achieved or maintained is low.** The EdL is clearly committed to improve distribution system efficiency through the 2013–2018 Power Distribution System Rehabilitation Project with a US$150 million loan from Thailand and 2015–2020 PGIP with a US$30 million IDA Credit. The PGIP will help improve distribution efficiency and reliability in the load area with the highest loss served by the EdL, with the intention that a similar approach is replicated in other load areas over time. The scope and ambition of these investments surpass REP II's US$2 million contribution to loss reduction activities. Consumer energy savings are also expected to be maintained given the observed reduction in energy demand from targeted consumers and shift in market share incandescent bulbs to compact fluorescent lamps. The PGIP also includes efforts to advance consumer energy savings.

40. **The risk that the project's achievement to adopt renewable energy in the government's RE program will not be maintained is low.** The 260 kW biogas turbine has already proved so successful since commissioning in June 2015 that the pig farm hopes to install another. The farm has financial and technical capacity and strong incentives to operate and maintain the turbine as an integral part of the farm's operations, with the mutual benefits of reducing power bills by 10 percent as well as containing pig waste odors and pollution (and avoiding complaints from neighbors). The two 25 kW village hydro stations are likely to be maintained as the villages are sufficiently remote that the grid is unlikely to connect in the foreseeable future.

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