Document of
The World Bank

Report No.ICR00002358

# IMPLEMENTATION COMPLETION AND RESULTS REPORT
(IBRD-73660 TF-56023)

ON A

LOAN
IN THE AMOUNT OF US$50 MILLION

AND A

GLOBAL ENVIRONMENTAL FACILITY GRANT
IN THE AMOUNT OF US$10 MILLION

TO THE

REPUBLIC OF PERU

FOR A

RURAL ELECTRIFICATION PROJECT

December 26, 2013

Sustainable Development Department
Bolivia, Ecuador, Peru and Chile Country Management Unit
Latin American and Caribbean Region

## CURRENCY EQUIVALENTS

(June 30, 2013)

Currency Unit = Nuevo Soles
US$ 1.00 = 2.78 Nuevo Soles

## FISCAL YEAR

[January 1 – December 31]

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ADINELSA | Administration Office of Electric Infrastructure |
| CAS | Country Assistance Strategy |
| CMU | Country Management Unit |
| $CO_2$ | Carbon dioxide |
| DFC-DGER | Directorate of Competitive Funding |
| DEP | Executive Office for Projects |
| DGER | General Directorate of Rural Electrification |
| DGPI | General Directorate of Investment Policy |
| DGPM | General Directorate for Multiannual Programming |
| DP-DGER | Directorate of Projects |
| ERR | Economic Rate of Return |
| ESMAP | Energy Sector Management Assistance Program |
| FIRR | Financial Internal Rate of Return |
| FONAFE | National Fund for Financing the Entrepreneurial Activity of the State |
| FOSE | Fund for Social Compensation of Electricity |
| FY | Fiscal Year |
| GDP | Gross Domestic Product |
| GEF | Global Environmental Facility |
| GEO | Global Environmental Objective |
| GNI | Gross National Income |
| GoP | Government of Peru |
| IBRD | International Bank for Reconstruction and Development |
| ICR | Implementation Completion Report |
| IFR | Financial Monitoring Report |
| ISR | Implementation Status and Results Report |
| kWh | Kilo-Watt/hour |
| MEF | Ministry of Economy and Finance |
| MEM | Ministry of Energy and Mines |
| M&E | Monitoring and Evaluation |
| MTR | Mid-Term Review |
| MW | Mega-Watt |
| MWh | Mega-Watt/hour |

| | |
|---|---|
| NGOs | Non-Governmental Organizations |
| OSINERGMIN | Supervisory Commission for Energy and Mining Investment |
| PAD | Project Appraisal Document |
| PDO | Project Development Objective |
| PEU | Project Executing Unit |
| PNER | National Plan for Rural Electrification |
| PV | Photovoltaic |
| RE | Rural Electrification |
| SIAF | Financial Administration Integrated System |
| SMU | Sector Management Unit |
| SNIP | National System of Public Investment |
| TA | Technical Assistance |
| WTP | Willingness to Pay |

| | |
|---|---|
| Vice President: | Hasan A. Tuluy |
| Country Director: | Susan G. Goldmark |
| Sector Manager: | Malcolm Cosgrove-Davies |
| Project Team Leader: | Janina Franco |
| ICR Team Leader: | Enrique Crousillat |

**PERU**
**Rural Electrification Project**
**CONTENTS**

| A. Basic Information | | | |
|---|---|---|---|
| Country: | Peru | Project Name: | PE Rural Electrification |
| Project ID: | P090116,P090110 | L/C/TF Number(s): | IBRD-73660,TF-56023 |
| ICR Date: | 12/27/2013 | ICR Type: | Core ICR |
| Lending Instrument: | SIL,SIL | Borrower: | GOVERNMENT OF PERU |
| Original Total Commitment: | USD 50.00M,USD 10.00M | Disbursed Amount: | USD 49.34M,USD 3.71M |
| | | | |
| **Environmental Category: B,B** | | **Focal Area**: C | |
| **Implementing Agencies:**<br>MINISTRY OF ENERGY DFC Y DGER | | | |
| **Cofinanciers and Other External Partners:** | | | |

| B. Key Dates | | | | |
|---|---|---|---|---|
| **PE Rural Electrification - P090116** | | | | |
| **Process** | **Date** | **Process** | **Original Date** | **Revised / Actual Date(s)** |
| Concept Review: | 08/03/2004 | Effectiveness: | 08/10/2006 | 08/10/2006 |
| Appraisal: | 10/24/2005 | Restructuring(s): | | 03/26/2010<br>09/27/2010<br>01/14/2011<br>03/13/2012<br>09/24/2012 |
| Approval: | 03/07/2006 | Mid-term Review: | 01/31/2009 | 05/11/2009 |
| | | Closing: | 12/31/2011 | 06/30/2013 |

| PE Rural Electrification - P090110 | | | | |
|---|---|---|---|---|
| **Process** | **Date** | **Process** | **Original Date** | **Revised / Actual Date(s)** |
| Concept Review: | 08/03/2004 | Effectiveness: | | 08/10/2006 |
| Appraisal: | 10/24/2005 | Restructuring(s): | | 07/09/2010<br>03/13/2012<br>09/24/2012 |
| Approval: | 03/07/2006 | Mid-term Review: | | 05/11/2009 |
| | | Closing: | 12/31/2011 | 06/30/2013 |

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

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

| C.3 Quality at Entry and Implementation Performance Indicators | | | |
|---|---|---|---|
| **PE Rural Electrification - P090116** | | | |
| **Implementation Performance** | **Indicators** | **QAG Assessments (if any)** | **Rating:** |
| Potential Problem Project at any time (Yes/No): | No | Quality at Entry (QEA) | None |
| Problem Project at any time (Yes/No): | Yes | Quality of Supervision (QSA) | None |
| DO rating before Closing/Inactive status | Unsatisfactory | | |

| PE Rural Electrification - P090110 | | | |
|---|---|---|---|
| **Implementation Performance** | **Indicators** | **QAG Assessments (if any)** | **Rating:** |
| Potential Problem Project at any time (Yes/No): | No | Quality at Entry (QEA) | None |
| Problem Project at any time (Yes/No): | No | Quality of Supervision (QSA) | None |
| GEO rating before Closing/Inactive Status | Moderately Satisfactory | | |

## D. Sector and Theme Codes

| PE Rural Electrification - P090116 | | |
|---|---|---|
| | Original | Actual |
| **Sector Code (as % of total Bank financing)** | | |
| General public administration sector | 1 | 1 |
| Power | 86 | 86 |
| Renewable energy | 13 | 13 |
| | | |
| **Theme Code (as % of total Bank financing)** | | |
| Infrastructure services for private sector development | 25 | 25 |
| Regulation and competition policy | 25 | 25 |
| Rural services and infrastructure | 50 | 50 |

| PE Rural Electrification - P090110 | | |
|---|---|---|
| | Original | Actual |
| **Sector Code (as % of total Bank financing)** | | |
| General public administration sector | 1 | 1 |
| Power | 79 | 86 |
| Renewable energy | 20 | 13 |
| | | |
| **Theme Code (as % of total Bank financing)** | | |
| Infrastructure services for private sector development | 25 | 25 |
| Regulation and competition policy | 25 | 25 |
| Rural services and infrastructure | 50 | 50 |

## E. Bank Staff

| PE Rural Electrification - P090116 | | |
|---|---|---|
| Positions | At ICR | At Approval |
| Vice President: | Hasan A. Tuluy | Pamela Cox |
| Country Director: | Susan G. Goldmark | Marcelo Giugale |
| Sector Manager: | Malcolm Cosgrove-Davies | Susan G. Goldmark |
| Project Team Leader: | Janina Andrea Franco Salazar | Victoria Susan Bogach |
| ICR Team Leader: | Enrique O. Crousillat | |
| ICR Primary Author: | Enrique O. Crousillat | |

| PE Rural Electrification - P090110 | | |
|---|---|---|
| **Positions** | **At ICR** | **At Approval** |
| Vice President: | Hasan A. Tuluy | Pamela Cox |
| Country Director: | Susan G. Goldmark | Marcelo Giugale |
| Sector Manager: | Malcolm Cosgrove-Davies | Susan G. Goldmark |
| Project Team Leader: | Janina Andrea Franco Salazar | Victoria Susan Bogach |
| ICR Team Leader: | Enrique O. Crousillat | |
| ICR Primary Author: | Enrique O. Crousillat | |

## F. Results Framework Analysis

**Project Development Objectives** (from Project Appraisal Document)
The objective of the proposed Project is to increase access to efficient and sustainable electricity services in rural areas of Peru.

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

**Global Environment Objectives** (from Project Appraisal Document)
The Project's global environmental objective is to achieve reduction of greenhouse gas emissions through use of renewable energy in rural areas for provision of electricity.

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

**(a) PDO Indicator(s)**

| Indicator | Baseline Value | Original Target Values (from approval documents) | Formally Revised Target Values | Actual Value Achieved at Completion or Target Years |
|---|---|---|---|---|
| **Indicator 1 :** | Number of electricity connections by subprojects co-financed with electricity distribution companies outside concession areas. | | | |
| Value (quantitative or Qualitative) | 0 | 160,000 | | 105,045 |
| Date achieved | 02/07/2006 | 12/31/2012 | | 06/30/2013 |
| Comments (incl. % achievement) | 66% accomplished | | | |
| **Indicator 2 :** | Increase in MWh electricity consumed for productive uses. | | | |
| Value (quantitative or Qualitative) | 0 | 18,000 (in first five years) | | 19,107 |

| | | | | |
|---|---|---|---|---|
| Date achieved | 02/07/2006 | 12/31/2012 | | 06/30/2013 |
| Comments (incl. % achievement) | 106% accomplished | | | |

**(b) GEO Indicator(s)**

| Indicator | Baseline Value | Original Target Values (from approval documents) | Formally Revised Target Values | Actual Value Achieved at Completion or Target Years |
|---|---|---|---|---|
| **Indicator 1 :** | Number of electricity connections using renewable energy. | | | |
| Value (quantitative or Qualitative) | 0 | 20,000 | | 7,100 |
| Date achieved | 02/07/2006 | 12/31/2012 | | 06/30/2013 |
| Comments (incl. % achievement) | 36% accomplished | | | |
| **Indicator 2 :** | Reduction in tons of CO2 emissions. | | | |
| Value (quantitative or Qualitative) | 0 | 151,717 | | 5,626 |
| Date achieved | 02/07/2006 | 12/31/2012 | | 06/30/2013 |
| Comments (incl. % achievement) | Target of 151,717 was for first 5 years.<br>Small hydro component was cancelled. Lifetime reduction of residential PV systems is estimated to be 5,626 tons of CO2. | | | |

**(c) Intermediate Outcome Indicator(s)**

| Indicator | Baseline Value | Original Target Values (from approval documents) | Formally Revised Target Values | Actual Value Achieved at Completion or Target Years |
|---|---|---|---|---|
| **Indicator 1 :** | Investments by service providers in rural electrification outside concession areas (US$ million). | | | |
| Value (quantitative or Qualitative) | 0 | 23 | | 29.25 |
| Date achieved | 02/07/2006 | 12/31/2012 | | 06/30/2013 |
| Comments (incl. % achievement) | 127% accomplished | | | |
| **Indicator 2 :** | Issuance of norms, regulations and guidelines and their adoption for all rural electrification projects. | | | |
| Value | 0 | 100% | | Conventional: 75%; |

| | | | | |
|---|---|---|---|---|
| (quantitative or Qualitative) | | | | renewable systems: 100% |
| Date achieved | 02/07/2006 | 12/31/2012 | | 06/30/2013 |
| Comments (incl. % achievement) | | | | |
| **Indicator 3 :** | Number of proposals approved for financing<br>- Conventional grids<br>- Renewable systems | | | |
| Value (quantitative or Qualitative) | 0 | 81 proposals approved for financing<br>- 67 conventional grids<br>- 14 renewable systems | | 63 proposals approved for financing<br>- 54 conventional grids<br>- 9 renewable systems |
| Date achieved | 02/07/2006 | 12/31/2012 | | 06/30/2013 |
| Comments (incl. % achievement) | 78% accomplished | | | |
| **Indicator 4 :** | Increase in number of enterprises adopting electricity using equipment. | | | |
| Value (quantitative or Qualitative) | 0 | 9,000 | | 21,111 |
| Date achieved | 02/07/2006 | 12/31/2012 | | 06/30/2013 |
| Comments (incl. % achievement) | 235% accomplished | | | |
| **Indicator 5 :** | Increase in investment in electricity using equipment (US$ million). | | | |
| Value (quantitative or Qualitative) | 0 | 1.81 | | 15.2 |
| Date achieved | 02/07/2006 | 12/31/2012 | | 06/30/2013 |
| Comments (incl. % achievement) | 840% accomplished | | | |
| **Indicator 6 :** | MW of new small hydropower installed for electricity generation to feed the grid. | | | |
| Value (quantitative or Qualitative) | 0 | 15 | | 0 |
| Date achieved | 02/07/2006 | 12/31/2012 | | 06/30/2013 |
| Comments (incl. % achievement) | Small hydro component was cancelled. | | | |

## G. Ratings of Project Performance in ISRs

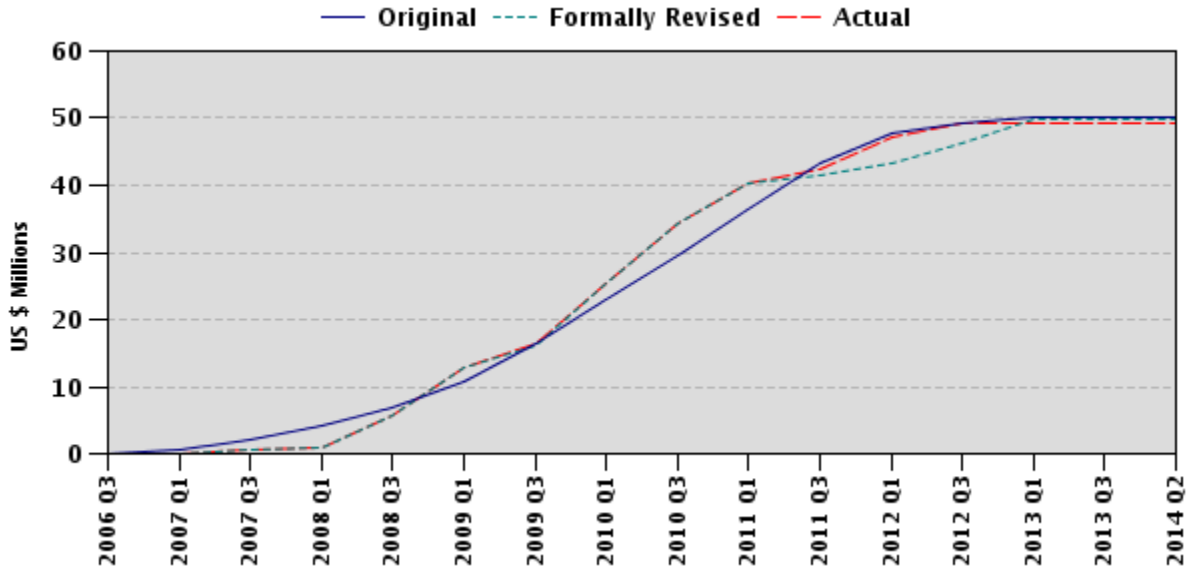
| - | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Date ISR Archived** | **DO** | **GEO** | **IP** | **Actual Disbursements (USD millions)** | |
| | | | | | **Project 1** | **Project 2** |
| 1 | 06/23/2006 | S | S | S | 0.00 | 0.00 |
| 2 | 12/15/2006 | S | S | S | 0.13 | 0.00 |
| 3 | 06/28/2007 | MS | MS | MS | 0.77 | 0.17 |
| 4 | 12/04/2007 | MS | MS | MS | 1.15 | 0.22 |
| 5 | 06/06/2008 | MS | MS | MS | 6.65 | 0.24 |
| 6 | 12/15/2008 | MS | MS | MS | 15.01 | 1.00 |
| 7 | 06/04/2009 | S | MS | S | 17.46 | 1.11 |
| 8 | 11/30/2009 | S | MS | S | 30.46 | 1.20 |
| 9 | 05/21/2010 | S | MS | S | 39.43 | 1.66 |
| 10 | 02/21/2011 | S | MS | S | 41.79 | 2.40 |
| 11 | 08/22/2011 | S | MS | S | 46.30 | 2.67 |
| 12 | 03/01/2012 | S | MU | MS | 49.39 | 3.16 |
| 13 | 10/28/2012 | U | MS | U | 49.39 | 3.84 |
| 14 | 07/07/2013 | MS | MU | MS | 49.39 | 4.13 |

## H. Restructuring (if any)

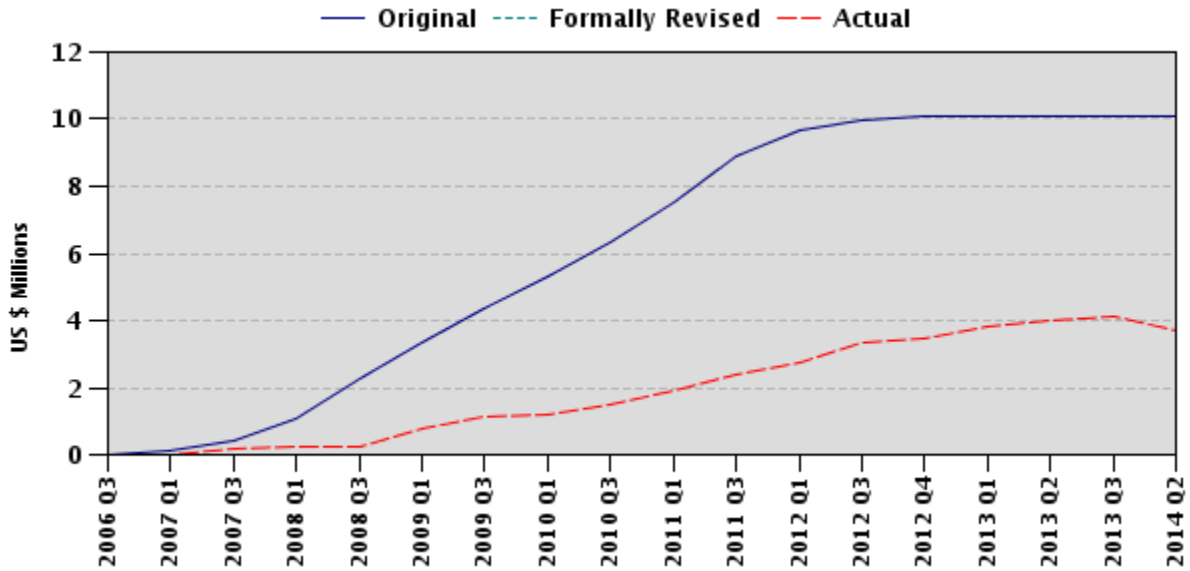
| Restructuring Date(s) | Board Approved | | ISR Ratings at Restructuring | | | Amount Disbursed at Restructuring in USD millions | | Reason for Restructuring & Key Changes Made |
|---|---|---|---|---|---|---|---|---|
| | PDO Change | GEO Change | DO | GEO | IP | Project1 | Project 2 | |
| 03/26/2010 | | | S | | S | 34.43 | | |
| 07/09/2010 | | | | MS | S | | 1.66 | Reallocation of the Global Environment Facility (GEF) grant funds. |
| 09/27/2010 | | | S | | S | 40.39 | | Reallocation of the IBRD loan funds. |
| 01/14/2011 | | | S | | S | 40.39 | | Nine month extension of the closing date of the IBRD loan funds. |
| 03/13/2012 | | | S | | MS | 49.39 | | Change the definition of “Rural Electrification Providers”. |
| 03/13/2012 | | | | MU | MS | | 3.33 | Change the definition of “Rural Electrification Providers”. |
| 09/24/2012 | | | S | | MS | 49.39 | | Nine month extension for the Loan Agreement; cancellation of US$608,641.31 from the Loan Agreement and; cancellation of Component 4 of the Project (financing small hydropower stations). |
| 09/24/2012 | | | | MU | MS | | 3.84 | Cancellation of US$5 million from the GEF Grant Agreement and; cancellation of Component 4 of the Project (financing small hydropower stations). |

## I. Disbursement Profile

P090116




P090110



## 1. Project Context, Development and Global Environment Objectives Design

### 1.1 Context at Appraisal

**a. Country Political and Economic Background**. Peru is the fourth largest country in South America, after Brazil, Colombia, and Argentina. It spans over 1.28 million square kilometers and has an estimated population of 30 million and a density of 23 inhabitants per square kilometer. During the preparation and implementation of the Rural Electrification Project, Peru experienced stable political conditions and highly favorable economic growth with annual GDP growth of 6.8 percent form 2006-2013. With a GNI per capita above US$10,000 (PPP) in 2012, Peru has one of the best performing economies of Latin America.

Sustained economic growth over recent years has had a positive impact on reducing poverty and creating jobs, but poverty (26 percent nationally in 2012) and inequality still remain a major concern. Poverty continues, despite healthy macro-economic growth, mainly because growth has been driven by capital-intensive industries, particularly commodity extraction, which have a low demand for labor and hence a low direct impact on poverty.

The national poverty rate masks important differences across urban and rural areas, and across regions. An estimated 8 million people live in rural areas, accounting for 29 percent of the population.[1] Poverty levels are notably higher in rural areas where the percentage of people living in poverty in 2012 was 53 percent compared to 14.5 percent in Lima.

**b. Sectoral and Institutional Context**

**Electricity sector.** The electricity sector in Peru was reformed in 1992, resulting in separation of generation, transmission, distribution and regulation, and the creation of the regulatory body, OSINERG, later OSINERGMIN. Cost-recovery tariffs based on an efficient enterprise model were introduced. Generation and transmission were largely privatized. Private companies are responsible for electricity distribution in Lima (Edelnor and Luz del Sur) and a few other urban centers. In the rest of the country, including rural areas, public distribution companies are responsible for electricity service. Distriluz, comprising four regional companies (Electro Centro, Electro Noroeste, Hidrandina and Electro Norte) is the largest public company with about 1.5 million customers. There are about twenty public distribution companies in total, some of the larger ones being Sociedad Eléctrica del Sur Oeste (Arequipa), Electro Sur Este (Cusco) Electro Oriente (Iquitos), Electro Puno (Puno) and Electro Sur (Tacna). The public distribution companies are under the control of the National Fund for Financing the Entrepreneurial Activity of the State (FONAFE), which controls budgets and investments of publicly owned companies in all sectors. Most public electricity distribution companies have reasonable performance, including losses of less than 12 percent and payment rates above 95 percent.

**Rural Electrification**. During preparation of the Rural Electrification (RE) Project in 2005, rural electrification coverage was estimated at 30 percent, one of the lowest in Latin America, particularly low for a middle-income country. This estimate was confirmed in the 2007 census, showing 29.5 percent coverage. Electricity distribution companies hold concessions concentrated in small areas around urban centers, with an obligation limited to meet service requests within

[1] According to the census definition of rural population centers, i.e. population centers that have less than 100 homes grouped contiguously and that are not district capitals.

100 meters of their existing network. As a result, since the power sector reform of the early nineties, rural electrification had been based on 100 percent direct investment by the central government. To expand coverage, the Government of Peru (GoP) had been investing, in the ten years prior to the Project, an average of US$40-50 million per year for electrification. Investments were carried out through the Executive Office for Projects (DEP), a division of the Ministry of Energy and Mines (MEM). DEP planned, designed and constructed projects. After construction, rural electricity systems were turned over either to state-owned distribution companies, or to ADINELSA, a specially created state-owned asset-holding company that manages more isolated and less profitable rural systems under operation contracts with state-owned companies, or municipalities.[2]

Prior to the Project, there had been limited progress in leveraging additional funds from service providers or in addressing the electricity demand of isolated areas (off-grid), and developing renewable energy technologies. This was an important gap because MEM estimated that more than 300,000 dispersed rural households in Peru could only be reached with renewable energy, mainly individual solar photovoltaic (PV) systems.[3]

The GoP gave high priority to rural electrification during Project preparation and implementation. It recognized that lack of electricity in rural areas, together with lack of access to other infrastructure, resulted in lower quality of life, poor medical care and education, and limited opportunities for economic development. The high priority of rural electrification was reflected in MEM's annual National Plan for Rural Electrification (PNER).[4] During appraisal, MEM's goal in the 2004 Plan was to increase rural electricity coverage to 75 percent by 2013 and to mobilize US$860 million for this effort during the next ten years (2004-2013).

c. **Rationale for Bank assistance**. The Bank's participation in the Project supported the objectives of access to basic services and decentralization as set out in the Country Assistance Strategy (CAS) discussed by the Board on December 7, 2004. By contributing to the expansion of electricity service, the project aimed to improve the quality of life in rural areas and, through the productive uses promotion program, to increase opportunities for commercial and agro-industrial activities. The Project aimed also to demonstrate an approach to rural electrification that would result in more efficient provision of rural electricity services and higher leveraging of subsidies of the central government with funds from others, including electricity service providers.

The Project was also consistent with the Bank's Country Partnership Strategy (CPS) for 2007-2011, which aimed to support the country's efforts to increase economic growth and fight poverty. The Project supported two of the main pillars of the CPS: social development and economic growth. In fact, the social development pillar had a specific goal of increasing access to electricity in rural areas from 30 to 65 percent. The PNER for 2012-2021 estimated that rural electricity coverage reached 63 percent by the end of 2011.

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

The objective of the Project was to increase access to efficient and sustainable electricity services in rural areas of Peru. The Project would achieve this by: (a) investment in sub-projects to supply

[2] Under this scheme, sometimes the distribution companies were reluctant to accept the rural electrification projects and they were turned over to ADINELSA for operation.

[3] See MEM, *Plan Maestro de Electrificación Rural con Energía Renovable*, 2008.

[4] http://dger.minem.gob.pe/ArchivosDger/PNER-2004-2013.pdf

electricity services to about 160,000 currently unserved rural households, businesses and public facilities, such as schools and health clinics (serving about 800,000 people), using both conventional grid extension and renewable energy sources; (b) demonstration of key elements of a framework for electricity provision in rural areas of Peru that would attract investment from private and public sector electricity providers, as well as national, regional and local governments; and (c) implementation of a pilot program to increase productive uses of electricity that would increase opportunities for income generation in rural areas. The key performance indicators were the number of new electricity connections, as well as increased productive use of electricity in targeted rural areas.

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

The project's global environmental objective was to achieve reduction of greenhouse gas emissions through use of renewable energy in rural areas for provision of electricity. The key global performance indicator was avoided carbon dioxide ($CO_2$) emissions. Total estimated emission reductions from facilities installed during the project's life were estimated at 3.61 million metric tons of $CO_2$, over the lifetime of the systems. Annex 3 of the PAD contains two other indicators, MW of renewable generation and numbers of connections based on renewable energy generation.

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

No changes were made to the PDO or the related performance indicators. During the mid-term review and subsequent supervision missions, it became clear that the Project would not reach the target values set for the new connections indicators, mainly due to higher costs and the delayed establishment of a rural tariff for isolated systems, as explained in Section 3.2. Consequently, the Bank team recommended that the indicator targets be revised downward. However, the Ministry of Economy and Finance (MEF) indicated that, while it considered the Project satisfactory despite not meeting the original indicators, its practice in such situations was not to formally revise the indicators but to maintain the original values and explain the situation in the completion report. Therefore, the target values of the indicators were not formally revised.

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

No changes were made to the GEO. However, GEF-financed Component 4: Financing Facility for Small Hydropower, was cancelled in September 2012 (see section 1.8). As part of the cancellation, the key indicator of emission reductions of carbon dioxide and MW of renewable energy generation capacity were eliminated.

### 1.6 Main Beneficiaries

As intended, the Project benefited rural households and small enterprises, in particular those of the rural poor. More than 105,000 households and small businesses, representing about 450,000 people, benefited from receiving new electricity connections, including around 35,000 indigenous people and around 2,900 schools, health clinics and community centers. Of these, 7,100 households (i.e. 31,540 people) living in isolated areas received electricity service using solar home systems.

The Project was also instrumental in the establishment of a national tariff for regulated service with household offgrid PV systems, first published by OSINERGMIN in August 2010. This tariff, together with OSINERGMIN's decision that PV customers would be eligible for the FOSE cross-subsidy to small consumers, opens the way for sustainable and regulated electricity provision with household PV systems to the 300,000 households that cannot be reached by the grid.

Finally, the Project's productive uses promotion component assisted more than 21,000 rural producers, including women who comprised more than a third of the beneficiaries, to adopt electricity-using equipment that increased their productivity and incomes. The Second RE Project will continue both the rural electrification with household solar home systems and the productive uses promotion activities of the Project, which are expected to be sustained beyond the life of both Projects by MEM's rural electrification team together with participating distribution companies.

### 1.7 Original Components (as approved)

The Project had five components: (a) investment in rural electrification sub-projects, to provide new electricity connections for rural households, businesses and public facilities, using both conventional grid electricity or renewable energy systems; (b) technical assistance for rural electrification and promotion of renewable energy; (c) a pilot program to promote productive uses of electricity; (d) a small hydro financing facility; and (e) project management. These components are described below:

**Investment in rural electrification sub-projects** was to provide service to about 160,000 newly connected rural households, businesses, and health centers, schools and community centers. The target was based on cost estimates per connection from 2005. The Project was to provide targeted capital cost subsidies to public and private electricity service providers investing in rural electrification.[5] Rural electrification sub-projects were defined as projects to provide service to new customers outside of existing concession areas, using both conventional grid extension and renewable energy. Subsidies would be calculated individually for each subproject to make investments financially viable. The sub-projects would meet minimum criteria such as an acceptable rate of economic return under the SNIP system, a minimum of 10 percent investment contribution from the distribution company, and an adequate return on investment to the distribution company. It was estimated that about 20,000 of the rural connections to be financed would involve systems using renewable energy. This component financed directly the desired outcome of expansion of efficient and sustainable access. *(Estimated cost US$114.325 million: US$43.375 million IBRD, no GEF.)*

**Technical assistance for rural electrification**. Technical assistance was to be provided to support the implementation of the proposed rural electrification approach, including: (a) development of the institutional framework and regulations for rural provision of electricity service, on- and off-grid; (b) capacity building for demand-driven and decentralized identification, planning and development of projects; (c) promotion of private sector investment in rural electrification; and (d) renewable energy promotion. This component financed activities that would contribute to the outcome by helping distribution companies build capacity to develop rural subprojects, and helping develop regulatory arrangements for increasing access through

[5] Consumption cross subsidies would also be provided, separately, under the existing *Fondo Social de Electrificación* (FOSE) scheme, to customers that use less than 100 kWh per month.

renewable energy. *(Estimated cost US$3.75 million of which US$0.75 million IBRD and US$2.5 million GEF.)*

**Pilot Program for Promotion of Productive Uses of Electricity.** This component supported productive uses of electricity. The approach was one of capacity building to assist potential productive users, user groups and communities to identify opportunities, barriers and solutions; working closely with the electricity service suppliers to ease access; and facilitating access to other necessary services, including financing. This component financed measures to increase electricity access of rural producers who were failing to utilize electrical equipment and thus contributing to low consumption levels in rural electricity systems. *(Estimated cost US$3.95 million of which US$2.0 million IBRD and US$1.5 million GEF.)*

**Small Hydro Financing Facility**: Funds under this component were to be used to leverage private equity and commercial debt financing for grid-connected small hydro generating plants that would sell power to the interconnected grid. The Facility was to assist in the financial closure of small hydroelectric plants (capacity less than 10 MW) on a project finance basis. The facility would provide 'bridge-financing' for small hydro projects, i.e. loans, at commercial interest rates, covering the period of construction and initial operation; the loans would then be refinanced by commercial banks. Beneficiaries would be private companies that would invest in, own, and operate the plants. This component was to have financed activities leading to a decrease in $CO_2$ emission, thus contributing to the GEO. *(Estimated cost US$15.0 million, of which US$5.0 million GEF.)*

**Project Management.** This component supported the overall management of the proposed Project. It comprised three activities:

a. Technical management of project investment activities;
b. Project administration (procurement and financial management); and
c. Monitoring and evaluation, including safeguards.

### 1.8 Revised Components

The only significant change in components was the cancellation of the Small Hydropower Financing Facility (Component 4). While the Project made a significant effort to implement this Facility, MEM ultimately concluded in September 2012 that the component could not be implemented and the funds were cancelled. Also, GoP's objective to develop small hydro was met through a policy alternative to the Project (section 2.2). Prior to cancellation, the Project tried several options for its implementation, including hiring a qualified company to act as a Fund Manager and, subsequently, a set of specialists to promote the Facility. Expressions of interest for 14 sites were presented but none of the sponsors was able to satisfy the requirements (technical, environmental, and social, and evidence of co-financing). No other significant changes were made to the components during implementation.

### 1.9 Other significant changes

**Implementation Arrangements.** The GoP, together with local and regional governments, strengthened efforts to increase electrification during Project implementation. MEM increased investment in electrification markedly, from an annual average of US$40-50 million to more than US$150 million, and reaching a peak of US$200 million in 2010. As part of these efforts, a Rural Electrification Law was passed in July 2006 and its regulations published in 2007.

The new legal framework changed the institutional setup for rural electrification and affected the Project. From July 2006 until December 2007, an independent Project Executing Unit (PEU) under the Vice Minister of Energy executed the Project. In September 2007, the Government passed Supreme Decree No. 026-2007-EM that established the Directorate General of Rural Electrification (DGER) within MEM. Two Directorates were created under the DGER. The larger Directorate of Projects (DP-DGER) replaced the former Executive Directorate of Projects (DEP), and executes MEM's 100 percent subsidy model of rural electrification. The other, the Directorate of Competitive Funds (DFC-DGER), replaced the PEU as executing agency of the Bank and GEF-assisted RE Project. In December 2007, the Project's loan and grant agreements were revised to recognize the DGER as the executing agency. MEM maintained the staff of the former PEU to achieve a smooth transition.

**Extensions of loan and grant for a total of eighteen months**. In January 2011, the Bank approved a nine-month extension of the loan, extending the closing date from December 31, 2011 to September 30, 2012. In April 2011, the Bank authorized an eighteen-month extension of the grant agreement to June 30, 2013. In September 2012, a second extension of the loan was granted to June 30, 2013.

## 2. Key Factors Affecting Implementation and Outcomes

### 2.1 Project Preparation, Design and Quality at Entry

**a. Fit with CAS and Government Priorities**. Project design was well aligned with the CAS and the objectives of subsequent Peruvian administrations to invest in rural infrastructure and social inclusion. Government support for the Project from both MEM and MEF has been strong and consistent, partly because some of its challenging activities –early involvement of distribution companies, household PV systems to serve isolated populations and the promotion of productive uses of electricity – support the development strategy of the Government.

**b. Soundness of the Background Analysis**. Project design was based on the knowledge obtained from the ESMAP and MEM supported "Peru National Survey of Rural Household Energy Use" (2005), a comprehensive rural energy survey conducted by the Bank that provided a valuable input for the Project's design and economic justification. The PAD included a summary of the economic analysis and annexes with the background on the sector and the implementation arrangements that were followed largely as originally set out.

**c. Incorporation of Lessons Learned in Previous Rural Electrification Efforts**. Rural projects in Argentina, Bolivia, Chile, Ecuador, Laos, Philippines, and Vietnam were studied to inform the Project's design. Especially important was experience from Latin American countries that used similar approaches to subsidize distribution companies for rural electrification, including Chile, Ecuador, and El Salvador. Lessons incorporated were: (a) need for detailed and clear procedures to estimate financial viability of projects and amounts of subsidy required; (b) productive uses promotion was needed to increase demand and economic impact; (c) approval of sub-projects should be based on a simple, clear and transparent methodology; and (d) criteria for allocation of subsidies should assure that the least-cost technology, including renewable energy, is used when viable. Renewable energy technologies were integrated into the Project. To this end, GEF financing was included to help develop institutional and regulatory requirements, as well as build capacity and provide technical assistance.

**d. Risks**. A set of political, institutional, and commercial risks was identified at preparation level. None of these risks materialized. However, a risk that was realized but not foreseen was the impact of a new policy for renewable energy that offered a highly competitive financing option for small hydropower plants and, as the Small Hydro Financing Facility was no longer needed, it was cancelled.

## 2.2 Implementation

The Project was rated satisfactory throughout most of its implementation and rarely required major management attention. A Mid-Term Review (MTR) took place May 11-22, 2009. The main conclusions were:

- The Project's performance was considered satisfactory with respect to development objectives, implementation, and fiduciary requirements.
- 47 percent of the funds for the rural electrification component were committed.
- In view of the early commitment of loan funds, MEF put on record its intention to investigate the possibility of additional financing. This resulted in approval of the Second Rural Electrification Project in 2011.[6]
- The slow disbursement of GEF funds, then at less than 10 percent, was recognized as a problem and it was agreed to accelerate the use of these funds.
- The replacement of four specialists and the addition of a specialist in monitoring and evaluation were proposed.
- Safeguards were rated as moderately satisfactory and measures were agreed to improve the ratings.
- The Bank recommended that MEM should: (a) seek to reduce the target value of several performance indicators, including the number of total electricity connection and PV systems to 120,000 and 10,000 respectively; and (b) solicit changes to the implementation arrangements of the Small Hydropower Facility.

While the Project succeeded in implementing most of its innovative activities, the following challenges were faced after the MTR: (a) difficulties in implementation of the Small Hydropower Financing Facility that resulted in its cancellation; (b) delays in execution of the productive uses promotion and rural electrification with household PV system activities; and (c) delays by the distribution companies of right-of-way payments. Restructuring was carried out a number of times to adjust implementation arrangements to changing circumstances (e.g. cancelation of a specific component, allocation of unallocated resources), and to extend the Project closing date by a total of 18 months.

**a. Difficulties in implementation of the Small Hydropower Financing Facility.** The Project made a significant effort in implementing this Facility, however, the market response was weak. The limited number of subprojects presented was mainly due to changes in the conditions for financing small hydropower projects after Project effectiveness. It could be argued, also, that the design of the Facility did not take full advantage of potential of donors' financing; i.e. bridge-financing was designed to address project construction risks, but did not incorporate the financing characteristics most appealing to long-term hydropower investments: a longer tenor. In 2008, the GoP passed a Law to Promote Renewable Energy Development, which introduced renewable energy auctions to select projects that would receive an attractive premium price for electricity generated. In the first auction held in 2009-2010, the GoP signed contracts with 17 small

[6] MEF proposed on a four-year implementation period, too long for an additional financing option.

hydropower projects, ranging from 1.5 MW to 19.9 MW, for a total of 161.7 MW, with a price ranging from US$55 to US$70/MWh. In the second auction held in 2011, the GoP signed contracts for 7 projects representing additional 100 MW at prices averaging US$53/MWh.[7]

With the introduction of the premium price, credible sponsors of small hydro projects were able to finance projects with conventional means. Only small projects with weaker sponsors sought financing under the Project's Facility, but none of them was able to meet the requirements of the Project, as noted above. After various efforts made to implement the facility, and acknowledging that the objectives of the Project were already met through a parallel promotional policy (the renewable energy auctions), the DFC-DGER consulted the Bank the possibility to change the use of the funds for the installation of hydro-meteorological stations and pre-feasibility studies for specific project, but these were not eligible to GEF financing as they did not directly reduce carbon emissions. Finally, the GoP requested the cancellation of the component late in the Project life, in September 2012.

**b. Delays in execution of productive uses and renewable energy projects**. The late implementation of both productive uses and PV related subprojects meant that these activities ran up against the closing date of the Project and determined the need for a first extension to ensure the achievement of the Project's development objectives.

After effectiveness, MEF required that MEM prepare a prefeasibility study for the productive uses component for SNIP approval, before beginning implementation. After approval, the DFC-DGER needed to finalize selection of target areas, and develop contracts for the promotion work. The first contract, that tested the model, was signed in September 2008 and completed in November 2009. Two additional contracts were completed by December 2010 and March 2011. A further six contracts were signed in mid-2011, and another six in December 2011. The productive uses component ultimately exceeded expectations, making a unique contribution to integrating rural electrification into overall development efforts.

With respect to PV system projects, the delays were mainly caused by the need to establish a tariff for regulated service with household PV systems and access to the FOSE subsidy for such customers before the distribution companies were willing to apply for financing for subprojects using these systems. These conditions were met in August 2010. Subsequently, 10 subprojects were presented and approved for financing, 9 of which were completed.

**c. Delays in right of way payments**. The sub-project subsidy agreements signed between MEM and the distribution companies established that the companies would be responsible for meeting all safeguard requirements according to Peruvian law and Bank safeguards. Most of the companies complied with these obligations. With respect to payments for right-of-way, most companies used a specifically appointed manager, often associated with the construction contractor. However, two of the nine companies, Electrocentro and Hidrandina, fell behind in making such payments. This was the main reason for the second extension of the loan, to maximize right-of-way payments before closing.

**d. Project Response to Difficulties**. The DFC-DGER was pro-active in working with the distribution companies, OSINERGMIN, and other stakeholders to find solutions and solve problems. The Project was successful in completing almost all activities, to the satisfaction of

[7] These two auctions imply a private investment in the order of US$500 million in medium and small hydropower plants.

MEM and MEF, as well as the participating distribution companies and communities, with the exception of the Small Hydropower Financing Facility.

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

The Monitoring and Evaluation design, implementation, and utilization were in general satisfactory. There were a limited number of outcome and intermediate outcome indicators that provided an adequate insight into the Project's achievements. The DFC-DGER included a monitoring team that maintained accurate measures of the Project indicators, and provided additional information that is useful for analyzing impact (e.g. data bases of Project beneficiaries provided insight into gender as well as average electricity consumption per household in each subproject). The monitoring team conducted appraisals of subprojects that identified benefits of electrification as perceived by households and problems such as supply interruptions due to system constraints, etc. As stipulated in the loan and grant agreements, the DFC-DGER supplied to the Bank semester progress reports, including an update of results indicators and results of surveys of beneficiaries.

With respect to the key indicator(s) on 'new connections', there were differing views on whether these targets had to be met during the Project's implementation period or during a more extended timeframe,[8] since the total capacity of connections of the infrastructure installed has a lifetime of 20 years and not all of the connections would be made during the initial construction of the subprojects. Although the effectiveness of setting targets to be met after the implementation period could be questioned, this lack of specificity in setting indicators has been addressed in the preparation of the second RE Project.

The Bank's criteria in rating Project performance was not uniform throughout the implementation period. A few months prior to closing, the Project was downgraded due to short term implementation problems; this meant switching the focus from a longer term PDO criteria to short term project implementation issues. That is, changes in ratings responded to a different assessment criteria rather than the Project's likelihood of achieving its development objectives. This lack of uniformity provided an uneven message to Management and the Borrower.

### 2.4 Safeguard and Fiduciary Compliance

**a. Environmental and Social Safeguards**. The Project triggered several World Bank safeguard policies as identified in the PAD: (i) Environmental Assessment (OP/BP/GP 4.01); Indigenous Peoples (OP 4.20 being revised as OP4.10, Involuntary Resettlement (OP/BP 4.12) and Safety of Dams (OP/BP4.37). Since the Component to finance small hydropower plants was cancelled and no such plants were financed, the Safety of Dams Policy was not applied.

Environmental and social screening was required for all sub-projects prior to approval and appropriate management plans were prepared and executed. Guidelines for preparation and implementation of rural electrification subprojects were developed and training was provided to electricity distribution companies and contractors to ensure good environmental and social practices for aspects such as site-cleanup and communication with local residents. All rural electrification projects were screened for the presence of indigenous peoples, and where they

[8] ISR14 states that "since systems have 20 year life and not all connections would be made during construction, this implies that the number of new electricity connections would be defined as capacity for number of new connections".

were identified, indigenous peoples development plans were prepared. Screenings, assessments and final reports were reviewed and approved by the Bank.

With respect to Involuntary Resettlement, two cases of families being moved were reported and reviewed. The Bank specialist concluded that they had been handled in a satisfactory way. Although most electricity distribution companies complied with required payments for right of way, two distribution companies were late in organizing and completing these payments. This ongoing problem is in part attributed to: (a) inadequate emphasis given by the involuntary resettlement framework to right of way payments; and (b) the fact that contracts for installation companies did not spell out payment responsibilities and arrangements. The Project, distribution companies, and Bank staff were actively engaged in ensuring compliance with this requirement. DFC-DGER reported that 86 percent of the amount of the right of way payments corresponding to 84 percent of the affected people had been made by July 31, 2013. DFC-DGER reports that obstacles faced in the compliance of the right of way payments include, *inter alia*, the absence of land titles, difficulties in locating owners, and the owners' perception that the amount to be paid did not justify the time and expenses to cash it.

**b. Financial Management and Audits**. Overall, financial management arrangements were satisfactory. Centralization of project administration in the hands of qualified and experienced staff, combined with stability of key staff and utilization of the Financial Administration Integrated System (SIAF), led to satisfactory financial management arrangements. The Project consistently provided timely and reliable financial information. Audits did not identify reportable conditions and unqualified opinions were submitted. Furthermore, financial monitoring reports (currently called IFRs) were delivered in timely fashion and recommendations were implemented on an ongoing basis.

**c. Procurement.** The DFC-DGER was responsible for procurement, in coordination with the electricity distribution companies, in the case of rural electrification subprojects. The DFC-DGER was responsible for the procurement plan and supervising the contracting processes. The electricity distribution companies were responsible for conducting the contracting process for construction of subprojects, including preparing contracts and terms of reference, evaluating offers, and contracts management. These responsibilities were handled in a satisfactory manner. The procurement plan was implemented each year as defined. The performance of DFC-DGER in general, and the distribution companies, was generally satisfactory, with some larger companies demonstrating higher levels of competence in this area.

### 2.5 Post-completion Operation/Next Phase

The Project financed rural electrification subprojects in collaboration with distribution companies, technical assistance activities and the promotion of productive uses of electricity. The technical assistance for rural electrification and renewable energy development does not require explicit post-completion measures since it has been absorbed by the MEM and many of the tools and studies developed are in active use. The other two components face separate issues with respect to sustainability:

***Rural Electrification Sub-projects:*** The Project has succeeded in establishing a model where distribution companies, with the technical support of DGER, propose, construct, own, and operate a large number of rural electrification sub-projects. The grid extension subprojects were designed to be financially viable after the application of the partial capital cost subsidy. However, in general costs have been higher than expected and consumption levels lower. Recent estimates

indicate that, as an aggregate, distribution companies will yield returns that would allow them to keep the subprojects functioning during their expected lifetime. However, a capital subsidy in the order of 85 percent, as opposed to the 75 percent given by the Project, would be necessary for the companies to achieve their target rate of return of 12 percent. The unenthusiastic response of distribution companies to the Second RE Project is evidence of this financial difficulty. While the challenge of the Second project may be addressed through a higher subsidy to capital costs, the underlying problem has a regulatory nature. It is evident that the progress made by the country in scaling up the expansion of electricity services to remote and more costly areas (through the Project and a larger 110 percent public initiative) requires a revision of the tariff system, particularly a more frequent revision of the 'typical section 5' (low density markets), that has been lagging behind. The GoP is aware of this issue, and options for its solution are being considered.

Other problems that may affect the sustainability of this component are: (a) possible bottlenecks in the sub-transmission lines that feed the rapidly expanding network of small rural systems. DGER is aware of this issue and recently announced a decision to use its funds to support expansion of the lines; and (b) the PV model for isolated areas is not yet fully tested as the first subprojects were implemented late in the Project's life. A positive signal is that ADINELSA, who has been operating about 4,000 solar home systems for about 2 years before the approval of the national tariff has presented another 4,000 solar home systems for financing under the Second Rural Electrification project. Once placed within the framework of the national PV tariff and the FOSE cross-subsidy, such arrangements should be sustainable from a financial and commercial standpoint. Once placed within the framework of the national PV tariff and the FOSE cross-subsidy, such arrangements should be sustainable from a financial and commercial standpoint. The MEM is currently assessing the experience of the Project's PV model for its future use. However, although there are no concerns about the sustainability of the PV systems installed by the Project, the replication of the delivery and regulatory model for PV is being threatened by MEM's massive plan to auction and install hundreds of thousands of PV systems within a very short period (less than two years), thus casting doubts on the future use of the Project's PV model, as well as on the sustainability of MEM's ambitious plan.

***Promotion of Productive Uses of Electricity*.** In this component, the Project provides TA through NGOs to rural producers to help them adopt electricity-using equipment. The sustainability of the operation of the equipment depends on the continued operation of producers. The adoption of electricity-based production processes implies –besides enhanced production and greater efficiency– an improvement in terms of sustainability as new equipments are generally simple, with maintenance support available in rural markets, and easily managed by the producers. The NGOs and the distribution companies involved in this component have a long-term commitment in the areas,[9] and have also demonstrated that they will continue to support productive users of electricity as part of their regular development activities.

[9] The distribution companies realizing the benefits of supporting rural producers increase their energy consumption for load management

## 3. Assessment of Outcomes

### 3.1 Relevance of Objectives, Design and Implementation

The Project's objective of increasing access to efficient and sustainable electricity service in rural areas of Peru remains **highly relevant** in the light of the current Government's commitment to social inclusion.[10] The National Plan for Rural Electrification for the 2013-2022 period sets higher than ever goals for rural electricity coverage, of 92.4 percent by 2020. The continued support to rural electrification and consistently positive perception of the Project from MEM and MEF in the past and current administrations[11] are evidence of its ongoing relevance.

Overall, the Project's design is fully consistent with its development objectives and, hence, **highly relevant**, since it includes investment components that directly address the electricity access and sustainability objectives, complemented by a productive uses component to enhance the economic and financial benefits of the said investments, and technical assistance to facilitate its implementation and sustainability. In the light of these ambitious goals, three of the Project's innovative activities included in the original design are particularly valuable: (a) a more efficient grid extension approach aimed at maximizing the use of project resources and mobilizing additional financing through the active involvement of distribution companies; (b) promotion of productive uses of electricity in rural areas; and (c) assistance to distribution companies to provide the first off-grid regulated service using household PV systems. As rural electrification has progressed, it is the hardest to reach isolated households that can only be reached by nonconventional means such as household PV systems supported by the Project.

Technical Assistance supported by the RE Project enabled OSINERGMIN to adopt the first national PV tariff for regulated service (BT-8 tariff) and to make PV system users eligible for the cross-subsidy to small electricity consumers under the FOSE. That is, the provision of electricity through PV systems is now regulated at the national level based on a cost-recovery tariff for a quality service that is complemented by a cross subsidy for low income customers. These are unique and important building blocks for providing service to the 300,000 households that cannot be reached by conventional grid extension. Also, the Project's pilot in promotion of productive uses of electricity reached more than double the number of entrepreneurs expected, with 21,111 rural entrepreneurs having invested their own funds in electricity using equipment, to improve their productivity and incomes. The Project's pioneer experience in productive uses of electricity had a significant impact and it has been incorporated into the national rural electrification plan (PNER 2013-2022) as the Government no longer sees rural electrification in isolation, but as an instrument of rural development.

According to the most recent Country Partnership Strategy (CPS) for FY12-FY16, the Bank Group's aim is to help the Government achieve four objectives: (a) increased access and quality of social services for the poor; (b) connecting the poor to services and markets; (c) sustainable growth and productivity; and (d) inclusive governance and public sector performance. The Project is directly relevant to the current Bank strategy, mainly to objective (b) by proving

[10] The first speech of this Government's premier in August 2011 highlighted productive uses of electricity in the context of social inclusion. Moreover, the promotion of productive uses of electricity has been included in MEM's National Plan for Rural Electrification (PNER 2013-2022).

[11] MEF's view of the Project as satisfactory is reflected, among other expressions, by the special report highlighting the Project in SNIP's *Boletín Político de Inversiones, Lima, Noviembre de 2011, p.7* "*Una experiencia en electrificación rural usando fondos concursables.*"

increased access for rural people to electricity services, and also to objectives (a) and (c) through the provision of electricity to schools and health centers, and the productive uses component, respectively.

### 3.2 Achievement of Project Development Objectives and Global Environment Objectives

**Project Development Objective**

The objective of the proposed Project was to increase access to efficient and sustainable electricity services in rural areas of Peru by: (a) investments in sub-projects to supply electricity services, using both conventional grid extension and renewable energy; (b) demonstrating key elements of a framework for electricity provision in rural areas that would attract co-investment; and (c) the implementation of a pilot program to increase productive uses of electricity. Compliance with the key performance indicators associated to the PDO and Project components are presented in Annex 2.

The Project's contribution in increasing rural electrification access is expected to be sustainable since subprojects have been developed, constructed and are being operated by distribution companies that took ownership of the subprojects since the initial stage and work within a regulatory framework that promotes efficiency and has historically guaranteed the financial sustainability of efficient operations. Overall, the Project's performance in achieving its PDOs is considered **Moderately Satisfactory**. The Project met most of the targets with the exception of the Small Hydro Facility that was cancelled due to reasons associated mainly to a change on the GoP's renewable energy policy that made it unnecessary (section 2.2). As shown in Annex 2, while some indicators were surpassed, others were not fully met.

As noted (section 1.4) the MEF, MEM and the Bank were aware since the Mid Term Review (May 2009) that the Project was not going to be able to fully meet the targets of the two key indicators associated to number of connections. It was suggested that MEM and MEF seek a formal restructuring of the Project to revise such indicators. However, MEF indicated that its approach to implementation of public investment projects did not allow changing the indicators after Project design; rather, their practice is to retain the original indicator and explain the reasons why a Project may be considered successful despite the deviation from the expected result. It is worth noting that if the main targets would have been adjusted as per the MTR recommendations,[12] compliance with the total number of electricity connections and connections using renewable energy would have been 87.5 percent and 71 percent respectively (instead of 66 and 36 percent). Further elaboration on the results for each outcome is given below.

***(a) Results of investment in RE subprojects (indicator: number of connections) – Moderately Satisfactory***. The Project installed infrastructure for connections to over 105,000 mostly households (an estimated 450,000 people), including approximately 2,900 schools, clinics and community centers, increasing rural electricity coverage by 5.9 percent. While making a significant contribution towards rural electrification, the additional number of connections installed is 34 percent below the original indicator of 160,000 due to higher average costs per connection, i.e. US$1,100 versus an estimate in preparation of US$715 (February 2006). Costs were higher and, subsequently, the number of connections lower mainly for a set of exogenous reasons that could not be foreseen during preparation: (a) in July 2006, after effectiveness, the RE Law mandated that the cost of about US$100 for the household connection and meter be included

[12] Reducing the number of new connections to 120,000 and the number of PV systems installed to 10,000.

in the capital cost rather than being paid by the household. This change was welcomed as it made access easier, but it also raised the cost per connection by about 14 percent; (b) the value of the Nuevo Sol increased by 20 percent against the dollar between February 2006 and 2012; and (c) inflation in local construction costs, accelerated by the GoP's high investments in rural areas, further increased connection costs. Together, these factors explain great part of the cost increase that resulted in a reduction in the number of connections achieved. On this basis, it is evident that Project's shortcomings in meeting the original targets of this component are not a reflection of an inefficient implementation but the result of mostly exogenous factors and the inflexibility of a government policy that did not allow changing the performance indicators.[13]

***(b) Results of Demonstration of a Framework for Electricity Service Provision that would attract co-financing (intermediate indicators: co-investment by service providers; and issuance of norms, regulations and guidelines for rural electrification)- Satisfactory.*** The Project succeeded in demonstrating a framework for rural electrification where the distribution companies developed, constructed and co-financed the rural electrification subprojects. The framework was institutionalized within the DGER through the creation of the DFC-DGER, within MEM, with the sole purpose of implementing projects with distribution companies using the model of the Project. Nine distribution companies in sixteen regions participated in co-financing the Project, mobilizing an average of 25 percent of co-investment (compared to the 20 percent expected in design), for a total of US$29 million, surpassing the target of US$23 million. While most of the participating distribution companies are publicly owned, one of the subprojects was with Edelnor, a private company operating in the Lima area.

The Project was instrumental in developing an innovative model for regulated service by electricity distribution companies using PV systems, based on national tariffs set by the regulator and access to the FOSE cross-subsidy for such clients. The establishment of a regulated service for isolated PV systems has been a very relevant accomplishment to address sustainability issues of these systems and a unique achievement in the Latin American region. The Project also financed subprojects to provide regulated electricity service to 7,100 households using PV systems. Although the number of individual household systems was less than foreseen in preparation due mainly to budget constraints associated to cost overruns explained in the previous section and the time it took for the adoption of the tariff, the achievement of a national tariff for PV systems offers a sound framework for the provision of a sustainable electricity service to the large number of households that will not receive service from the grid.

***(c) Demonstration of a pilot program to promote productive uses of electricity (indicator: additional consumption of electricity for production) – Highly Satisfactory.*** Fourteen contracts with NGOs for the promotion of productive uses were completed by Project close. The assistance to rural producers to adopt electricity using equipment, further increased access and sustainability. As shown in the table, this component was highly successful in meeting or surpassing all its targets.

[13] It is worth noting that if the main targets had been adjusted as per the MTR recommendations, compliance with the total number of electricity connections and connections using renewable energy would have been 87.5 percent and 71 percent respectively (instead of 66 and 36 percent).

| Indicator | Target | Actual |
|---|---|---|
| Increase in MWh electricity consumed for productive uses. | 18,000 (in first five years) | 19,107 |
| Intermediate Outcome Indicator | | |
| Increase in number of enterprises and families adopting electricity using equipment. | 9,000 | 21,111 |
| Increase in investment in electricity using equipment (US$ million) | 1.81 | 15.2 |

The program areas ranged from the semi-arid coastal communities, to the Andean highlands and the Amazon rain forests. The pilot project activities have helped families, small and micro-enterprises, and cooperatives to adopt electricity and use equipment to process rice, cereals, coffee, cocoa, baked goods, meat products, milk, wood and metal products and handicrafts, and to pump water for expanded agricultural production and processing. It is estimated that the program has benefited directly more than 100,000 people, and seems to have been effective reaching women producers as they comprised more than a third of the beneficiaries. Overall, the economic value of the annual consumption of electricity associated to the program is in the order of one million US dollars.

This component is a rare international example of highly successful promotion of productive uses that is documented in the ESMAP-supported report "Promoting productive uses of electricity in rural areas of Peru: Experience and lessons learned" and the World Bank featured the productive uses promotion activity on its webpage announcing the latest CPS. The activity will be continued in the Second RE Project now underway in Peru and has the potential for scale-up by the Ministry with rural electrification funds, as it has been incorporated in the National Rural Electrification Plan 2013-2022.

**Global Environmental Objective Outcome Rating**

The Project's global environmental objective was to achieve reduction of greenhouse gas emissions through use of renewable energy in rural areas. Key global performance indicators proposed at appraisal were avoided carbon dioxide emissions and the number of new electricity connections using renewable energy. As noted in section 2.2, the main component associated to the Project's Global Environmental Objectives, i.e. Small Hydro Financing Facility, was cancelled as global environmental objectives were met (and surpassed) through a renewable energy auctions policy that was alternative to the Project.[14]

Despite not reaching the number of connections using PV systems, the Project succeeded in developing an innovative and unique model for regulated service by electricity distribution companies using household PV systems, based on national tariffs set by the regulator and access to the FOSE cross-subsidy for such clients. This provides a sustainable model that could be

[14] Although the success of the renewable energy auctions cannot be attributed to the Project, the World Bank conducted during that period two studies on hydropower development that helped enhance the debate on the issue. These were: (a) "Peru: Overcoming Barriers to Hydropower", May 2010; and "Institutional and Financial Framework for development of Small Hydropower", June 2008. The two auctions held implied a private investment in the order of US$500 million in medium and small hydropower plants

applied to the remaining 300,000 households that cannot receive service from the grid. The Second RE Project now underway was designed to install an additional 20,000 systems.

It must be noted also, that GEF-assisted activities made important contributions to renewable energy development that go beyond the direct $CO_2$ reduction target. In addition to the national PV tariff for regulated service with PV systems, noteworthy contributions assisted by the GEF included: (a) the National Atlases of Wind and Small Hydropower Potential (Hidro-GIS), both of which provided data that assisted the development of projects presented in the second renewable energy auction; (b) pre-feasibility studies to assist the development of subprojects using 7,000 PV systems that were co-financed by GEF funds in the Project and four electricity companies; and (c) support for promotion of productive uses in areas with predominantly renewable energy that assisted more than 20,000 entrepreneurs. Hence, the Project's performance in meeting its GEO outcome is considered **Moderately Unsatisfactory**.

### 3.3 Efficiency

An important characteristic of the Project's design and implementation was its special attention to an efficient use of resources. In this respect, the Project's performance was **Satisfactory.** Salient features of this efficiency focus are: (a) the Project design incorporated incentives for an efficient use of subsidies that succeeded in mobilizing considerable investment from distribution companies; (b) the Project yielded positive economic returns as foreseen at appraisal; and (c) it demonstrated a more efficient use of public resources through its effort to reduce the electricity access gap in rural areas.

The design of the component on Rural Electrification Subprojects aimed to ensure efficiency, as selection of subprojects required that each be economically and financially viable, taking into account the capital cost subsidy. Subsidies were calculated for each subproject at the level required to allow the service provider to invest and earn the rate of return specified by law. On this basis, the average distribution company investment was 25.5 percent, ranging from 18 to 40 percent.[15]

The Project generated significant positive economic returns, with moderate shortcomings in terms of delays that resulted in an extension of eighteen months. The total cost of the Project is estimated at US$131 million as compared to the original estimate of US$144.5 million. The Project completed almost all planned activities, with the exception of the Small Hydropower Financing Facility, where US$5 million GEF funds were cancelled together with US$10 million funds expected from private investors.

The economic rate of return of the Project is estimated at 21.3 percent,[16] which compares to the ERR of 23.7 percent estimated at appraisal. The main differences relate to higher capital costs and higher willingness to pay (WTP) values, which tend to compensate each other. In the PAD, average benefits were estimated using WTP estimates obtained from the preliminary results of the rural energy survey. The analysis in the ICR uses values obtained from the survey as presented in

[15] Overall, distribution utilities expressed their satisfaction in participating in the Project, in spite of the additional financial responsibility involved (compared to the 100 percent capital investment subsidy of MEM's main RE program). An advantage noted by some (Electro Noroeste, Electro Sureste) was the ownership and better preparation gained through their involvement at the early stages of subprojects.

[16] 21.9 percent for grid extension subprojects and 10.3 percent for PV. It should be noted, however, that these are conservative estimates of the economic performance of the project as a whole, because the benefits of the very successful productive uses component are only partially incorporated.

the National Survey of Rural Household Energy Use (shown in Annex 3), as well as actual project costs.

An important measure of the Project's efficiency is reflected in its outstanding contribution in improving rural electricity coverage in the country relative to the overall public investment effort. During the period 2007-2012 rural coverage improved from 29.5 percent to 63 percent. This means an increase in 33.5 percent of which the Project contributed in 5.9 percent (corresponding to 105,045 new connections), i.e. 18 percent of the outcome is directly attributed to the Project. On the other hand, the Project's share of the Government's total investment in rural electrification (which was US$ 898 million for the same period) was only 11 percent of that investment, thus revealing a much more efficient use of public resources.

### 3.4 Justification of Overall Outcome and Global Environment Outcome Rating

**Rating—Overall Outcome:** Moderately Satisfactory

A **Moderately Satisfactory** rating is assigned based on the high relevance of the Project's objectives and innovative design, its positive outcomes in terms of the sustainability and efficiency of its components –in particular, the exceptional success of the productive uses component, in spite of the fact that the target of an important indicator (number of connections) was not fully met and that the Small Hydro Facility was cancelled. It is worth noting that the Project outcomes have been consistently considered successful by all parties involved, MEF, MEM, and the Bank (SMU and CMU), despite the fact that it was known since the mid-term review that the said indicator target –which remained unchanged– would not be met fully. This view, as well as the moderately satisfactory rating for the overall outcome, reflect the acknowledgment that, independent from the rigidities of an administrative process, the Project actually made a positive contribution to the country's and sector's development objectives as set in the PDOs. Furthermore, the Project's contribution goes beyond the Peruvian context as its successful experience in implementing innovative approaches is being studied by countries such as Bolivia, Argentina, Haiti, and South Africa, and replicated in other countries in Africa.

**Rating—Global Environment Outcome:** Moderately Unsatisfactory

A **Moderately Unsatisfactory** rating is assigned for the Global Environmental Outcome. While the relevance of activities in rural electrification is high, the rating is low due to the cancellation of the Small Hydro facility (the main component aimed at reducing greenhouse gas emissions that was cancelled and its objectives assumed by an alternative renewable energy policy), the subsequent smaller than expected impact on carbon emissions as well as the smaller number of renewable energy based connections. However, it is recognized that GEF-assisted activities of the Project made a contribution towards the future development of renewable energy resources in: (a) assisting the establishment of a national tariff for PV electricity supply to rural households and the eligibility of such customers for the FOSE cross-subsidy; and (b) assessing wind and small hydropower energy resources.

### 3.5 Overarching Themes, Other Outcomes and Impacts

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

Activities on expanding service coverage of electricity and promotion of productive uses of electricity were targeted toward low-income rural areas. In these areas, access to electricity has brought many benefits to low income population, including women and indigenous people,[17] as shown by surveys undertaken by the Project monitoring team (Annex 5). Among other benefits, beneficiaries noted that the number of productive hours was extended by improved lighting, thus enabling social and productive processes to take place over a longer span of hours. Electric lighting provides a healthy living environment (e.g. better indoor air quality and higher quality light, fewer respiratory illnesses and accidents from kerosene lighting, and more leisure time) and enables access to valuable information, through different means of communication (e.g. television, computers) thus enhancing education. Women specially were appreciative of improved safety as a result of street lighting. In combination with indoor electrical lighting, this has resulted in more evening social activities among women, as well as increased study time by young people.

In the productive uses promotion activity, 30 percent of the beneficiaries were women nationwide, while in the rural highlands (Cuzco, Puno and Ancash) this figure reached 50 percent. The implementation approach, while not deliberately designed with gender in mind, was effective in reaching women producers. The result came naturally as women entrepreneurs are represented in a broad range of productive activities and play a significant role in areas of production such as baked goods, milk production, ceramics, and textiles.

#### (b) Institutional Change/Strengthening

The Project has had important impacts in strengthening institutions through the activities carried out in all components. First, through the investment in rural electrification component, electricity distribution companies have strengthened their capacity to develop rural electrification projects. Second, through the productive uses promotion component, the DGER, NGOs, and distribution companies have all experienced a stronger awareness, and improved its capacity, to assist rural entrepreneurs to benefit from electricity. The DGER's policies on rural electrification now stress its development impact through the incorporation of productive uses activities. Third, the Project's activities to support rural electrification with the use of household PV systems have strengthened the capacity of the DFC-DGER, OSINERGMIN, and the electricity distribution companies in this area. Fourth, the wind and hydropower atlases prepared by the Ministry have enhanced knowledge about renewable energy resources in Peru.

### 3.6 Summary of Findings of Beneficiary Survey

Annex 5 summarizes the findings of surveys on beneficiaries carried out by the Project monitoring team.

[17] About 8 percent (about 35,000) of the Project beneficiaries were indigenous people.

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

**Rating—Overall:** Negligible or Low

The rural electrification subprojects used proven technologies and will continue to be operated by electricity distribution companies for their lifetime, under the supervision of OSINERGMIN. The electrical equipment adopted by rural enterprises in the productive uses components is in common use. Its operation and maintenance is well supported by rural markets. The continuity secured by the approval of the Second RE Project ensures that MEM's support for the capacities developed for rural electrification subproject design and operation, especially for subprojects with PV systems, and for productive uses promotion, will remain in place and available to the stakeholders of the RE Project for another four years.

While the grid extension component of the Project will require some regulatory adjustments in the future, subprojects will yield returns –even at current tariff levels– to allow distribution companies to keep them functioning satisfactorily during their expected lifetime.

**Rating—GEF:** Negligible or Low

The PV subprojects used proven technologies and will continue to be operated by electricity distribution companies for their lifetime, under the supervision of OSINERGMIN. The GoP's commitment to continued rural electrification with renewable energy can be seen in the 2009 Master Plan for Renewable Energy and in the 2012 National Plan for Rural Electrification that prioritize renewable energy development. The policies to develop renewable energy electricity are off to a very promising start that exceeds the modest results expected in the RE Project. This is reflected by the adjudication of a premium price for 262 MW of small hydropower in the 2010 and 2011 renewable energy auctions, compared to the expected results of 15 MW within the RE Project.

## 5. Assessment of Bank and Borrower Performance

### 5.1 Bank Performance

#### (a) Bank Performance in Ensuring Quality at Entry

**Rating:** Moderately Satisfactory

Project design involved the assessment and proposal of innovative approaches to rural electrification that were consistent with the nature of the challenges and remain highly relevant. The PAD was highly detailed in terms of implementation arrangements, including criteria for selection of subprojects that continue to be used with little change in the Second RE Project. The Project has proceeded essentially as designed, with the exception of the cancellation of Small Hydro Facility. Funds were committed early and the success of the Project led to the approval of the Second Rural Electrification Project in 2011. As noted, there were shortcomings in the outcome indicators. Although it is recognized that establishing down-to-earth outcome indicators is particularly difficult when dealing with innovative approaches, the definitions of the term "connections" could have been more precise. Also, arrangements for assuring implementation of safeguards requirements could have been better defined. These lessons were incorporated into the design of the Second RE Project. There were no fiduciary issues.

**(b) Quality of Supervision**

**Rating:** Moderately Satisfactory

The Bank actively supervised the Project, frequently reengaging with new government authorities following changes at the presidential and ministerial levels. Support was attained from new authorities and efforts were made to accelerate project execution as much as possible. Fiduciary and safeguard aspects operated smoothly, and according to interviews with the implementing agencies, the technical advice of the Bank team was generally considered valuable. Restructuring was carried out a number of times to adjust implementation arrangements to changing circumstances, and to extend the Project by a total of 18 months. There were some shortcomings with respect to early detection of problems with late payments for rights of way by distribution companies, especially Hidrandina and Electrocentro, and the inability to re-allocate the funds for the Small Hydro Facility when this was cancelled. Also, lack of consistency in the criteria for rating the Project's performance may have caused some confusion.

**(c) Justification of Rating for Overall Bank Performance**

**Rating:** Moderately Satisfactory

Taking into account preparation and supervision ratings, an overall rating of moderately satisfactory is assigned.

**5.2 Borrower Performance**

**(a) Government Performance**

**Rating:** Moderately Satisfactory

Ownership and commitment to achieving the development objectives was strong from the Bank's counterpart, MEF. The Project enjoyed an adequate level of support, high quality technical supervision by professionals of DGPM, later changed to DGPI, and budget allocations were adequate and timely. Although SNIP procedures for approval of subprojects were initially cumbersome, they were streamlined during implementation. However, the Government's current program for a massive and quick development of PV systems could jeopardize the future of the Project's innovative PV model and the sustainability gains that this model offers.

**(b) Implementing Agency or Agencies Performance**

**Rating:** Moderately Satisfactory

The implementing agency of the Project was the Ministry of Energy and Mines, through the PEU in 2006 and 2007, and the DGER from December 2007 to Project close in 2013. There was considerable continuity of staff until 2008 and implementation proceeded smoothly. While the Project unit kept a strong staff, some key staff resigned in 2009 and there were delays in their replacement. This, together with the lack of a Director of the DFC for much of this time, contributed to weaker Project implementation during the last two years of the Project. In particular, the supervision of some safeguards aspects was not fully adequate.

**(c) Justification of Rating for Overall Borrower Performance**

**Rating:** Moderately Satisfactory

The ratings for the Government and the Implementing Agency result in an overall Borrower performance rating of Moderately Satisfactory.

## 6. Lessons Learned

**Scaling-up Rural Electrification brings about pressures on the financial situation of distribution utilities, and the power sector as a whole, which require regulatory action.** A significant effort in expanding electricity services to remote and costly areas, may entail structural changes in the electricity market that require a revision or update of the regulatory regime. The slow progress of the Second RE project is evidence of this constraint. A more frequent revision of the tariff regime that responds to the structural changes caused by rapid expansion in coverage – the increase in rural customers, their growing share in the consumer base, and the higher costs of distribution as coverage is expanded– is required to ensure the sustainability of the rural electrification effort.

**The potential conflict between the long-term nature of Rural Electrification and short-term political objectives requires a sustained commitment and understanding of authorities to avoid distortions in programs' design and implementation**. In the Peruvian case the Project has been under constant pressures from –and comparisons with– a larger public RE program that tended to prioritize short-term outcomes above sustainability objectives. Furthermore, current GoP plans for a massive and quick development of PV systems may jeopardize the future of the Project's sustainable PV model. This may be an unavoidable threat that requires the understanding and long-term commitment of the Central Government, as well as building alliances with those interested in a sustainable RE program: local Governments, distribution utilities, and other local/regional stakeholders. The early involvement and empowerment of these stakeholders could be an effective way to achieve greater sustainability.

**A Rural Electrification program that engages distribution companies from the early stage and is complemented by a regulatory framework that targets barriers to development and provides the right incentives is likely to defeat the 'common wisdom' that distribution companies are not interested in rural electrification.** The Project's approach to involve distribution companies from the early stages of grid-extensions sub-projects proved to be instrumental in gaining the companies' ownership, a better design and ensuring their financial contribution. Also, the incorporation of isolated PV systems into the power sector regulatory framework, complemented by reliable funding for subsidies, provided the required assurances to service providers and distribution companies to engage in the PV systems business.

**Promotion of Productive Uses of Electricity can be a highly beneficial component of a RE project, particularly in middle income countries where a critical mass of entrepreneurs is present**. The Project's promotion of productive uses was innovative, important and highly beneficial, as it engaged NGOs with recognized presence in the field and its technical assistance and financial support was tailored to each case. The distribution companies, who were initially reticent, were able to understand the benefits from supporting productive uses of electricity for their load management. The benefits of a well designed technical assistance and investment support provided by the Project were multiple: (a) extending the benefits of rural electrification to both communities and electricity companies; (b) actively involving a considerable number of women; (c) improving the relationship between the client and the electricity company; (d) helping create awareness of Project activities; and (e) building capacity of communities, individuals and NGOs to improve livelihoods through use of electricity. The DGER's policies now recognize that the promotion of productive uses of electricity is key to achieving long term development impacts of rural electrification.

**Safeguard issues need to be addressed thoroughly at an early stage and incorporated into the project design in order to minimize negative and/or irreversible impacts**. The effective identification of social and environmental impacts, and the pertinent safeguards, should be matter of an early and thorough assessment and incorporated into the design of bids and contracts, including the explicit definition of all parties' responsibilities in meeting safeguard requirements. In particular, right of way payments should be explicitly defined in both the subsidy contract and the construction contract, and included in the construction contractor's responsibilities and costs.

**A precise definition of Key Performance Indicators and the accurate estimation of values, as well as a flexible use of them, are requirements for an effective and smooth monitoring and evaluation.** The definition of "connections" lacked precision at Project preparation and the values of some indicators needed to be adjusted. The inflexible practice of not adjusting indicators, even when technically justifiable, prevented a more effective and accurate monitoring and evaluation of the project. In the PAD of the Second RE Project, the definition of the PDO was separated from the achievement of key indicators, the definition of connections was clarified and themore realistic targets were estimated for the indicators values were estimated conservatively, taking into account the most recent experience and factors of uncertainty such as exchange rate changes and inflation.

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

### (a) Borrower/implementing agencies

Annex 7 summarizes the findings and conclusions of the Borrower's draft Completion Report.

### (b) Co-financiers

N/A

### (c) Other partners and stakeholders

N/A

## Annex 1. Project Costs and Financing

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

The following table compares the original costs estimates by component with actual costs, as of April 30, 2012. The main difference is that US$5.0 million of the GEF grant that was committed to the Small Hydropower Financing Facility Component was cancelled with no disbursements. This also resulted in the elimination of US$10 million in counterpart funding of Component 4, reducing the total Project cost by US$15 million.

| Components and sub-components | | Sources (US$million) | | | | |
|---|---|---|---|---|---|---|
| | | IBRD | GEF | GoP | Distrib. Utilities | Total |
| **1. Rural electrification subprojects** | PAD estimates | **43.38** | **---** | **47.85** | **23.10** | **114.33** |
| | Actual | **44.16** | **---** | **44.69** | **29.25** | **118.10** |
| **2. TA for rural electrification and renewable energy** | PAD estimates | **0.75** | **2.5** | **0.50** | **---** | **3.75** |
| | Actual | **0.50** | **1.84** | **0.69** | **---** | **3.03** |
| **3. Pilot program to increase productive uses of electricity** | PAD estimates | **2.00** | **1.50** | **0.45** | **---** | **3.95** |
| | Actual | **1.36** | **0.99** | **0.45** | **---** | **2.80** |
| **4. Small hydro financing facility** | PAD estimates | **---** | **5.00** | **---** | **10.00** | **15.00** |
| | Actual | **---** | **---** | **---** | **---** | **---** |
| **5. Project management** | PAD estimates | **2.75** | **1.00** | **2.65** | **---** | **6.40** |
| | Actual | **3.20** | **0.88** | **3.56** | **---** | **7.64** |
| **Unallocated & front end fee** | PAD est. | **1.12** | **---** | **---** | **---** | **1.12** |
| | Actual | **0.12** | **---** | **---** | **---** | **0.12** |
| **Total** | PAD estimates | **50.00** | **10.00** | **51.45** | **33.10** | **144.55** |
| | Actual | **49.34** | **3.71** | **49.39** | **29.25** | **131.69** |

## Annex 2. Outputs by Component

**The table below presents the project's outputs by the closing date.**

| Objective/Output | Indicator | Baseline | Target * | Actual *(% accomplished)* |
|---|---|---|---|---|
| Increase access to efficient and sustainable electricity in rural areas of Peru | Number of electricity connections by subprojects co-financed with electricity distribution companies outside concession areas. | --- | 160,000 | 105,045 *(66%)* |
| | Increase in MWh electricity consumed for productive uses. | --- | 18,000 (in first five years) | 19,107 *(106%)* |
| Global Environmental Objective: Reduction of greenhouse gas emissions through provision of electricity using renewable energy. | Number of electricity connections using renewable energy. | --- | 20,000 | 7,100 *(36%)* |
| | Reduction in tons of $CO_2$ emissions. | --- | 151,717 (in first five years) | Small hydro component was cancelled. Lifetime reduction of residential PV systems is estimated to be 5,626 tons of $CO_2$ |
| **Intermediate Outcome Indicators** | | | | |
| | Investments by service providers in rural electrification outside concession areas (US$ million) | 0 | 23 | 29.25 *(127%)* |
| | Issuance of norms, regulations and guidelines and their adoption for all rural electrification projects. | --- | 100% | Conventional: 75%; renewable systems: 100% |
| | Number of proposals approved for financing<br>• Conventional grids<br>• Renewable systems ** | --- | <br>81<br>67<br>14 | <br>63 *(78%)*<br>54<br>9 |
| | Increase in number of enterprises adopting electricity using equipment. | --- | 9,000 | 21,111 *(235%)* |
| | Increase in investment in electricity using equipment (US$ million) | --- | 1.81 | 15.2 *(840%)* |
| | MW of new small hydropower installed for electricity generation to feed the grid. ** | --- | 15 | Small hydro component was cancelled. |

* It is worth noting that if the main targets would have been adjusted as per the recommendation made by the Bank during the Mid Term Review, i.e. to reduce the targets for total electricity connections and connections using renewable energy to 120,000 and

10,000 respectively, compliance with these two indicators would have been 87.5 percent and 71 percent.

** Intermediate Outcome Indicator associated to the Global Environmental Objective

*Source: ISRs and MEM's completion report.*

## Annex 3. Economic and Financial Analysis

### Economic Analysis

Following the Appraisal's approach, the economic analysis focuses on the main component: investment in rural electrification sub-projects that encompassed grid extension and off-grid PV sub-components. This component accounted for 90 percent of the Project's total cost.

The economic internal rate of return (ERR) of the aggregate is 21.3 percent and its net present value (NPV) is estimated at US$80.7 million, based on a 10 percent discount rate that, as at appraisal, is considered to be the economic opportunity cost of capital in Peru. These results compare to an ERR of 23.7 percent estimated at appraisal for the same component of the Project. It should be noted, however, that these are conservative estimates of the economic performance of the project as a whole, because the benefits of the very successful productive uses component are minimally incorporated (to the extent that households electricity consumption capture some of the small enterprises supported by the project). The magnitude of these benefits are reflected by the additional consumption of electricity associated to these productive uses (in the order of 9,500 MWh/year), that valued at an average distribution tariff of 10 US.cents/kWh, would yield an additional benefit of around one million US$ per year.

**- Grid extension sub-component**

**Costs:** The analysis includes the actual investment cost of US$108.5 million for 92,152 residential connections to the grid, including capital investment and connection costs, and excluding taxes and duties. It includes also annual O&M costs (3.3% of investment costs) plus the cost of energy that is estimated on the basis of a tariff of S/. 0.154 per kWh (5.92 US.cents/kWh) that reflects supply costs (for generation and transmission).

**Benefits:** New users replace kerosene lamps or alternative forms of lighting and other uses of energy by electricity and start to consume considerably more given the lower price. Surveys carried out among households recently connected to the grid by the Project indicate an average consumption of 20.98 kWh per month. Willingness to pay for electricity is reflected by the savings in traditional energy resources according to the following table.

| | Willingness to Pay PAD Estimate S./kWh | Willingness to Pay Final Survey S./kWh |
|---|---|---|
| Household <15 kWh/m | 2.3 | 4.27 |
| Household > 15-30 kWh/m | 1.4 | 1.57 |
| Household > 30 kWh/m | | 0.66 |
| Other <= 90 kWh/m | 3.20 | 3.50 |
| Other>= 90 kWh/m | | 0.66 |

Source: National Survey of Rural Household Energy Use

Other assumptions are:

- Installations have an economic life of 15 years.
- Residential consumption of electricity will increase at an annual rate of 2 percent.
- Exchange rate: Nuevo Sol 2.61 per US$

**Grid Extension Component – Cost and Benefits (thousand US$)**

| Year | Households Connected | Capital Cost | Cost of Energy | O&M 1/ | Total Cost | Total Benefits 2/ | Net Benefits |
|---|---|---|---|---|---|---|---|
| 1 | 92,152 | 108,457 | 0 | 0 | 108,457 | 0 | -108,457,1 |
| 2 | 0 | 0 | 1,371 | 3,590 | 4,961 | 27,992 | 23,030,8 |
| 3 | 0 | 0 | 1,384 | 3,590 | 4,974 | 28,510 | 23,535,1 |
| 4 | 0 | 0 | 1,398 | 3,590 | 4,988 | 29,039 | 24,050,2 |
| 5 | 0 | 0 | 1,412 | 3,590 | 5,002 | 29,579 | 24,576,3 |
| 6 | 0 | 0 | 1,426 | 3,590 | 5,016 | 30,130 | 25,113,1 |
| 7 | 0 | 0 | 1,441 | 3,590 | 5,031 | 30,691 | 25,659,9 |
| 8 | 0 | 0 | 1,455 | 3,590 | 5,045 | 31,264 | 26,218,5 |
| 9 | 0 | 0 | 1,470 | 3,590 | 5,060 | 31,848 | 26,787,9 |
| 10 | 0 | 0 | 1,484 | 3,590 | 5,074 | 32,444 | 27,369,2 |
| 11 | 0 | 0 | 1,499 | 3,590 | 5,089 | 33,052 | 27,962,3 |
| 12 | 0 | 0 | 1,514 | 3,590 | 5,104 | 33,672 | 28,567,4 |
| 13 | 0 | 0 | 1,529 | 3,590 | 5,119 | 34,305 | 29,185,2 |
| 14 | 0 | 0 | 1,545 | 3,590 | 5,135 | 34,950 | 29,814,9 |
| 15 | 0 | 0 | 1,560 | 3,590 | 5,150 | 35,609 | 30,458,5 |
| 16 | 0 | 0 | 1,576 | 3,590 | 5,166 | 36,280 | 31,113,9 |
| | | | | | | NPV: | **$80,563,5** |
| | | | | | | IERR: | **21.9%** |

1/ Based on MEM estimates

2/ Based on WTP of 4.27 soles <15kWh/mo and 1.57 soles from 15-30kWh/mo

This yields an economic ERR of 21.9 percent and a NPV of $80.6 million.

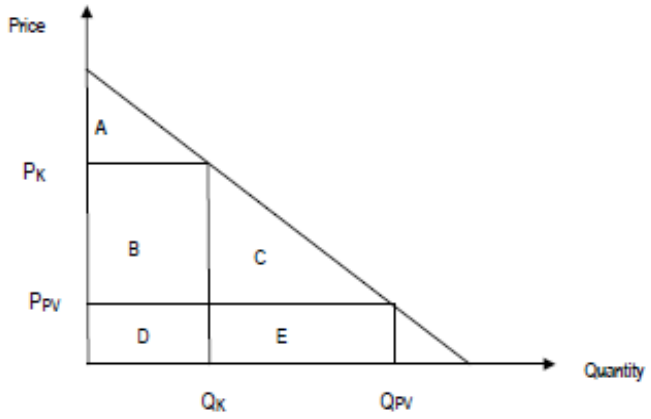
**- Photovoltaic sub-component.**

The economic internal rate of return for the residential solar component is 10.3 percent. These results are based on actual data for energy consumption per household of 8.96 kWh per month per household. Data and assumptions on costs and benefits are presented below.

**Costs:** The analysis includes the actual investment cost of US$6.54 million for 7,100 Photovoltaic Home Systems installed by the project. It includes also a cost of US$156 per household per year for O&M costs plus the annualized cost of the replacement of batteries every five years, and an economic life of fifteen years.

**Benefits:** SHS have two types of benefits: on one hand, they substitute the expense associated with traditional energy sources, i.e. lighting and communications devices, such as kerosene lamps, candles, gas and batteries, by solar panels whose running costs are practically negligible (replacement of parts and batteries are considered as maintenance costs and are taken into account in the analysis). In addition to the savings over traditional lighting and communications devices, PV systems make available more energy —and of better quality—and, therefore, they bring additional welfare benefits to the beneficiaries. Benefits are explained in the figure below that represents schematically the rural household demand for energy.

When using traditional energy, users consume $Q_K$ at price $P_K$ and the value of saved traditional energy resources is given by areas B+D. Once the consumer adopts a PV system, demand increases to $Q_{PV}$ at price $P_{PV}$, and the additional benefits associated with the extra energy are given by areas C+E. A straight line approximation to the demand curve is used given the lack of quantifiable information regarding consumers' preferences.




The analysis considers the case of a typical household with the following characteristics based on the findings of surveys undertaken by the executing agency:

$Q_K$: 107.5 kWh per year
Pk: US$1.64 per kWh, based on surveys on households recently served by the Project; i.e. savings in traditional energy (B+D): US$ 175 per year.
$Q_{PV}$: 216 kWh per year
$P_{PV}$: US$0.0 per kWh (i.e. running costs are only fixed maintenance costs)

The table below presents the flow of costs and benefits for the project's SHS component in thirteen provinces.

**Residential Photovoltaic Component – Cost and Benefits (thousand US$)**

| Year | PV units installed | Capital Cost | O&M 1/ | Total Cost | Avoided Cost | WTP 2/ | Total Benefits | Net Benefits |
|---|---|---|---|---|---|---|---|---|
| 1 | 7,100 | 6,539 | 0 | 6,539 | 0 | 0 | 0 | -6,539 |
| 2 | 0 | 0 | 1,108 | 1,108 | 1,248 | 630 | 1,878 | 770 |
| 3 | 0 | 0 | 1,108 | 1,108 | 1,261 | 636 | 1,897 | 789 |
| 4 | 0 | 0 | 1,108 | 1,108 | 1,274 | 642 | 1,916 | 808 |
| 5 | 0 | 0 | 1,108 | 1,108 | 1,286 | 649 | 1,935 | 827 |
| 6 | 0 | 0 | 1,108 | 1,108 | 1,299 | 655 | 1,955 | 847 |
| 7 | 0 | 0 | 1,108 | 1,108 | 1,312 | 662 | 1,974 | 866 |
| 8 | 0 | 0 | 1,108 | 1,108 | 1,325 | 668 | 1,994 | 886 |
| 9 | 0 | 0 | 1,108 | 1,108 | 1,339 | 675 | 2,014 | 906 |
| 10 | 0 | 0 | 1,108 | 1,108 | 1,352 | 682 | 2,034 | 926 |
| 11 | 0 | 0 | 1,108 | 1,108 | 1,365 | 689 | 2,054 | 946 |
| 12 | 0 | 0 | 1,108 | 1,108 | 1,379 | 695 | 2,075 | 967 |
| 13 | 0 | 0 | 1,108 | 1,108 | 1,393 | 702 | 2,096 | 988 |
| 14 | 0 | 0 | 1,108 | 1,108 | 1,407 | 709 | 2,117 | 1,009 |
| 15 | 0 | 0 | 1,108 | 1,108 | 1,421 | 716 | 2,138 | 1,030 |
| 16 | 0 | 0 | 1,108 | 1,108 | 1,435 | 724 | 2,159 | 1,051 |
| | | | | | | | NPV: | **$97,6** |
| | | | | | | | IERR: | **10.3%** |

1/ Incorporates battery replacement

2/ Additional benefits associated to more and a better quality of energy source

**Financial Analysis**

The Project's increase in capital costs had a negative impact in its financial viability. Taking into account actual subsidy levels for the different rural electrification subcomponents –73.6% of capital costs for grid extension and 90% for PV– the internal financial rate of return (FRR) of the Project was a negative -0.61% for grid extension[18] and 31.9% for off-grid PV subprojects. FRR for the grid extension component ranged from negative values (Hidrandina) to 32% (Edelnor). The main factor explaining such a diverse performance was the consumption level of new consumers, which ranged from 12.2kWh/month to 100kWh/month for the utilities mentioned above, respectively.

An ex-post analysis concluded that the level of subsidy required for the grid extension component (following a conventional metering approach) to achieve a return of 12% was, in average, 85% (as opposed to the actual 73.6%). The following table presents subsidy and FRR for different cases.

| Sub-projects | No. | Subsidy Level (%) | Electricity Consumption (kWh/mo.) | FRR (%) |
|---|---|---|---|---|
| Grid Extension: conventional metering and pre-paid | 51 | 75 | 20.9 | -0.61 |
| Grid Extension: conventional metering | 33 | 75 | 25.2 | 5.78 |
| Subsidy required for FRR of 12% | | | | |
| Grid Extension: conventional metering | 33 | 85 | 25.2 | 12.0 |
| | | | | |
| Photovoltaic Systems | 9 | 90 | 8.96 | 31.9 |

[18] Including a prepaid component that comprised 18 of the 55 sub-projects. This component has registered a very low level of households' consumption (8.86 kWh/month as an average) that is attributed to deficiencies in the distribution of pre-paid cards.

## Annex 4. Bank Lending and Implementation Support/Supervision Processes

**(a) Task Team members**

| Names | Title | Unit | Responsibility/ Specialty |
|---|---|---|---|
| **Lending** | | | |
| Susan V. Bogach | Senior Energy Economist | LCSEG | TTL |
| Demetrios Papathanasiou | Senior Infrastructure Specialist | EASNS | Co-TTL |
| **Supervision/ICR** | | | |
| | | | |
| Alonso Zarzar Casis | Sr Social Scientist | LCSSO | |
| Ana Lucia Jimenez Nieto | Financial Management Specialist | LCSFM | |
| Demetrios Papathanasiou | Senior Infrastructure Specialist | EASNS | |
| Eduardo H. Zolezzi | Consultant | LCSEG | |
| Francisco Rodriguez | Procurement Specialist | LCSPT | |
| Gabriela Arcos | Environmental Specialist | LCSEN | |
| Iris Del Valle Oliveros | Program Assistant | LCSEG | |
| Isabella Micali Drossos | Senior Counsel | LEGES | |
| James R. Finucane | Consultant | LCSEG | |
| Janina Andrea Franco | Energy Specialist, TTL | LCSEG | |
| Leopoldo Montanez | Senior Energy Specialist, TTL | LCSEG | |
| Luis M. Schwarz | Senior Finance Officer | CTRLA | |
| Luis M. Vaca-Soto | Consultant | LCSEN | |
| Maria Lucy Giraldo | Senior Procurement Specialist | LCSPT | |
| Nelly Ikeda | Financial Management Analyst | LCSFM | |
| Nicolas Drossos | Consultant | EAPCO | |
| Pilar Elisa Gonzalez Rodriguez | Senior Counsel | LEGCF | |
| Pilar Larreamendy | Senior Social Development Spec | EASVS | |
| Thomas Edward Haven | Senior Private Sector Development | LCSPF | |
| Susan V. Bogach | Senior Energy Economist, TTL | LCSEG | |
| Enrique Crousillat | Senior Energy Consultant | | |
| César Adrian Arreola | Energy Specialist | LCSEG | |
| Karen Bazex | Energy Specialist | LCSEG | |

**(b) Staff Time and Cost for IBRD Loan (P090116) and GEF Grant (P090110)**

| Stage of Project Cycle | Staff Time and Cost (Bank Budget Only) | |
|---|---|---|
| | No. of staff weeks | USD Thousands (including travel and consultant costs) |
| **Lending** | | |
| **FY05** | 36.73 | 191,769.55 |
| **FY06** | 44 | 276,927.65 |
| **Total:** | **80.73** | **468,697.20** |
| **Supervision/ICR** | | |
| **FY06** | 7.47 | 41,856.01 |
| **FY07** | 33.39 | 147,559.97 |
| **FY08** | 27.42 | 189,672.10 |
| **FY09** | 18.32 | 152,530.14 |
| **FY10** | 23.57 | 165,689.54 |
| **FY11** | 29.7 | 185,093.10 |
| **FY12** | 22.47 | 169,121.81 |
| **FY13** | 14.76 | 128,923.24 |
| **FY14** | 1.83 | 21,148.29 |
| **Total:** | **178.93** | **1,201,594.20** |

## Annex 5. Beneficiary Survey Results

Surveys undertaken by the Project monitoring team on subprojects that have been completed and are in commercial operation arrived to the following findings on the benefits of the Project:

***Benefits of Grid-extension***

In education; (a) teachers have improved the quality of their work through the use of technology (computers, access to internet, microscopes); (b) students have the option to study during night hours, have access to educational videos and, overall, do better their homework; and (c) parents are more involved in their children's education and participate in parents meetings.

Family economy; (a) significant savings in lighting; (b) enhanced possibilities of increasing their income through night work and longer hours for trade; (c) benefits of better services in localities.

Health; (a) reduced incidence of respiratory and eye infections as candles and kerosene are no longer used; (b) reduction in gastrointestinal diseases due to better conservation and handling of food; and (c) better service of health posts – longer hours and better quality of service.

Safety; (a) public lighting has helped in reducing the number of robberies; (b) lower incidence of fires in households as candles are no longer used.

***Benefits of Photovoltaic Systems***

Education; children can do their homework during night hours, thus enhancing the quality and quantity of their work.

Greater availability of light; beneficiaries report the benefit of seeing better, as well as the advantage in engaging in productive activities during the night.

Better quality of leisure time, as they have better access to radio and a more comfortable social life.

Health; reduced incidence of respiratory and eye infections as candles and kerosene are no longer used.

Others; the availability of electricity allows beneficiaries to charge cell phone batteries at home. This is an important benefit since prior to the availability of solar energy most households had to travel –often walk many hours– to the closest town for this purpose.

## Annex 6. Stakeholder Workshop Report and Results

Not applicable

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

DFC-DGER has prepared a thorough draft Completion Report (Informe de Cierre) that addressed budgetary execution, scope and results as well as lessons learned from the Project. Lessons learned are summarized below.

- The Project's model implied from is early stages the active participation of distribution companies as strategic partners in the RE effort. This explicit participation requires that both FONAFE (holding of state-owned enterprises) and the distribution companies internalize the model into their long-term perspective.
- Concessionaires need to consolidate within their organization an area for planning and engineering –separate from the O&M unit– in charge of formulating and proposing project profiles, and managing work contracts.
- It is necessary to strengthen the monitoring of works reception and ensure that distribution companies strengthen the supervision of works.
- On right of way; (a) include within the project cost the payments for right of way, compensation for negative impacts of construction and mitigation of environmental impact; and (b) incorporate right of way payments into the contractor's activities.
- Incorporate technical assistance activities within the development of RE projects in order to guarantee learning and implementation of safety measures.
- Issues associated to the sustainability of RE and, in particular, grid extension projects are: (a) enhancement of demand through the promotion of productive uses of electricity; (b) seek greater operational efficiency in order to reduce O&M costs; and (c) an adequate subsidy to guarantee a balanced financial performance of projects.
- Photovoltaic home systems require the training of customers to ensure the adequate use of facilities. Distribution companies should be involved in this activity.
- RE programs become a more effective instrument to promote economic and social development when the promotion of productive uses of electricity are incorporated into the projects.

## Annex 8. Comments of Co-financiers and Other Partners/Stakeholders

Not applicable

## Annex 9. List of Supporting Documents


DFC-DGER, 2013. Estrategia para la Sostenibilidad Técnica y Económica de los proyectos SFVD. Taller 'Electrificación Rural en Zonas Rurales Dispersas y Aisladas'. Sucre, Mayo.

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World Bank, 2006. Project Appraisal Document on a Proposed Loan in the Amount of US$50 Million and a Proposer Grant from the Global Environmental Facility Trust Fund in the Amount of US$10 Million to the Republic of Peru for a Rural Renewable Electrification Project.

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