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PROJECT PERFORMANCE ASSESSMENT REPORT



PERU

Rural Electrification Project

Report No. 117145

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Report No.: 117145

PROJECT PERFORMANCE ASSESSMENT REPORT

PERU

RURAL ELECTRIFICATION PROJECT

(IBRD LOAN 7366-PE)

(GLOBAL ENVIRONMENT FACILITY TRUST FUND GRANT 056023-PE)

June 30, 2017

Currency Equivalents (annual averages)

Currency Unit = Nuevo Soles (S/.)

2006	US\$1.00	—
2007	US\$1.00	—
2007	US\$1.00	—
2009	US\$1.00	—
2010	US\$1.00	—
2011	US\$1.00	S/. 2.77
2012	US\$1.00	S/. 2.69
2013	US\$1.00	S/. 2.54

Abbreviations

CPS	country partnership strategy
DFC	Directorate of Competitive Funding
DGER	Directorate General of Rural Electrification
EDC	electricity distribution company
FOSE	Fund for Social Compensation of Electricity
GEF	Global Environment Facility
ISP	Institutional Support Platform
kWh	kilowatt hour
LPG	liquid petroleum gas
M&E	monitoring and evaluation
MEM	Ministry of Energy and Mines
OSINERGMIN	Supervisory Commission for Energy and Mining Investment
PEU	Project Executing Unit
PFU	productive family unit
PPAR	Project Performance Assessment Report
PV	photovoltaic
RE	rural electrification
REP	Rural Electrification Project
REP II	Second Rural Electrification Project

All dollar amounts are U.S. dollars unless otherwise indicated.

Fiscal Year

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This report was prepared by Migara Jayawardena (task team leader) and Fernando Manibog (author), who assessed the project in December 2016. The report was peer reviewed by Raghavan Narayanan and panel reviewed by Alain Barbu. Richard Kraus and Jean Jacques Alain Ildevert Ahouansou provided administrative support.

Principal Ratings

	ICR*	ICR Review*	PPAR
Outcome	Moderately satisfactory	Satisfactory	Satisfactory
Risk to Development Outcome	Negligible	Negligible to low	Negligible
World Bank performance	Moderately satisfactory	Moderately satisfactory	Moderately satisfactory
Borrower performance	Moderately satisfactory	Moderately satisfactory	Satisfactory

* The Implementation Completion and Results Report (ICR) is a self-evaluation by the responsible World Bank Global Practice. The ICR Review is an intermediate Independent Evaluation Group product that seeks to independently validate the findings of the ICR.

Key Staff Responsible

Project	Task Manager or Leader	Division Chief or Sector Director	Country Director
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IEG Mission: Improving World Bank Group development results through excellence in independent evaluation.

About this Report

The Independent Evaluation Group (IEG) assesses the programs and activities of the World Bank for two purposes: first, to ensure the integrity of the World Bank's self-evaluation process and to verify that the World Bank's work is producing the expected results, and second, to help develop improved directions, policies, and procedures through the dissemination of lessons drawn from experience. As part of this work, IEG annually assesses 20–25 percent of the World Bank's lending operations through fieldwork. In selecting operations for assessment, preference is given to those that are innovative, large, or complex; those that are relevant to upcoming studies or country evaluations; those for which Executive Directors or World Bank management have requested assessments; and those that are likely to generate important lessons.

To prepare a Project Performance Assessment Report (PPAR), IEG staff examine project files and other documents, visit the borrowing country to discuss the operation with the government, and other in-country stakeholders, interview World Bank staff and other donor agency staff both at headquarters and in local offices as appropriate, and apply other evaluative methods as needed.

Each PPAR is subject to technical peer review, internal IEG panel review, and management approval. Once cleared internally, the PPAR is commented on by the responsible World Bank country management unit. The PPAR is also sent to the borrower for review. IEG incorporates both World Bank and borrower comments as appropriate, and the borrowers' comments are attached to the document that is sent to the World Bank's Board of Executive Directors. After an assessment report has been sent to the Board, it is disclosed to the public.

About the IEG Rating System for Public Sector Evaluations

IEG's use of multiple evaluation methods offers both rigor and a necessary level of flexibility to adapt to lending instrument, project design, or sectoral approach. IEG evaluators all apply the same basic method to arrive at their project ratings. Following is the definition and rating scale used for each evaluation criterion (additional information is available on the IEG website: <http://ieg.worldbankgroup.org>).

Outcome: The extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently. The rating has three dimensions: relevance, efficacy, and efficiency. *Relevance* includes relevance of objectives and relevance of design. Relevance of objectives is the extent to which the project's objectives are consistent with the country's current development priorities and with current World Bank country and sectoral assistance strategies and corporate goals (expressed in poverty reduction strategy papers, Country Assistance Strategies, sector strategy papers, and operational policies). Relevance of design is the extent to which the project's design is consistent with the stated objectives. *Efficacy* is the extent to which the project's objectives were achieved, or are expected to be achieved, taking into account their relative importance. *Efficiency* is the extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared with alternatives. The efficiency dimension is not applied to development policy operations, which provide general budget support. *Possible ratings for outcome:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, highly unsatisfactory.

Risk to Development Outcome: The risk, at the time of evaluation, that development outcomes (or expected outcomes) will not be maintained (or realized). *Possible ratings for risk to development outcome:* high, significant, moderate, negligible to low, and not evaluable.

World Bank Performance: The extent to which services provided by the World Bank ensured quality at entry of the operation and supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan or credit closing, toward the achievement of development outcomes). The rating has two dimensions: quality at entry and quality of supervision. *Possible Ratings for World Bank performance:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, and highly unsatisfactory.

Borrower Performance: The extent to which the borrower (including the government and implementing agency or agencies) ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes. The rating has two dimensions: government performance and implementing agency(ies) performance. *Possible ratings for borrower performance:* highly satisfactory, satisfactory, moderately satisfactory, moderately unsatisfactory, unsatisfactory, and highly unsatisfactory.

Preface

This is the Project Performance Assessment Report (PPAR) by the Independent Evaluation Group (IEG) of the World Bank Group on the Peru Rural Electrification Project (IBRD-7366). The project was the first of two rural electrification projects financed by the World Bank in Peru, with the ongoing Second Rural Electrification Project (IBRD-80340) scheduled to close on August 31, 2017. The World Bank's financing amounted to \$50 million of the actual project cost of \$131.69 million. The Global Environment Facility also financed \$10 million, of which \$3.71 million was used. The project was appraised on October 24, 2005; approved by the World Bank's Board of Executive Directors on March 27, 2006; declared effective on August 10, 2006; and closed on June 30, 2013, after a delay of 18 months from the original closing date of December 31, 2011.

This report presents findings based on a review of the project's Implementation Completion and Results Report dated December 26, 2013, project and legal documents, prior World Bank sector studies and reviews, records on file, and other relevant materials. An IEG mission visited Peru in December 2016 to conduct field visits and hold discussions with the World Bank's sector staff at the country office, government officials, project staff, public and private companies engaged in rural electrification, and other development agencies (see appendix D).

This project was selected for an in-depth PPAR for three main reasons: First, it is useful and necessary to understand the factors underlying the project's performance to inform continuing efforts to address sustainably the persistent challenges facing Peru's rural electrification subsector. Second, the PPAR would serve as input to IEG's forthcoming major evaluation on renewable energy technologies, which relies on a geographically and operationally diverse set of project-level performance assessments and country case studies. Third, almost four years after the project's closing date, it is important to revalidate the effectiveness of the project's interventions and assess the long-term sustainability of related outcomes, particularly the pilot activities related to the promotion of productive uses of electricity and the installation of photovoltaic home systems in remote areas.

The contributions of all stakeholders, including World Bank staff in Washington, DC, and Lima, are gratefully acknowledged.

Following standard IEG procedures, the draft PPAR was shared with relevant government officials and agencies for their review. Comments from the borrower are presented in appendix E.

Summary

Peru has been one of the Latin America and the Caribbean Region’s fastest-growing economies. It grew an average 6.2 percent between 2004 and 2013. Moderate poverty was more than halved from 58 percent to 22 percent of the population between 2004 and 2015. Extreme poverty, which is mainly rural, also fell from 16 percent to 4 percent during that period. Although urban inequality declined substantially, rural inequality was reduced only modestly. To avoid a reversal of its achievements, the government needs to raise the quality of basic services, expand access to markets for the poor and vulnerable, and close infrastructure gaps to facilitate access to markets and services—all of which underscores the high priority of addressing rural electricity needs.

The reform of Peru’s electricity sector in 1992 separated the generation, transmission, distribution, and regulatory functions. Based on an efficient enterprise model, the reforms introduced cost-recovery tariffs, and generation and transmission were privatized. A new regulatory body was created, and private companies are now in charge of electricity distribution in Lima and other urban centers. In rural areas, about 20 public electricity distribution companies (EDCs) provide electricity service. Most of the EDCs have performed well operationally and financially, with losses of less than 12 percent and payment rates above 95 percent.

In 2005, when the first Rural Electrification Project (REP I) was appraised, Peru had a rural electrification rate of 30 percent—one of the lowest in the Region. According to the Ministry of Energy and Mines, more than 300,000 isolated households in rural areas could be reached only through renewable energy technologies, specifically individual solar photovoltaic (PV) systems. Prior to REP I, service providers allocated negligible funding to meet this off-grid demand through renewable energy. The scarcity of rural electricity—coupled with the broader lack of access to infrastructure—have perpetuated the cycle of low quality of life, poor education and medical care, and limited opportunities for economic development in Peru’s rural areas.

Before REP I’s appraisal, the government of Peru had just enunciated its National Plan for Rural Electrification, in which the Ministry of Energy and Mines gave high priority to increasing rural electricity coverage to 75 percent of the rural population by 2013, or more than doubling the 30 percent coverage in 2005. (Rural electricity coverage reached 65 percent by 2011, according to the National Plan for Rural Electrification for 2012–21.) The government of Peru also committed to mobilizing \$860 million over 10 years from 2004 to 2013.

REP was appraised in October 2005 and designed to expand electricity service, pilot PV systems in remote areas, and promote productive uses of electricity in agricultural, commercial, and industrial activities in rural areas. More strategically, the REP was intended to (i) demonstrate an approach to providing rural electricity more efficiently and (ii) achieve higher leveraging of central government subsidies with funds from electricity service providers and other sources.

On April 21, 2011, the World Bank approved a Second Rural Electrification Project (REP II), which had a similar development objective as the first project and “would build on the achievements of the First [Rural Electrification] Project but would operate in more challenging conditions, providing electricity service in localities that are increasingly distant from the grid with more dispersed populations.” REP II is expected to close on August 31, 2017, with nearly all performance indicators exceeded or fully achieved.

Ratings

The relevance of REP I's objective is rated **high**. The goal of “increasing access to efficient and sustainable electricity in rural areas” to help alleviate poverty in Peru was aligned with the World Bank's Country Assistance Strategy at appraisal and remains consistent with pillars of the current World Bank strategy. This objective was also consistent with the government's current National Plan for Rural Electrification (2013–22) and earlier plans, which also cover the ongoing REP II project. The project's three subobjectives, on which this assessment was based, were also highly relevant: (i) to supply electricity services to unserved rural households, businesses and public facilities; (ii) to demonstrate electricity provision that attracts investment from private and public providers; and (iii) to pilot a program for promoting productive uses of electricity.

The relevance of the project's design is rated **substantial**. The project's results framework adequately captured the causal linkages leading to final outcomes. Moreover, to enhance the achievement of the project's objective, the “REP model” complemented the core activity of increasing electricity access with innovative components that were intended to (i) mobilize additional financing and the active involvement of the EDCs; (ii) promote productive uses of electricity to augment demand and improve the financial viability of rural electrification; and (iii) provide regulated service to isolated households based on PV solar home systems.

The efficacy rating is **modest** for the first subobjective of installing new rural electrification connections, including PV systems in remote areas, given the significant difference between connection targets and the lower levels achieved. Efficacy ratings are both **substantial** for the two other subobjectives of (i) demonstrating an electricity provision model that attracts public and private investments, and (ii) promoting productive uses of electricity, given that for both, the outputs and outcomes fully met or largely exceeded targeted levels.

The project's global environment objective—to reduce greenhouse gas emissions through renewable energy use for electricity in rural areas—was not achieved under the project because the government canceled the related small hydro component in favor of launching openly competitive and successful auctions for providing electricity using renewable energy, including small hydro, which obviated the need for a publicly financed Small Hydro Financing Facility.

The project's efficiency is rated **substantial**. Despite initial delays that led to a closing date extension of 18 months, the project rolled out incentives for using subsidies efficiently, significant investments were mobilized from the EDCs, rates of return estimated at 21 percent were adequate and near the 23 percent estimated at appraisal, and public resources were used efficiently.

Overall, the project's development outcome is rated **satisfactory**.

Risks to development outcome are rated **negligible**. The General Directorate for Rural Electrification of the Ministry of Energy and Mines has issued regulations that incorporate in its programs the REP model, which requires that each subproject be financially viable at current tariff levels after the application of the partial capital cost subsidy. This has significantly enhanced the sustainability of outcomes under both REP I and REP II. However, challenges

remain related to (i) sustaining the support system for promoting productive uses, and (ii) strengthening the maintenance and financial sustainability of PV systems.

Lessons

Lessons are derived from the project's implementation experience and IEG's assessment of the sustainability of outcomes that included a field visit in 2016. The lessons focus on (i) innovative rural electrification activities that the project has supported, specifically, the promotion of productive uses of electricity and PV systems for isolated areas; and (ii) the overall sustainability of rural electrification efforts in Peru.

- **The promotion of productive uses of electricity needs consistent and adequate levels of technical assistance and investment support, without which their sustainability is put at risk.** The benefits of promoting productive electricity uses have been demonstrated under both REP I and REP II. Starting out as an innovative pilot, these promotion activities have now been mainstreamed—notably through the government's incorporation of the REP model within its rural electrification plan. However, after a solid start, the REP's Institutional Support Platform for promoting productive uses needs to be reinforced. If the positive outcomes from promoting the productive use of electricity are to be sustained, the government will have to maintain its political and technical support for promoting productive uses; the nongovernmental organizations, together with the Institutional Support Platform, need to continue working directly with individual producers; and the EDCs have to revive more vigorously their leadership and proactive follow-up as originally designed.
- **Achieving the financial sustainability of solar photovoltaic systems remains a challenge that the government and electricity distribution companies need to address.** Given the remote and often isolated conditions where PV systems are installed, the EDCs need to identify low-cost maintenance measures and effective billing systems that can minimize delinquent payments. The users also need adequate training in the use and maintenance of the batteries and the PV units. Some users also report a “disconnect” between the tariffs being charged and the restricted availability of electricity, which is used mainly for lighting. Many users count on grid connections to eventually reach their remote areas but this will not be economically and logistically feasible for large numbers; hence the need to resolve the foregoing issues.
- **To reach “the last mile” of rural electrification while ensuring sustainability, the government and the EDCs need to take specific actions.** The government has incorporated the rural electrification model—tested and proven under both REP I and REP II—of mobilizing financing and the active involvement of EDCs, mainstreaming productive uses of electricity, and installing PV systems in isolated rural areas. The government may need to exercise greater flexibility on market structure, regular updates on the regulatory regime, more frequent revisions of the tariff regime, and other actions that would accommodate the rapid expansion of rural customers and their higher distribution costs. The EDCs need to ensure their continued financial contributions,

provide better training of users on the maintenance of PV systems, and develop more cost-effective ways to improve billing collection and minimize delinquent payments.

José Cándido Carbajo Martínez
Director, Financial, Private Sector, and Sustainable
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1. Background and Context

Project Context

1.1 Peru has been one of the Latin America and the Caribbean Region's fastest growing economies. Between 2004 and 2013, the economy grew at an average annual rate of 6.2 percent. Peru's high growth has stemmed from a favorable external environment, prudent macroeconomic policy, and deep structural reforms. Strong employment and income growth have both contributed significantly to poverty reduction and improvements in shared prosperity. Between 2004 and 2015, rates of moderate poverty were more than halved from 58 percent to 22 percent of the population. Extreme poverty, which is mainly in rural areas, also fell from 16 percent to 4 percent during that period. While urban inequality declined substantially, rural inequality was reduced only modestly (World Bank 2017a, 3 and 5). However, as is the case for many other emerging markets, the external environment is worsening and Peru's growth, though still above the regional average of 0.8 percent, has slowed down to 2.4 percent in 2014 (World Bank 2015, 2). Income inequality is still relatively high but is higher in rural than in urban areas (World Bank 2015, 4).¹ Extreme poverty is concentrated in only 8 percent of Peru's districts (namely, Cajamarca, Piura, La Libertad, and Apurimac). The government will need to strengthen the links between growth and equity, in part by addressing shortcomings in public investment management and decentralization arrangements that make public infrastructure spending less efficient (World Bank 2017b). To avoid a reversal of its achievements, the government needs to increase the quality of basic services, expand access to markets for the poor and vulnerable, and close infrastructure gaps—all of which underscores the high priority of addressing rural electricity needs.

1.2 The reform of Peru's electricity sector in 1992 separated the generation, transmission, distribution, and regulatory functions. A new regulatory entity was created, namely, the Supervisory Commission for Energy and Mining Investment (OSINERGMIN). Based on an efficient enterprise model, the reforms introduced cost recovery tariffs, and generation and transmission were privatized. Private companies (Edelnor and Luz del Sur) are now in charge of electricity distribution in Lima and other urban centers. Elsewhere, including in rural areas, about 20 public electricity distribution companies (EDCs) provide electricity service. Distriluz, the largest public company, has four regional companies of its own—Electro Centro, Electro Noroeste, Hidrandina, and Electro Norte—and serves about 1.5 million customers. Other large public distribution companies include Sociedad Eléctrica del Sur Oeste (in Arequipa), Electro Sur Este (in Cusco), Electro Oriente (in Iquitos), Electro Puno in (Puno), and Electro Sur (in Tacna). The National Fund for Financing the Entrepreneurial Activity of the State controls the budgets and investments of public companies, including those in the electricity sector. Most of the public EDCs have performed well, with losses of less than 12 percent and payment collection rates above 95 percent.

Rural Electricity Access Issues in Peru

1.3 In 2005, when the Rural Electrification Project (REP) was appraised, Peru had a rural electrification rate of 30 percent—one of the lowest in the Latin America and the Caribbean Region. Since the early 1990s, rural electrification has been fully financed by the central

government, which had been directly investing \$40–\$50 million annually in the 10 years prior to REP. The Ministry of Energy and Mines (MEM)—through its Directorate General for Rural Electrification—planned, designed and implemented rural electrification projects, after which the assets were turned over to either (i) state-owned distribution companies, or (ii) a special state-owned asset holding company that manages isolated and less profitable rural systems. The latter is the Administration Office of Electric Infrastructure, which manages contracts with state-owned companies or municipalities to operate those rural systems.

1.4 EDCs hold concessions that are concentrated in small areas around urban centers and have service obligations within 100 meters of their existing networks. For rural areas, the MEM estimated that there were more than 300,000 isolated rural households throughout Peru that could be reached only through household-level renewable energy technologies—specifically individual photovoltaic (PV) solar home systems. Prior to REP, however, EDCs allocated negligible funding to meet this off-grid demand that could be served with renewable energy. The scarcity of rural electricity—coupled with the broader lack of access to infrastructure—has perpetuated the cycle of low quality of life, poor education and health care, and limited opportunities for economic development.

1.5 Before REP’s appraisal, the government of Peru had just enunciated its National Plan for Rural Electrification, in which the MEM gave high priority to increasing rural electricity coverage by more than doubling the 30 percent coverage to 75 percent by 2013. (Rural electricity coverage reached 65 percent by 2011, according to the National Plan for Rural Electrification for 2012–21.) The government also committed to mobilizing \$860 million over 10 years from 2004 to 2013. REP was appraised in October 2005 and designed to expand electricity service, pilot PV systems in remote areas, and promote productive uses of electricity in agricultural, commercial, and industrial activities in rural areas. More strategically, the REP intended to (i) demonstrate an approach to providing rural electricity more efficiently; and (ii) achieve better leveraging of central government subsidies with funds from electricity service providers and other sources.

2. Objectives, Design, and Their Relevance

Objectives

2.1 According to the loan agreement, the development objective of the Peru REP was “to alleviate poverty in the Borrower’s territory by increasing access to efficient and sustainable electricity services in rural areas” (loan agreement, schedule 2, 22). The project appraisal document indicated three subobjectives as follows: (i) to invest in subprojects for supplying electricity services to about 160,000 unserved rural households, business and public facilities, such as schools and health clinics (serving about 800,000 people); (ii) to demonstrate key elements of a framework for electricity provision in rural areas that would attract investment from private and public sector electricity providers, as well as national, regional, and local governments; and (iii) to implement a pilot program to increase productive uses of electricity so as to increase opportunities for income generation in rural areas (World Bank 2006, 2).

2.2 The REP also had a global environment objective “to achieve reduction of greenhouse gas emissions through use of renewable energy in rural areas for provision of electricity,” for which the performance indicator was avoided carbon dioxide emissions. These avoided

emissions were estimated at 3.61 million metric tons during the lifetime of the systems under the project, but it was expected that higher levels of carbon dioxide emissions avoidance would be achieved over the long term through broad replication of renewable energy use, by (i) establishing a national framework for rural electrification and (ii) developing financing mechanisms for small hydroelectric projects.

2.3 The World Bank approved a Second Rural Electrification Project (REP II) on April 21, 2011, or eight months before the REP's original closing date of December 31, 2011. REP was extended by 18 months to the actual closing date of June 30, 2013. REP II had a similar development objective as the first project and “would build on the achievements of the First [Rural Electrification] Project but would operate in more challenging conditions, providing electricity service in localities that are increasingly distant from the grid with more dispersed populations” (World Bank 2011, 4). With a closing date extension of 18 months, REP II is closing on August 31, 2017.

Relevance of Objectives

2.4 The project's objective was highly relevant at the time of appraisal and remains high at present. At appraisal, the government had already been funding electrification investments through the public sector at an average of about \$50 million per year, but was also attempting to change the institutional and legal framework for rural electrification. The project's objective was of high relevance to the government's efforts at that time to increase economic efficiency in the sector, attract broader participation and financing sources, and reduce the electrification gap by increasing rural coverage from 30 percent to 75 percent by 2013—thus committing an average of \$86 million annually from 2004 to 2013. With respect to the World Bank, the project at appraisal supported the objectives of access to basic services, decentralization, and employment generation as per its 2004 Country Assistance Strategy for Peru. During the implementation period, the project's objective remained highly relevant to the succeeding 2007–11 Country Partnership Strategy (CPS), which aimed to support the government's efforts to increase economic growth and fight poverty. A specific goal of the CPS's social development pillar was to increase electricity access in rural areas from 30 percent to 65 percent.

2.5 At present, the project's objective remains highly relevant to the government's National Plan for Rural Electrification (2013–22), which aims for electricity coverage of 92.4 percent by 2020 and continues to receive support from Ministry of Economy and Finance, MEM, and successive administrations. The project's objectives also remain highly relevant to the World Bank's recent 2012–16 CPS, which has as a key strategic objective connecting the poor to services and markets through improved coverage of reliable energy in rural areas. More specifically, the project directly supports the CPS goals, which are to (i) increase access and quality of social services for the poor; (ii) connect the poor to services and markets; (iii) enhance productivity and support sustainable growth; and (iv) promote inclusive governance and improve public sector performance.

2.6 The relevance of objectives is rated **high**, notwithstanding that the overarching objective “to alleviate poverty” as stated in the loan agreement was overly ambitious and difficult to monitor within the relatively short implementation time frame for this project. The project appraisal document was more realistic about the project's contributory role: it delineated the

three specific pathways for increasing electricity services in rural areas that the project will support; correspondingly, the performance indicators were keyed to the three subobjectives as assessed in section 4 (World Bank 2006).

Relevance of Design

2.7 The results framework of the project is logically robust and adequately captures the causal linkages between the project's activities, the outputs produced, and the intermediate and final development outcomes. An exemplary feature is the concrete effort by the World Bank team to delineate how the chain of information regarding the progress in incremental results—denominated in terms of specific actions implemented across the project period—would be used to assess the overall achievement of the project's objective. For example, in years 1 and 2, the effectiveness in leveraging financing for rural electrification and improving the efficiency of service delivery would be assessed. Based on that information, the strategic approaches to subsidy provision and renewable energy promotion would be reviewed during planned midterm review of the project in year 3. Toward project completion in year 5, this midterm assessment would feed into the process of (i) developing the legal and regulatory framework for rural electrification and (ii) informing Peru's overall rural electrification strategy.

2.8 The project's components are as follows:

- **Component A: Investment in rural electrification subprojects** (project costs: appraisal, \$114.3 million; actual, \$118.1 million). This component was intended to provide targeted capital cost subsidies to public and private electricity service providers investing in rural electrification. The subprojects were defined as those that would provide service to new customers outside of existing concession areas, through conventional grid extension and renewable energy. Subsidies would be calculated for each subproject to make the investments financially viable, subject to compliance with minimum criteria such as an acceptable rate of economic return, a minimum of 10 percent investment contribution from the distribution company, and an adequate return on investment. Renewable energy systems were targeted for about 20,000 rural connections. Consumption cross-subsidies would also be provided separately to customers using less than 100 kilowatt hours (kWh) per month, financed by the government's Fondo Social de Electrificación (FOSE) scheme.
- **Component B: Technical assistance for rural electrification** (project costs: appraisal, \$3.75 million; actual, \$3.03 million). This component was to provide support for implementing the proposed rural electrification approach, including: (i) development of the regulations and institutional framework for on- and off-grid provision of electricity service in rural areas, including through renewable energy; (ii) building the capacity of distribution companies for decentralized and demand-driven project identification, planning and development; (iii) promotion of private sector investment; and (iv) renewable energy promotion.
- **Component C: Pilot program for promoting productive uses of electricity** (project costs: appraisal, \$3.95 million; actual, \$2.8 million). This component was to support the removal of key barriers to productive uses of electricity, by targeting energy-intensive farm and off-farm enterprises using diesel power. Using a capacity-building and marketing approach, the component would: (i) identify target markets and segments; (ii)

increase awareness and skills; (iii) assist potential productive users and communities to identify opportunities, barriers, and solutions for increasing productive uses of electricity; (iv) work closely with the electricity service suppliers to ease access; and (v) facilitate other necessary services, including financing. Beyond the initial four to six areas to be targeted, services would be extended to other regions based on the following criteria: (i) low load factors owing to underused capacity, and not to supply-side constraints; (ii) commitment of the electricity service companies to support the promotion of productive uses; (iii) presence of significant potential for increased productive activities in farm and off-farm enterprises, among artisans, and in rural industries; (iv) existence of basic transport and communications infrastructure, and finance; and (v) for the renewable energy-focused “market” segment, service areas predominantly supplied with renewable energy-based electricity.

- **Component D: Small hydro financing** (project costs: appraisal, \$15.0 million; actual, \$0). This Global Environment Facility (GEF)-financed component was to leverage private equity and commercial debt to finance grid-connected, small hydro generating plants that would sell power to the grid (distribution systems or connections are excluded). A Small Hydro Financing Facility was to assist in the financial closure of small hydro plants of less than 10 megawatts on a project finance basis. The facility would (i) provide ‘bridge-financing’ through loans at commercial interest rates; (ii) assume the risk and cover the period of construction and initial operation; and (iii) subsequently refinance the loans through commercial banks. Beneficiaries were to be private companies that invest in, own, and operate the small hydro plants.
- **Component E: Project management** (project costs: appraisal, \$6.4 million; actual cost, \$7.64 million). This component was intended to support the project’s overall management, including technical management of the investment activities, project administration (including procurement and financial management), and monitoring and evaluation (including safeguards).

2.9 A strong feature of the project’s design is that while the main investment component directly serves the electricity access objectives, the project is also complemented by (i) innovative activities intended to enhance the economic and financial benefits of the main investments; and (ii) technical assistance to facilitate project implementation and sustainability of outcomes. These pilot activities include

- mobilizing additional financing through the active involvement of the EDCs,
- promotion of productive uses of electricity in rural areas, and
- assistance to distribution companies to provide the first off-grid regulated service using household PV systems, which are intended for remote, isolated households.

2.10 Given the expectation that these three activities, if successful, would enhance the sustainability of future rural electrification programs, they will be discussed in greater depth in section 4, which assesses the achievement of the project’s objectives. Harnessing the support of the EDCs could help mobilize investment financing sustainably and lessen the dependence on public support for rural electrification. Successful promotion of productive uses could lead to increased electricity demand, which would improve the financial viability of rural electrification investments, particularly in the more remote areas. PV systems could provide technically viable

and financially sustainable solutions for the hardest to reach areas, under certain conditions that needed to be tested through the project's interventions.

2.11 The relevance of project design is rated **substantial**, given the project's strong results framework (see also the Implementation and Utilization subsections under Monitoring and Evaluation in section 6) and the attention to complementary activities intended to enhance the long-term sustainability of outcomes.

3. Implementation

Institutional Framework and Implementation Arrangements

3.1 The International Development Association financed the actual project cost of \$49.34 million, which was just slightly below the appraisal estimate of \$50 million. The actual GEF grant disbursement was \$3.761 million, or significantly lower than the \$10 million estimated at appraisal. The project was appraised on October 24, 2005, approved by the World Bank's Board on March 7, 2006, and declared effective on August 10, 2006. Without any change to the project objective or components, the project was restructured eight times, mainly to reallocate the World Bank's loan funds, reallocate and then cancel the unused GEF grant funds, define "rural electrification providers," and extend the closing date. After two closing date extensions of nine months each, the project was closed on June 30, 2013, with a total delay of 18 months beyond the original closing date of December 31, 2011. The follow-on REP II will be closing on August 31, 2017.

3.2 Stemming from changes in the legal and institutional framework for rural electrification, REP was implemented from July 2006 to December 2007 by an independent Project Executing Unit (PEU) under the Vice Minister of Energy. In September 2007, following the government's Supreme Decree No. 026-2007-EM, the MEM established the Directorate General of Rural Electrification (DGER), with two directorates under it. The larger Directorate of Projects executed the MEM's rural electrification program based on a 100 percent subsidy. The other, the Directorate of Competitive Funds (DFC-DGER), replaced the PEU as the executing agency for REP. MEM maintained the PEU staff to facilitate the transition.

Implementation Experience

3.3 There were two sources of project implementation delays that resulted in the need for extensions of the project closing date. The delayed activities include: (i) the implementation of renewable energy installations and the promotion of productive uses of electricity, and (ii) right-of-way payments.

3.4 After the World Bank loan became effective, the Ministry of Economy and Finance required MEM to prepare a prefeasibility study for the productive uses component and submit it for approval under the National System of Public Investment before it could be implemented. Although approval was obtained, the DFC-DGER still needed time to select the actual target areas and initiate contracts with nongovernmental and other organizations to conduct the promotion work. The first contract to test the model was completed in November 2009, while two additional contracts were completed by December 2010 and March 2011. The original

closing date was December 2011, yet 12 contracts were signed during 2011, of which six were during December 2011 itself. Thus, although the productive uses component ultimately exceeded expectations by integrating the increased use of electricity within productive development efforts, a first extension of the closing date was needed to complete the promotion contracts. Regarding the PV systems, delays were caused by the need to: (i) establish a tariff for regulated service; and (ii) enable access to the subsidy provided by FOSE for customers of PV home systems, which was needed before the distribution companies would be willing to apply for PV subproject financing. These conditions were met only in August 2010, and although 10 subprojects were eventually presented and approved for financing (nine of which were completed), the credit closing date extension was also needed.

3.5 The subsidy agreements for the rural electrification subprojects between MEM and the distribution companies stipulated the responsibility of the companies to meet all safeguard requirements in accord with Peruvian law and World Bank safeguard policies. Most of the companies complied, and with respect to right-of-way payments, the companies specifically appointed a manager, often associated with the construction contractor. Two of the nine companies, however, fell behind in making such payments (Electrocentro and Hidrandina), thus necessitating a second extension of the closing date to enable right-of-way payments before project closing. Similar right-of-way payment delays were also encountered in REP II, also necessitating an extension of that project.

3.6 Consequently, both the World Bank loan and the GEF grant were extended for a total of 18 months. In January 2011, the World Bank approved a 9-month extension of the loan, extending the closing date from December 31, 2011, to September 30, 2012. In April 2011, the World Bank authorized an 18-month extension of the GEF grant agreement to June 30, 2013. In September 2012, a second extension of the loan was granted to June 30, 2013.

3.7 The GEF grant, however, was canceled in September 2012 because the government opted for auctions for electricity provision through renewable energy, including small hydro, which competitively yielded lower-cost private sector solutions than public sector financing as originally envisioned in the project. This decision obviated the need for the project's Small Hydro Financing Facility.

FIDUCIARY MANAGEMENT

The REP's financial management arrangements were reported as satisfactory, having been based on the use of the Financial Administration Integrated System, and centralized among qualified and experienced staff. Financial information was provided consistently throughout project implementation in a reliable and timely manner. The financial monitoring reports were delivered regularly without any delays, and recommendations were implemented fully. Financial audits did not identify reportable conditions and had no unqualified opinions.

PROCUREMENT

3.8 For the rural electrification subprojects, the DFC-DGER together with the EDCs were responsible for procurement, with a clear division of responsibilities. The DFC-DGER prepared the procurement plan and supervised contracting, while the EDCs handled the contracting for the

construction of subprojects—including preparing the terms of reference and contracts, evaluating the offers, and managing the contracts. Though the larger EDCs showed more advanced levels of competence in procurement, the DFC-DGER and the EDCs did demonstrate generally satisfactory procurement performance.

SAFEGUARDS COMPLIANCE

3.9 The project triggered four of the World Bank’s safeguard policies: OP/BP 4.01 on Environmental Assessment; OP/BP 4.12 on Involuntary Resettlement; OP/BP 4.10 on Indigenous Peoples; and OP/BP4.37 on Safety of Dams. The policy on Safety of Dams became “not applicable” on the cancellation of the component intended to construct small hydro plants.

3.10 The project was assigned an Environmental Category B. All rural electrification subprojects required environmental and social screening prior to approval, after which adequate management plans were prepared and implemented. Guidelines for subproject preparation and implementation were prepared, and training was provided to the EDCs and contractors. Good environmental and social practices were followed, including site clean-up and communication with residents. All subprojects were also screened for their potential effects on indigenous peoples. When the screening identified impacts, development plans for indigenous peoples were prepared. The screenings, assessments, and final reports were all reviewed and approved by the World Bank. Compliance with environmental and social safeguards is reported as satisfactory.

3.11 Regarding involuntary resettlement, the World Bank’s specialist concluded that the two cases involving the relocation of two families were handled satisfactorily. Most EDCs complied with the right-of-way payment requirements, except for two EDCs who were delayed in completing those payments mainly because their respective contracts did not clearly delineate the payment responsibilities and arrangements. Obstacles to compliance also included the absence of land titles, difficulties in locating landowners, and their perception that the payment amount was not worth the time and expense to cash it. By July 31, 2013 (one month after the closing date), DFC-DGER reported that 86 percent of the amount of right-or-way payments, which corresponded to 84 percent of the concerned residents, had been made.

4. Achievement of the Objectives

Objective: To Alleviate Poverty in the Borrower’s Territory by Increasing Access to Efficient and Sustainable Electricity Services in Rural Areas

4.1 This overarching objective is vague and difficult to monitor. Thus, the following assessment of the project’s efficacy was based on the project’s three subobjectives, which are quantifiable and could be monitored, since they served as the basis for formulating the project’s performance indicators.

SUBOBJECTIVE 1: TO INVEST IN SUBPROJECTS FOR SUPPLYING ELECTRICITY SERVICES TO UNSERVED RURAL HOUSEHOLDS, BUSINESS, AND PUBLIC FACILITIES

4.2 Subobjective 1 was to invest in subprojects for supplying electricity services to about 160,000 unserved rural households, business and public facilities, such as schools and health clinics (serving about 800,000 people).

Outputs

- Infrastructure for 105,000 grid connections was installed to supply electricity services. Most of these were households, representing about 450,000 people. Around 2,900 schools, clinics, and community centers were also included.
- Regulated electricity service was provided to 7,100 households using PV systems.

Outcomes

- Rural electricity coverage increased by 5.9 percent. The overall electricity access rates (on public networks) to which the project contributed is shown in table 4.1. An in-depth assessment of the project's PV activities and rural electrification outcomes follows immediately below.

4.3 The number of new connections, though significant, was 34 percent below the original target of 160,000 because the average costs per connection (\$1,100) turned out to be higher than the estimate made during project preparation (\$715). This increased cost was the result of unforeseen exogenous factors. First, the government's Renewable Energy Law mandated that the \$100 in household connection and meter costs should be added to the capital cost instead of obliging the household to pay; while this was met with consumer support and facilitated access, it led to an increase of about 14 percent in connection costs. Second, overall inflation of local construction costs accelerated in line with the high rate of government investments in rural areas. Third, the nuevo sol appreciated by about 20 percent against the U.S. dollar between February 2006 and 2012, which coincided with the REP's implementation period. The World Bank project team sought the government's agreement to modify the targets to more realistic levels, as provided for under World Bank practice, but the Ministry of Economy and Finance informed the team that adjusting targets (downwards in this case) was not acceptable under their rules.

Table 4.1. Access to Electricity Service by Public Network, 2004–14 (percentage of total number of households)

Area	Year										
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
By residential area											
Urban	94.3	94.7	96.2	95.8	97.0	97.5	98.1	98.4	98.6	98.8	98.9
Rural	32.0	34.6	39.6	45.5	50.1	55.1	58.6	64.2	68.6	71.6	74.5
By region											
Metropolitan Lima	98.0	98.7	98.8	98.4	99.2	99.3	99.3	99.6	99.7	99.6	99.5
Coastal	84.2	83.7	87.8	89.0	91.0	92.5	94.2	95.5	96.2	96.8	97.1
Sierra	58.0	60.6	64.9	69.7	73.5	76.0	79.3	82.0	84.6	86.3	88.2
Forest	56.9	59.4	62.3	61.5	66.0	69.9	71.5	75.0	77.7	80.1	80.9
By region and residential area											
Metropolitan Lima	98.0	98.7	98.8	98.4	99.2	99.3	99.3	99.6	99.7	99.6	99.5
Coastal urban	92.5	91.6	94.6	94.3	95.8	96.1	97.6	97.9	97.7	98.2	98.5
Coastal rural	39.7	39.8	47.9	57.9	61.4	68.3	71.0	79.3	84.9	86.3	86.5
Sierra urban	91.7	92.8	94.1	94.3	95.5	96.8	97.5	97.7	98.5	98.4	98.5
Sierra rural	33.0	35.8	41.6	49.1	53.8	57.8	62.2	66.9	71.3	74.4	77.9
Forest urban	88.4	89.4	93.3	92.1	94.3	94.6	96.0	95.9	97.1	98.0	97.8
Forest rural	23.9	27.3	28.2	25.1	30.6	37.6	38.5	46.3	49.8	53.7	55.7
National total	75.7	77.2	80.2	82.0	84.7	86.4	88.1	89.7	91.1	92.1	92.9

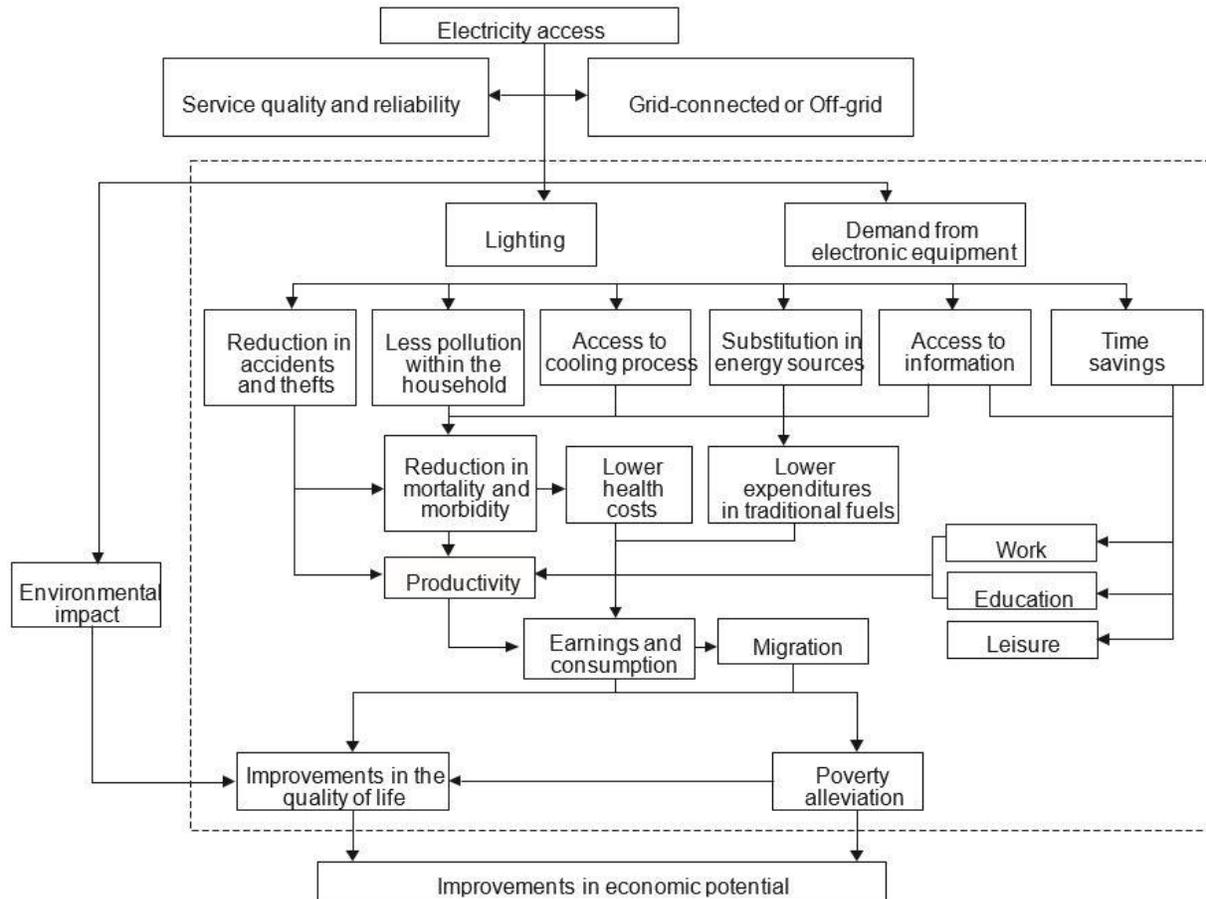
Source: Consorcio Macroconsult S.A. 2016, 22.

Note: Sierra refers to the mountainous regions of Peru.

Assessment of Rural Electrification and Photovoltaic Home Systems

4.4 Based on a causal model developed for the study (figure 4.1), the project's interventions to expand rural electrification are considered to have achieved the following results, which are discussed in more detail in this section:

- Household electricity consumption have reached the targeted average level of 26 kWh per month.
- The rural energy mix has adjusted toward more efficient energy sources (electricity and liquid petroleum gas [LPG]) while decreasing the use of traditional energy forms.
- The labor supply's movement toward activities that are not based purely on the agriculture sector represents improvement in the quality of work and in local economic conditions. This, in turn, has led to increased incomes and expenditures beyond basic needs.
- Solar home systems (SHSs) have proven to be technically viable, but remain risky because EDCs' capacity-building among household users has been negligible; solar home system owners lack the necessary capacity to maintain household PV units.

Figure 4.1. Causal Model for Rural Electrification

Source: Adapted from: Consorcio Macroconsult S.A. – Instituto Cuánto (2016, 31).

Grid Connections

4.5 An electricity consumption level between 21 and 29 kWh per month (most likely in the higher range) was estimated to have been achieved through the REP's grid-based connections. Though this matches the levels that were targeted during project appraisal, they are still relatively low consumption rates, which underscores the need to promote higher usage levels among households. Moreover, power outages remain an issue, as indicated by the average 21 hours of electricity availability per day. The worst power shortages occur during the rainy season. Nonetheless, surveys have indicated that more than half of the beneficiaries are satisfied with the electricity service overall.

4.6 Increased electricity use has led to changes in the household energy supply mix: battery use has been reduced by 25 percent and fuelwood use by 21 percent. The demand for cleaner and more efficient fuels, such as LPG, also increased. Consequently, expenditures on electricity substitutes have also decreased (for example, reductions of S/. 6.1, S/. 3.1, and S/. 3.5 per month for fuelwood, candles, and batteries, respectively), with the savings redirected toward LPG purchase, which has increased on average by S/. 4.5 per month.

4.7 Per capita incomes have also increased by about S/. 145.00 per month, which can be attributed to rural electrification interventions and is equivalent to 30 percent of the overall incremental income values that were observed among the beneficiaries of rural electrification programs. This increment is mainly due to a large increase in entries into the labor force, which is consistent with research findings. A smaller factor is the increase in the number of hours worked per day and a shift toward work with higher value-added outside the agriculture sector. More women have also entered the workforce and started earning incomes for the first time. Time used by women to fetch water, fuelwood, and other combustible products has decreased by about 55 minutes.

4.8 Subjectively, households surveyed have reported their perception that their poverty level decreased with the increase in and greater stability in their incomes. It should be noted that these perceived positive impacts are most pronounced in the highest quintiles of income distribution, where the relevant households tend to have the capacity to take full advantage of the opportunities offered by greater electricity availability and use; such positive impacts are less or not reported in the lower income quintiles.

Photovoltaic Systems

4.9 Based on the study's causal model, the findings related to the performance of PV systems are attributable to REP's interventions. Almost 64 percent of the beneficiaries were connected to PV units between 2008 and 2013, which was the implementation period of REP. The evidence indicates that PV systems have fulfilled the purposes for which they were designed, that is, to serve as an alternative energy source to traditional and inefficient fuel sources, and to meet basic electricity needs at the household level. Electricity from PV systems is being used mainly for lighting (96 percent of respondents), and to a much lesser extent for re-charging cell phones (19 percent) and other electrical gadgets (11 percent). Of the monthly average expenditures of income of S/. 496 among beneficiary households (in 2016 metropolitan Lima prices), S/. 38 are allocated for overall energy use, of which S/. 10.7 are payments related to the PV systems.

4.10 In educational benefits, improvements in student performance have not been observed, possibly because the number of actual study hours have not increased within the households with PV systems as the only (and minimal) electricity source; the time it takes students to walk the long distances between school and home and the chores they perform around the household, may leave them little or no time to do more studies while at home. The only observed change in student behavior is their greater use of newly acquired, electricity-using equipment while they are within the premises of the schools that have obtained connections to the grid.

4.11 Surveys have shown that around 91 percent of PV systems have undergone some repairs in the past five years. Overall, 94 percent are still functioning as of 2016, while 4 percent have fallen into permanent disrepair. Only 6 percent of the PV-only beneficiaries (that is, those with no grid connection) have indicated that at least one person in their household knows how to maintain the PV systems; moreover, only 10 percent of those households have indicated that a member has received any training on the use of PV systems. As many as 40 percent of the household beneficiaries report that they do not practice adequate maintenance, which could negatively affect the sustainability of those PV systems. Nonetheless, 98 percent report that they

pay the applicable tariffs, even though 60 percent report facing difficulties because of the distance to payment centers.

4.12 The EDCs became willing to risk investments in PV systems in isolated areas of Peru because of the REP's catalytic role and facilitation. Without REP, the EDCs would not have entered that market. Though they have adapted their operations to provide directly, or to subtract the provision of PV systems, many barriers have been encountered to date—ranging from logistical challenges of reaching remote areas, to difficult billing and collection systems, to low tariffs and delinquent payments. These issues have weakened the economic incentives for the EDCs who have continued to treat PV systems as an unprofitable and marginal business line. This, in turn, underlines the government's role in the financing and implementation of its PV programs, particularly in the remotest areas where grid connections are highly unlikely.

4.13 Many challenges remain before the financial sustainability of the PV systems can be achieved, among them the need to identify low-cost maintenance measures applicable to remote locations and effective billing systems that can minimize delinquent payments for those types of users. Because of spotty maintenance of the batteries and the PV units, their role in meeting household electricity needs could be at risk, especially during periods when there are gaps between demand and available supply. There are also reported “disconnects” between the perceived benefits and the tariffs being charged, which users consider high because the few hours of available electricity are restricted only to interior household lighting. The users also report inadequate training in the use and maintenance of the PV systems. Taken together, these perceived deficiencies have led users to assess their overall experience with PV systems as less than fully satisfactory and to count on grid connections to eventually reach their remote areas.

4.14 According to an REP census of population centers, 20 percent of the household beneficiaries of PV systems were eventually able to access connections to the grid, while 78 percent still have the PV systems as their only electricity source. This suggests a transition toward grid connection, which has been supported by the recent increases in local government funds for infrastructure development. Solar PV remains a small percentage of the electricity use in farming communities, as shown in table 4.2.

Table 4.2. Mix of Electricity Sources in Farming Units (percentage of total farming units)

Source	Coastal Region	Mountain Ranges	Forest Region	Total
Public network	76.0	68.2	47.0	66.3
Diesel generators	21.5	7.4	40.2	19.8
Wind generators	0.4	1.1	1.0	0.8
Solar photovoltaic	1.1	9.8	10.0	6.7
Batteries	0.1	11.4	0.1	4.8
Others	0.9	2.1	1.7	1.5
Total	100	100	100	100

Source: Consorcio Macroconsult S. A.–Instituto Cuánto 2016, 20.

4.15 The achievement of the subobjective of investing in subprojects for supplying electricity services is rated **modest**.

SUBJECTIVE 2: TO DEMONSTRATE A FRAMEWORK FOR ELECTRICITY PROVISION IN RURAL AREAS THAT ATTRACTS INVESTMENT FROM PRIVATE AND PUBLIC ELECTRICITY PROVIDERS

4.16 Subobjective 2 was to demonstrate key elements of a framework for electricity provision in rural areas that would attract investment from private and public electricity providers, as well as national, regional, and local governments

Outputs

- The project rolled out an innovative model whereby the EDCs can provide regulated service using PV systems.

Outcomes

- The two key components of the model's implementation were: (i) national tariffs set by OSINERGMIN, the regulator; and (ii) the clients' access to FOSE cross-subsidies.
- Sustainability of the PV systems was significantly enhanced by the establishment of regulated service for isolated PV systems—a unique achievement in Latin America.

4.17 The achievement of the project's subobjective of demonstrating an electricity provision model that attracts investments from public and private electricity providers is rated **substantial**.

SUBJECTIVE 3: TO IMPLEMENT A PILOT PROGRAM TO INCREASE PRODUCTIVE USES OF ELECTRICITY

4.18 Subobjective Three was to implement a pilot program to increase productive uses of electricity to increase opportunities for income generation in rural areas.

Outputs

- Productive uses of electricity were promoted through 14 implementation contracts with nongovernmental organizations (NGOs), resulting in 21,111 enterprises and families adopting electricity-using equipment, which was more than double (that is, 2.35 times) the target of 9,000.
- Investments in electricity-using equipment were even more impressive, reaching \$15.2 million or 8.5 times the target of \$1.81 million.

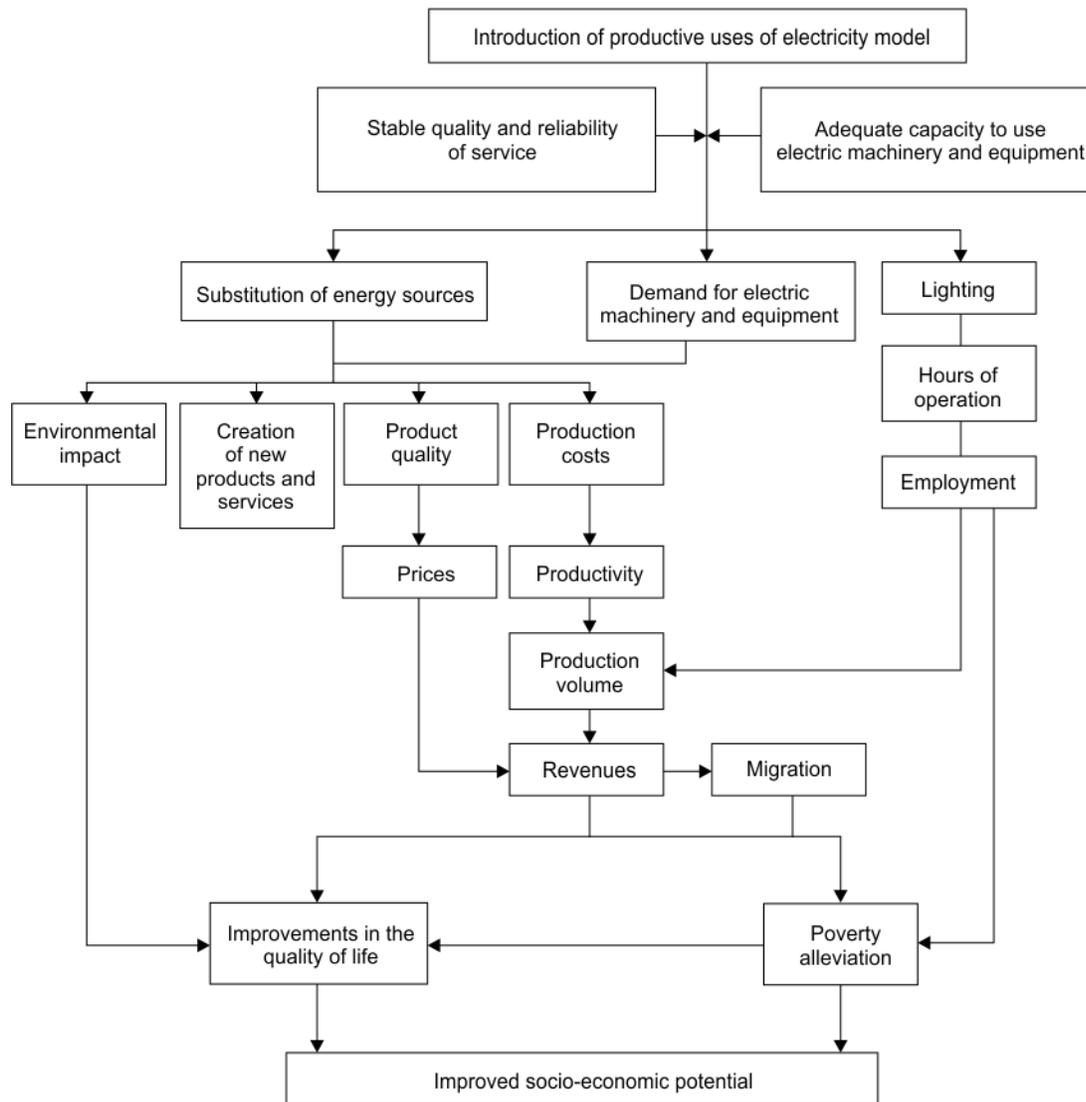
Outcomes

- Rural families, producers, and businesses adopted electricity-using equipment, resulting in an overall increase in electricity used to 19,107 megawatt hours, which surpassed the target of 18,000 megawatt hours in the first five years of operation. An in-depth assessment of the achievements and remaining challenges is provided immediately below.

Assessment of the Promotion of Productive Uses of Electricity

4.19 The REP's pilot program to promote productive uses of electricity covered an extensive geographic area, including semiarid coastal communities, Amazon rain forests, and Andean highlands—directly benefitting at least 100,000 people and having an economic value of about \$1 million at project closing. The program helped families, cooperatives, and small-/micro-enterprises to adopt electricity-using equipment to process coffee, cocoa, rice, cereals, milk, baked goods, meat products, handicrafts, and other wood and metal products. Agricultural production and processing expanded from increases in water pumping. About one-third of the beneficiaries were women. These findings and the updated results discussed below benefited greatly from the 2016 impact evaluation study on productive uses of electricity carried out under REP II (Consortio Macroconsult S. A.–Instituto Cuánto 2016).

4.20 To adequately appreciate the highly significant results of this component, it is important at the outset to delineate the causal model for promoting productive uses of electricity. Figure 4.1. indicates that, with “improved socioeconomic potential” as the desired long-term outcome, the initial input would be the introduction of the productive uses model, which in the case of REP involved the contracting of NGOs to promote the model—via an Institutional Support Platform—that pulled together and worked closely with the concerned EDCs, the relevant government officials, local commercial establishments, academic institutions, and other stakeholders with a contributing role toward achieving the targeted results. To work effectively, the model requires, as complementary inputs, reliable electricity supplies and sufficient capacity to use new electric machinery and equipment. The model, when implemented successfully, would lead to substitution of energy sources (from diesel or kerosene to clean electricity), as well as increased demand for electricity-operated equipment and lighting. Intermediate outcomes would result, ranging from increased employment and higher productivity to better product quality leading to higher market prices, and improved environmental conditions by lowering the use of kerosene. The final outcomes from the model's interventions would be a better quality of life and poverty alleviation, which would contribute to the overarching goal of sustainably improving the socioeconomic potential of the beneficiaries.

Figure 4.2. Causal Model for Productive Uses of Electricity

Source: Adapted from: Consorcio Macroconsult S.A.–Instituto Cuánto2016, 36.

4.21 The study indicates that the electricity consumption stemming from productive uses has continued to increase after REP closed, in a manner that is sustained and attributable to the project's interventions. Moreover, the study found that indicators related to household incomes of productive family units (PFUs) have also increased because of incremental electricity consumption through those productive uses. Outside the average figures, this trend is most pronounced in the northern part of Peru, which showed the highest increases in the rate of electricity consumption. A similar increase in indicators related to education and health were not observed, mainly because of data constraints. These findings were based on the causal model presented above.

4.22 Domestic energy use among project beneficiaries tripled on average from 12 kWh/month during 2005–08 to 37 kWh/month from 2013–15, based on data from the EDCs. Moreover, the average consumption of productive units benefited by the project more than quadrupled from

55.8 kWh/month from 2005–08 to 240 kWh per month from 2013 onwards. These results indicated that the project has resulted in an increase in electricity consumption directly among production units, and indirectly within the households of the project beneficiaries. A survey of the PFUs also indicated that the improved production indicators could be explained by increased electricity use for productive uses, through the following specific benefits (percentage of respondents in brackets):

- enabling more productive hours during the day (56 percent)
- higher levels of production (39 percent)
- better product quality (40 percent)
- better market prices (39 percent)

4.23 It is important to note that the PFUs benefited by the project continue to use complementary sources of energy, namely, candles (76 percent) for domestic uses, batteries (77 percent) for operating radios and wall clocks, and wood fuels (81.6 percent) for cooking and space heating, although the use of LPG is also being used increasingly as a cooking fuel. Of the total electricity consumed in Peru, the shares of various end-uses are shown in table 4.3.

Table 4.3. Shares of Multiple Electricity End-Uses in the Public Network (percent)

End Use	Shares
Lighting	99.2
Electrical devices ^a	70.6
Family businesses	5.4
Cooking ^b	4.1
Farm irrigation	1.6

Source: Consorcio Macroconsult S. A.–Instituto Cuánto (2016, 58).

a. Color television, refrigerators, irons, and blenders (in order of importance).

b. The predominant cooking fuel is liquefied petroleum gas, followed by wood fuels.

4.24 Using a difference-in-difference methodological approach, the study also found that there were notable increases in the incomes of those engaged in productive employment, compared with 2007 baselines. Among the household beneficiaries, the gross production value per month was estimated at S/. 2,119 based on metropolitan Lima prices in 2016, which is S/. 658 higher than the amount estimated in 2007 for those same households. Monthly sales for the beneficiary PFUs also reached S/. 1,558 per month, which, when compared with average business costs of S/. 829, represent average monthly gains of S/. 729. Because this increase cannot be entirely attributed to the project, a comparison was made between PFUs that benefited from REP interventions and those that did not, which indicated that the PFUs under REP had higher net gains of about S/. 130 per month. Among those who are employed, the difference-in-difference analysis also showed a per capita increase of around S/. 228 per month for those impacted by REP's interventions. These PFU and per capita gains were most pronounced in the northern region of Peru. Finally, the study conducted a benefit-cost analysis, which showed that over a ten-year period starting from REP completion, the net present value is \$7.6 million and the internal rate of return is 19 percent.

4.25 In the districts where REP was implemented, only 23.4 percent of households still lack access to some system of communication, whereas 85 percent lacked such systems in 2007. The main communication tool is the cellular phone, which has significantly improved access to information about rural market developments as well as the prices or inputs and final products. Internet use has also expanded considerably, which has permitted access to high-value market information and timely news, in turn bolstering positive public feedback on the benefits of increased electricity use.

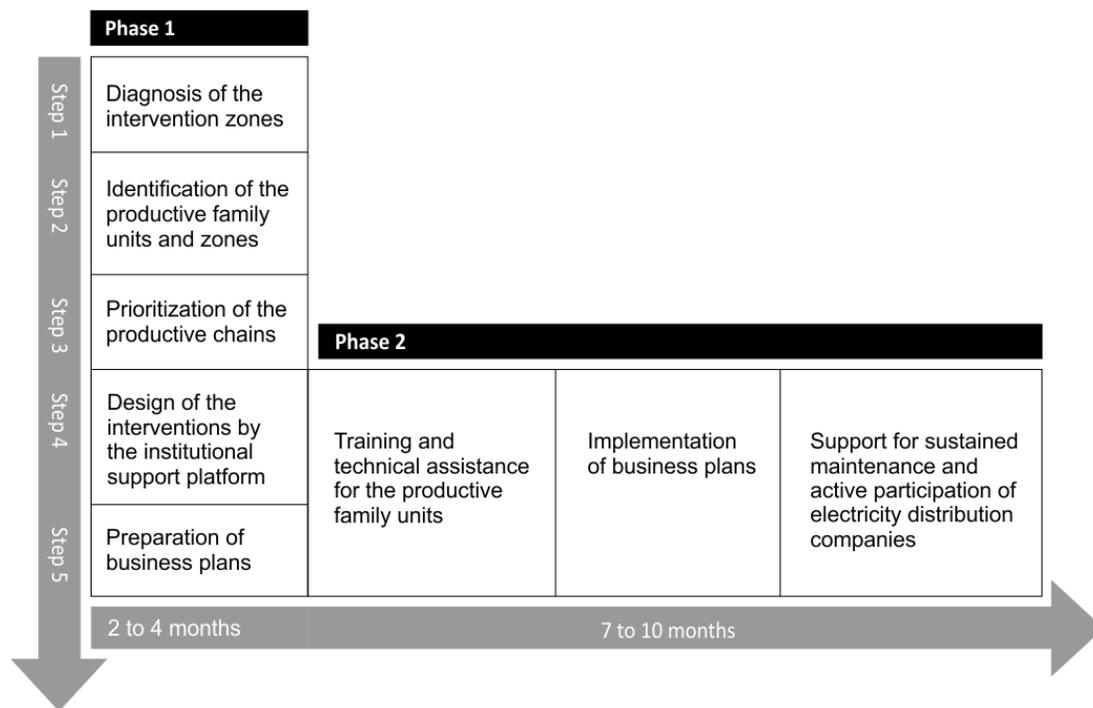
4.26 Replicability is conditioned by the socioeconomic context in which the productive uses model was implemented; that is, the model's interventions occurred among beneficiaries that are distinctly more advanced than the average profile within the district as a whole. The beneficiaries were generally in independently walled houses with access to the public water supply network, basic sewerage and sanitation facilities and electricity connections. In the districts where REP was implemented, 80 percent already had these connections, while only 20 percent did not. (These service indicators show a significant improvement compared with 2007 data in the same districts.) Replication of the model would require conditions that are significantly beyond subsistence levels, to take advantage of value chains and potential for integration with intermediate markets. Moreover, the available quality of supply should already be relatively high, and not comprised only of single-phase domestic connections. In addition, the regional and local authorities need to be willing to support promotion campaigns, including the provision of complementary financing.

4.27 However, keeping these positive impacts on track is not guaranteed because of institutional weaknesses, notably the lack of proactive leadership by the EDCs. The organizational changes that were required of the EDCs occurred only slowly and incrementally; in the best of cases, units—mostly for information dissemination only—were established to address broad demands for rural electrification, but not to perform an active role in seeking and targeting potential clients for productive uses, researching possible business opportunities, establishing follow-up procedures, and conducting day-to-day support activities.

4.28 At face value, the main hindrance for EDCs was limitations in the financial resources required to operationalize field units and mainstream decentralized programs that promote productive uses of electricity. However, interviews showed that the perception of benefits differed across EDCs, which may have affected their level of commitment. Enosa, operating in Piura and Tumbes, for example, concurs that the promotion of productive uses of electricity has increased its market share and revenues from electricity sales; however, it believes that returns on its investments in rural electricity will take up to 30 years to materialize. Electro Ucayali, which serves the Ucayali region, considers the promotion of productive uses a promising venture. Finally, SEAL, an electricity distributor in the Arequipa region, on the other hand, agrees that there have been some improvements in its commercial indicators but not enough to attribute them to REP interventions. Of these three EDCs, only Enosa assigned a substantial amount of resources for promoting productive uses; it also created a Sustainable Rural Development operational area that has an education sector program called Learning with Energy. Electro Ucayali made some initial budgetary and organizational changes but postponed further activities, thus signaling a weak commitment to promoting productive uses. SEAL did not allocate any resources.

4.29 Moreover, the Institutional Support Platform that was designed under REP I to bolster and sustain the promotion of productive uses of electricity functioned mostly at the project’s initial stages and mainly to spread the conceptual model. The actual promotion of productive uses was carried out as a series of area-specific activities, each of which involved a Memorandum of Understanding between the concerned EDC and a competitively procured non-NGO that was responsible for working directly with the individual producers. Figure 4.3 shows the overall scheme of promotional activities under each NGO contract of 9 to 12 months. The NGOs worked together with the ISP, which provided overall facilitation and coordination with other government and NGO programs in agriculture, rural development, as well as technical institutes and universities. This program design was modeled after the World Bank-assisted rural electrification projects in Indonesia.

Figure 4.3. Pilot Program on Productive Uses of Electricity Intervention Scheme



Source: Adapted from Consorcio Macroconsult S. A.–Instituto Cuánto 2016, 44.

4.30 The Institutional Support Platform was effective in diagnosing rural energy scarcity and catalyzing necessary responses among financing agencies, municipalities, and EDCs. It was also effective in convoking key stakeholders, such as the concerned national and regional authorities, as well as universities, institutes, and NGOs that could provide training and capacity-building (including promotional events at universities) to roll out the productive uses model. Television and radio advertising was also used for this purpose. During REP implementation, however, the role of the Institutional Support Platform became less and less clear. Consequently, its functions weakened increasingly, participation sagged (most likely worsened by the lack of leadership among the EDCs), and in the end, was no longer functioning in the multistakeholder catalyst role for which it was originally intended.

4.31 In sum, the REP's program to promote productive uses of electricity benefited from a high degree of political and technical support from the government and from project staff, as well as strong social support from beneficiary populations. However, the necessary financial and institutional support, which was expected from the EDCs as the project was originally designed, proved to be weak by the time REP closed.

4.32 The achievement of the project's subobjective of piloting a program for the productive uses of electricity is rated **substantial**.

GLOBAL ENVIRONMENTAL OBJECTIVE

4.33 The project's global environment objective was "to achieve reduction of greenhouse gas emissions through use of renewable energy in rural areas for provision of electricity." This objective was not achieved, as shown below:

Outputs

- National Atlases of Wind and Small Hydro Potential were produced, which provided data and assisted in eventual renewable energy auctions.
- However, the small hydro facilities were not constructed, because of the cancellation of the Small Hydro Financing Facility, which was displaced by a renewable energy auctions facility.

Outcomes

- Greenhouse gas reductions were only 5,626 tons for the lifetime of the residential PV systems installed, compared with the target of 151,717 tons for the first five years, because of the cancellation of the REP's small hydro component. However, the greenhouse gas reductions were expected to be achieved through the renewable energy auctions that were implemented instead of the small hydro component under REP.

5. Efficiency

Economic Efficiency

5.1 A key selection criterion for the RE subprojects is their economic and financial viability, including the capital cost subsidy. Each subproject had a specific subsidy level that would allow the service provider to invest and earn a rate of return within the legally compliant specifications. Under these conditions, the EDCs made investments ranging from 18 percent to 40 percent, or averaging about 26 percent. The REP's economic rate of return is estimated at 21.3 percent; this slightly lower rate than the 23.7 percent calculated during appraisal is explained by the higher capital costs, which was compensated for by the higher willingness-to-pay values. In addition to an adequate rate of return, the REP is also efficient relative to the public investment outlay. Rural electricity coverage improved from about 30 percent to 63 percent during the period of 2001 to 2012. Of this 34 percent increase, the REP contributed about 6 percent, which corresponds to 105,045 new connections. This means that 18 percent of the overall electrification outcome can

be attributed to REP, while using only 11 percent of the government's total investment amount of \$898 million for that same period.

5.2 The project's efficiency is rated **substantial**, despite the delays that led to a closing date extension of 18 months. The REP's design incorporated incentives for using subsidies efficiently, significant investments were mobilized from the EDCs, rates of return were adequate and near the levels estimated at appraisal, and public resources were used efficiently. The global environmental objective, however, was not achieved because of the cancellation of the small hydro facility that the GEF grant was intended to finance.

6. Ratings

Outcome

6.1 Overall project outcome is rated **satisfactory**. The relevance of the development objective was **high**, and the relevance of the project's design was also **substantial**. The achievement of the project's first subobjective is **modest**; achievements of the two other subobjectives are each rated **substantial**. Project efficiency was **substantial**.

Risk to Development Outcome

6.2 The follow-on REP II Project, which is closing in August 2017 and has an almost identical development objective and targeted outcomes as the preceding one, helped minimize the risks to REP I's outcomes to negligible levels. The latest Implementation Status and Results Report for REP II (dated December 2016) indicates that, by the closing date, three of the four development objective indicators would be exceeded, and the loan would be disbursed while generating some savings owing to the lower average costs that resulted from the bidding processes. Moreover, as a clear sign of the negligible risks to REP I's outcomes, and REP II's as well, the DGER of the MEM has issued regulations to incorporate the model that was rolled out under these two projects, that is, an approach where subprojects are proposed, constructed, owned, and operated by EDCs that have a strong incentive to maximize connection rates and are responsible for the provision of long-term, regulated electricity service under the supervision of OSINERGMIN. Moreover, the model requires that each subproject must be financially viable at current tariff levels after the application of the partial capital cost subsidy. The regulatory mainstreaming of this approach to rural electrification that was piloted and scaled-up under the two projects provides evidence of the efficiency and sustainability of their outcomes.

6.3 The EDCs designed, constructed, and continue to operate the REP subprojects—within a regulatory framework driven by efficiency criteria right from the initial stages. The rural electrification subprojects, including the PV systems, have relied on proven technologies that will continue to be operated throughout their useful lifetime by the EDCs under the supervision of OSINERGMIN. The policies to develop renewable energy were facilitated by the adjudication of a premium price for 262 megawatts of small hydro in the 2010 and 2011 renewable energy auctions. Regarding the productive uses component, the electrical equipment chosen by the rural enterprises are all in common use and have readily accessible repair and maintenance sources throughout the rural markets. This component has had a strong influence in Peru's electrification agenda. MEM has included the promotion of productive uses in its National Plan for Rural

Electrification (2013–22), which prioritizes renewable energy development and has an allocated budget.

6.4 A Productive Uses Workshop was held in Lima in November 2016, during which the Vice Minister for Energy and DGER committed to continue extending the productive uses of electricity. As of this report’s preparation, staff working on productive uses under the ongoing REP II Project have been processing NGO contracts to be implemented by DGER after REP II closes in August 2017. Although recognizing that the support of the government and the EDCs for promoting productive uses of electricity needs to be stepped up and sustained, and (ii) the user training and maintenance, billing and collections, and financial sustainability issues related to PV systems, the risk to the project’s development outcome is rated **negligible**.

World Bank Performance

QUALITY AT ENTRY

6.5 The background analysis for REP I was sound, having been based on a 2005 study (“Peru National Survey of Household Energy Use”) that was supported by MEM and the World Bank’s Energy Sector Management Assistance Program. The study consisted of a comprehensive rural energy survey that provided a highly valuable basis for the project’s design and economic justification. While piloting innovative components, namely, promotion of productive uses of electricity and off-grid PV systems, the project did incorporate lessons from earlier rural electrification efforts in other countries, including Argentina, Bolivia, Chile, Ecuador, El Salvador, Lao People’s Democratic Republic, the Philippines, and Vietnam. In particular, the project’s preparation benefited from studying the experience of other countries in the Region that used similar approaches for extending subsidies to EDCs for rural electrification. The lessons that were incorporated included: (i) the need for detailed and clear procedures to estimate the financial viability of subprojects hence the subsidy amounts required; (ii) the opportunity to promote productive uses to increase electricity demand and local economic benefits; (iii) approval of subprojects based on a simple, clear and transparent methodology; and (iv) subsidy allocation based on the least-cost technology, including renewable energy where viable. As a result, the project’s design integrated renewable energy technologies. The project appraisal document provided highly detailed implementation arrangements, including criteria for selection of subprojects, which continued to be applied in REP II. There were, however, some minor weaknesses related to the definition of performance indicators and the arrangements for implementing safeguards requirements.

6.6 The World Bank’s quality at entry is rated **moderately satisfactory**.

QUALITY OF SUPERVISION

6.7 Some continued follow-up to REP I was maintained during the supervision of the follow-on REP II, given the congruence of their development objectives, and the continued dialogue with the same lead and implementing agencies, the EDCs, and rural stakeholders. The World Bank proactively supervised REP I, even when there were frequent changes in government authorities the presidential and ministerial levels. The World Bank project team was effective in mobilizing support from the new authorities. Documentary evidence indicates that the World

Bank team consistently made efforts to accelerate project execution and address issues as expeditiously as possible. Based on interviews with the lead and implementing agencies, the World Bank team's technical advice was considered timely and valuable. Project restructurings were done when necessary to modify implementation arrangements considering changing circumstances. Fiduciary and safeguard aspects were also regularly addressed. However, there were some shortcomings in detecting early enough the delayed rights-of-way payments by distribution companies, especially Hidrandina and Electrocentro. The reallocation of funds after the small hydro facility was canceled also proved to be slow. Finally, the criteria for rating the project's performance lacked consistency and may have led to some confusion.

6.8 The quality of the World Bank's supervision is rated **moderately satisfactory**.

6.9 Overall, the World Bank's performance is rated **moderately satisfactory**.

Borrower Performance

GOVERNMENT PERFORMANCE

6.10 As indicated in the Relevance of Objectives section, the government consistently supported rural electrification development in its energy sector policies and strategies. Its ownership and commitment to achieving the REP I's development objectives were strong and consistent (this has proven true of REP II as well, based on the latest Implementation Status and Results Report). The project received sufficient levels of budget allocations, political support, and high quality technical supervision. SNIP procedures for approving subprojects were initially cumbersome, but they were streamlined during implementation. The DGER, with direct support from the Minister and Vice Minister of Energy and Mines, as well as Ministry of Economy and Finance officials, played a key role in convincing the EDCs to enter the individual PV market; moreover, they persuaded OSINERGMIN to set up a system for regulated service with PV systems through a formal tariff-setting process that included a tariff study, public hearings, and modification of the regulations of the FOSE cross-subsidy to make PV system tariffs affordable. Regarding productive uses of electricity, the MEM, DGER and the REP I staff, with support from the Ministry of Economy and Finance, also showed consistent commitment by (i) persuading the EDCs to participate via signed memorandums of understanding in attracting and competitively procuring NGOs to promote productive uses, and (ii) facilitating the work of the ISP. This culminated in the preparation under REP II of a highly rigorous and well-executed evaluation study (by Consorcio Macroconsult S. A.– Instituto Cuánto) that covered productive uses of electricity as well as financial, economic, regulatory and tariff aspects of the rural electrification subprojects.

6.11 Given the direct attribution between the government's actions and the achievement of project outcomes related to the rollout of a regulated service provision model for PV systems and the mainstreaming of productive uses of electricity, and the increase in the national rural electrification coverage by 5.9 percent, government performance is rated **satisfactory**.

IMPLEMENTING AGENCY PERFORMANCE

6.12 The MEM implemented the project through its PEU during 2006 and 2007. The DGER took over from PEU in December 2007 and continued implementing the project until it closed in 2013. Staff continuity was assured until 2008, thus facilitating smooth project implementation. However, some key personnel resigned in 2009 and there were delays in their replacement. This, together with the prolonged absence of a Director, weakened project implementation during its last two years. In particular, safeguards supervision became inadequate.

6.13 Implementing agency performance is rated **moderately satisfactory**.

6.14 Overall, borrower performance is rated **satisfactory**.

Monitoring and Evaluation

6.15 **Design.** The design of REP I's monitoring and evaluation (M&E) system included the right number of intermediate and final outcome indicators, which were well selected for providing adequate and accurate measurements of the project's achievements. There was a minor issue, however, with the key indicator of "new connections;" views differed on whether the targets had to be met during the project's implementation period, or during a more extended time frame. The latter position argues that the total capacity of connections installed has a lifetime of 20 years and not all the connections would be made during the initial construction of the subprojects. This lack of specificity in setting indicators was addressed during the preparation of the follow-on REP II.

6.16 **Implementation.** The project monitoring team within DFC-DGER maintained accurate records on the regular measurements of the project's indicators; they also extracted additional information that proved useful for analyzing impacts. For example, the databases on project beneficiaries provided insights into gender distribution, average electricity consumption per household in each subproject, benefits of electrification as perceived by households, supply interruptions, and other problems that might arise due to system constraints. DFC-DGER provided the World Bank with semester progress reports, which including an update of results indicators and results of surveys of beneficiaries, in full compliance with the stipulations of World Bank loan and GEF grant agreements.

6.17 **Utilization.** M&E results directly informed the project's restructuring events and the associated adjustment of indicators. The data also provided the basis for designing the follow-on REP II, which had similar development objectives as REP I. It must be noted that the World Bank's use of M&E data was not always consistent: sometimes it focused as it should on the long-term achievement of the development objective, but at other times it took into account mainly the short-term implementation issue, which led to uneven reporting and unclear messages to the management of the World Bank institutions and to the government.

6.18 M&E for the project is rated **substantial**.

7. Lessons

7.1 The following lessons are derived from the project’s implementation experience and IEG’s assessment of the sustainability of outcomes that included a field visit in 2016; the lessons also take into account the experience and results of REP II, which is closing in August 2017. The lessons below focus on: (i) innovative rural electrification activities that the projects have supported, specifically, the promotion of productive uses of electricity and PV systems for isolated areas and (ii) the overall sustainability of rural electrification efforts in Peru.

7.2 **The promotion of productive uses of electricity needs consistent and adequate levels of technical assistance and investment support, without which their sustainability would be put at risk.** The benefits of promoting productive electricity uses have been demonstrated under REP I and by REP II as well. From their inception as an innovative pilot, these promotion activities have now been mainstreamed—notably through the government’s incorporation of the REP model within its rural electrification plan. However, after a solid start, the REP’s Institutional Support Platform for promoting productive uses needs to be reinforced. If the positive outcomes from promoting the productive use of electricity are to be sustained, it is important for the government to maintain its political and technical support for promoting productive uses; the NGOs, together with the ISP, need to continue to work directly with individual producers; and the EDCs have to more vigorously revive their leadership and proactive follow-up as originally designed.

7.3 **Achieving the financial sustainability of PV systems remains a challenge that the government and EDCs need to address.** Given the remote and often isolated conditions where PV systems are installed, the EDCs need to identify low-cost maintenance measures and effective billing systems that can minimize delinquent payments. The users also need to be provided adequate training in the use and maintenance of the batteries and the PV units. Some users also report a “disconnect” between the tariffs being charged and the restricted availability of electricity, which is used mainly for lighting. Many users count on grid connections to eventually reach their remote areas but this will not be economically and logistically feasible for large numbers; these issues remain to be resolved.

7.4 **To reach “the last mile” of rural electrification while ensuring sustainability, the government and the EDCs need to take specific actions.** The government has incorporated the rural electrification model—tested and proven under both REP I and REP II—of mobilizing financing and the active involvement of EDCs, mainstreaming productive uses of electricity, and installing PV systems in isolated rural areas. The government may need to exercise greater flexibility on market structure, regular updates on the regulatory regime, more frequent revisions of the tariff regime, and other actions that would accommodate the rapid expansion of rural customers and their higher distribution costs. The EDCs need to ensure their continued financial contributions, provide better training of users on the maintenance of PV systems, and develop more cost-effective ways to improve billing collection and minimize delinquent payments.

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¹ As measured by the Gini coefficient of 0.44 in 2013.

Appendix A. Basic Data Sheet

RURAL ELECTRIFICATION PROJECT (IBRD 7366)

Key Project Data (US\$, millions)

	Appraisal estimate	Actual or current estimate	Actual as % of appraisal estimate
Total project costs	144.55	131.69	91
Loan amount	50	49.34	99
Global Environment Facility	10	3.71	37
Electricity distribution companies	33.10	29.25	88
Government of Peru	51.45	49.39	96

Cumulative Estimated and Actual Disbursements

	FY07	FY08	FY09	FY10	FY11	FY12
Appraisal estimate (US\$, millions)	3.6	11.0	21.6	34.7	49.5	60.0
Actual (US\$, millions)	0.75	6.0	17.4	35.9	44.9	52.7
Actual as % of appraisal	21	55	81	103	9	88

Note: Including the Global Environment Facility grant.

Project Dates

Project Stage	Original	Actual
Concept review	8/10/2006	08/03/2004
Appraisal		10/24/2005
Board of Executive Directors approval	01/31/2009	03/07/2006
Effectiveness		08/10/2006
Midterm review		05/11/2009
Closing date	12/31/2011	06/30/2013

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

Stage of Project Cycle	Staff Time and Cost (World Bank Budget Only)	
	Staff Weeks (no.)	US\$, 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

Other Project Data
Borrower or Executing Agency
Follow-on Operations

Operation	Credit no.	Amount (US\$, millions)	Board date
Second Rural Electrification Project	IBRD 80340	50.00	April 21, 2011

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	LCSFN	
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	LCSFN	
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	

Appendix B. Project Costs and Financing

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)					Total
		IBRD	GEF	GoP	Distrib. Utilities	
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

Appendix C. Economic Analysis

The ex post economic analysis conducted for the Implementation Completion and Results Report focused on the main project component consisting of investments in rural electrification subprojects that encompassed grid extension and off-grid photovoltaic (PV) installations. These activities accounted for 90 percent of the project's total cost. The updated economic internal rate of return was 21.3 percent and the net present value was estimated at \$80.7 million, based on a 10 percent discount rate as at appraisal. This result is near the appraisal's economic internal rate of return estimate of 23.7 percent for the same project components.

The Implementation Completion and Results Report indicates that these are conservative estimates of the project's economic performance because the benefits of the very successful productive uses component have been minimally incorporated, that is, the extent to which the measurement of household electricity consumption has captured 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 (around 9,500 megawatt hours per year), which—when valued at an average distribution tariff of \$0.10 per kilowatt hour (kWh)—would yield an additional benefit of around \$1 million per year.

Grid Extension Subcomponent

COSTS

The analysis includes the actual investment cost of \$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 operation and maintenance costs (3.3 percent of investment costs) plus the cost of energy that is estimated based on a tariff of S/. 0.154 per kWh (US\$0.0592/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 that were connected to the grid by the project indicated an average consumption of 20.98 kWh per month.

Other assumptions are that (a) the installations have an economic life of 15 years; (b) residential consumption of electricity will increase at an annual rate of 2 percent; and (c) the exchange rate of S/. 2.61 per US dollar.

Photovoltaic Subcomponent

The economic internal rate of return for the residential solar PV systems 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.

COSTS

The analysis includes the actual investment cost of \$6.54 million for 7,100 PV home systems installed by the project. It includes also a cost of \$156 per household per year for operation and maintenance costs plus the annualized cost of the replacement of batteries every 5 years and an economic life of 15 years.

BENEFITS

Solar PV systems have two benefits. First, they substitute for the expenses on traditional energy sources, that is, lighting and communications devices, such as kerosene lamps, candles, gas and batteries, by using solar, the running costs of which are practically negligible (replacement of parts and batteries are considered as maintenance costs and are taken into account in the analysis). Second, in addition to the savings over traditional lighting and communications devices, PV systems make more and better quality energy available, thus bringing additional welfare benefits to the beneficiaries.

Appendix D. List of Persons Met

Lima

Ministry of Economy and Finance (MEF)

Manuel Starke, Energy Sector, General Directorate for Public Investment
Manuel Zamora, General Directorate for Indebtedness and the Public Treasury

Ministry of Energy and Mines (MEM)

Gonzalo Francisco Alberto Tamayo Flores, Minister
Raúl Pérez-Reyes Espejo, Vice Minister
Hugo Sulca, Director General, General Directorate for Rural Electrification
Gustavo Gonzalez de Otoya, Adviser to the Office of the Vice Minister
Pablo Ponce, Technical Chief, Project Implementation Unit (PIU)
Jorge Ascaño, Monitoring and Evaluation Chief, PIU
Wilson Miranda, Coordinator, PIU
Edgar G. Gonzalez, Principal Specialist in Productive Uses of Electricity, PIU
Martin Flores, Specialist in Renewable Energy, PIU

National Fund for Financing the Entrepreneurial Activity of the State (FONAFE)

Tania Jezabel Valera Morey, Business Corporate Executive

Supervisory Commission for Energy and Mining Investment (OSINERGMIN)

Jorge Manuico Mallma, Specialist

Administration Office of Electricity Infrastructure (ADINELSA)

Luis Enrique Santillán Cervantes, General Manager
Carlos San Miguel Caballa, Technical Manager

Distriluz

Felipe Casasola N., Corporate Technical and Rural Electrification Manager
Roberto La Rosa Salas, Corporate Projects Manager

Macroconsult

Álvaro Monge Zegarra, Partner, Social and Economic Development

World Bank

Oliver Braedt, Program Leader

Challabamba

Nerio Lovon, Engineer, Electro Sur Este (ELSE)
Eusebia Ascona Torres, beneficiary of solar home system in Sector Aymara
Several Chusa Alta residents

Paucartambo

Policarpio Delgado, District Office, Electro Sur Este (ELSE)

San Salvador, Urubamba

Rosana Mamani, beneficiary of the component for productive uses of electricity

Washington, D.C.

Janina Franco, Senior Energy Specialist

Ines Perez Arroyo, Consultant

Appendix E. Borrower Comments



PERÚ

Ministerio
de Economía y FinanzasSecretaría
General

"AÑO DEL BUEN SERVICIO AL CIUDADANO"

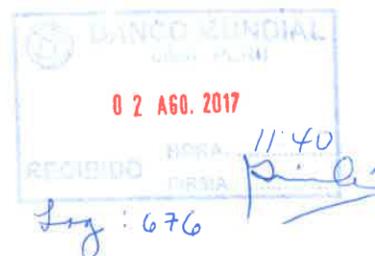
Lima, 01 AGO. 2017

OFICIO N° 3736 -2017-EF/13.01

Señora

MIDORI MAKINOManager, Sustainable Development Unit
Independent Evaluation Group**BANCO INTERNACIONAL DE RECONSTRUCCION Y FOMENTO**

Av. Alvarez Calderón N° 185, Piso 7. San Isidro

Presente.-

Asunto : Informe de Evaluación de Desempeño del Programa de Electrificación Rural - Contrato de Préstamo N° 7366-PE y Donación N° TF 056023

Referencia : a) Carta del BIRF de fecha 13.06.2017
b) Oficio N° 0617-2017-MEM/DGER

Es grato dirigirme a usted, con relación a los documentos de la referencia a) y b), mediante los cuales se solicita la opinión de este Ministerio sobre el Informe de Evaluación de Desempeño del Programa Electrificación Rural (FONER I) financiado con el Préstamo y Donación suscritos entre la República del Perú y el Banco Internacional de Reconstrucción y Fomento - BIRF, hasta por US\$ 50,0 y US\$ 10,0 millones respectivamente.

Al respecto, remito a usted copia del Informe N° 152-2017-EF/52.04 elaborado por la Dirección General de Endeudamiento y Tesoro Público de este Ministerio, para su conocimiento y fines pertinentes.

Hago propicia la oportunidad para expresarle los sentimientos de mi especial consideración y estima personal.

Atentamente,

ROCÍO DEL PILAR MONTERO LAZO
Secretaria General (e)



MINISTERIO DE ECONOMÍA Y FINANZAS
DIRECCION GENERAL DE ENDEUDAMIENTO Y TESORO PÚBLICO

"AÑO DEL BUEN SERVICIO AL CIUDADANO"

INFORME N° 152-2017-EF/52.04

Para : Señora
Rossana Polastri Clark
Viceministra de Hacienda

Asunto : Requerimiento de información

Referencia : Carta del BIRF de fecha 13.06.2017

Fecha : Lima, 07 JUL 2017

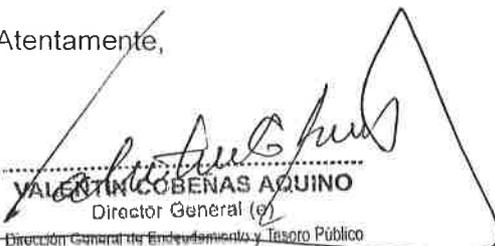
Me dirijo a usted, con relación al documento de la referencia, mediante el cual el Banco Mundial solicita la opinión de este Ministerio sobre el Informe de Evaluación de Desempeño del Programa Electrificación Rural (FONER I), financiado con el Préstamo y Donación suscritos entre la República del Perú y el Banco Internacional de Reconstrucción y Fomento - BIRF, hasta por US\$ 50,0 y US\$ 10,0 millones, respectivamente.

Sobre el particular se informa lo siguiente:

1. Mediante el Oficio N° 628-2017-EF/52.04, este Despacho solicitó a la Dirección de Fondos Concursables del Ministerio de Energía y Minas, su opinión sobre el texto del Informe de Evaluación de Desempeño del Programa Mejoramiento de la Electrificación Rural mediante Fondos Concursables - FONER I, a fin de atender el requerimiento del Banco Mundial.
2. El Ministerio de Energía y Minas, a través de la Dirección General de Electrificación Rural, con el Oficio N° 0617-2017-MEM/DGER, ha alcanzado su opinión y comentarios sobre el citado Informe. Se adjunta copia de dicho documento para conocimiento del Banco Mundial.
3. En los aspectos que son competencia de esta Dirección General, expresamos nuestra conformidad al Informe de Desempeño del Programa Mejoramiento de la Electrificación Rural mediante Fondos Concursables - FONER I, elaborado por el Banco Mundial.
4. Sin perjuicio de lo antes señalado, estimamos pertinente mencionar que el préstamo BIRF N° 7366-PE, se contrató en el año 2006 hasta por US\$ 50,0 millones, para financiar el Programa FONER I, cuyo plazo para su ejecución estuvo previsto hasta el 31.12.2011, y por diversas circunstancias se requirió ampliar dicho plazo hasta el 30.06.2013. Entre otras causas, se puede mencionar las dificultades suscitadas entre las empresas distribuidoras y algunos contratistas, que conllevaron a cancelar contratos de obra; que afectaron el cumplimiento de las metas esperadas, el plazo de ejecución previsto para el Programa, y no permitieron utilizar totalmente los recursos del préstamo BIRF.

En tal sentido, a fin de atender el requerimiento solicitado por el Banco Mundial, se adjunta un proyecto de oficio para la firma de la Secretaria General del Ministerio de Economía y Finanzas, de estimarlo pertinente.

Atentamente,


VALENTÍN COBENAS AQUINO
Director General (e)
Dirección General de Endeudamiento y Tesoro Público



PERÚ

Ministerio
de Energía y Minas

"AÑO DEL BUEN SERVICIO AL CIUDADANO"

Lima, 28 JUN. 2017

OFICIO N° 0617-2017-MEM/DGER

Señora
Elizabeth Cáceres Merino
Directora General
Dirección General de Endeudamiento y Tesoro Público
MINISTERIO DE ECONOMÍA Y FINANZAS
Presente.-



Asunto : Informe de Evaluación de Desempeño del Proyecto de Electrificación Rural –
Contrato de Préstamo N° 7366 y Donación N° TF 056023

Ref. : a) Oficio N° 628-2017-EF/52.04 Expediente N° 2717412
b) Carta del Banco Mundial de fecha 13.06.2017

Además de saludarla, tengo el agrado de dirigirme a usted en relación al tema del Asunto y a su Oficio de referencia a), mediante el cual nos solicita emitir opinión sobre el Reporte de Desempeño del Proyecto de Electrificación Rural - FONER I.

Como es de su conocimiento, es práctica usual del Banco Mundial realizar una Evaluación de Implementación, Término y Resultados de sus Proyectos. Fue en este marco que el Banco Mundial (BM) realizó su Informe de Resultados al FONER I (ICR) calificando la performance del mismo como "Moderadamente Satisfactoria". Posteriormente se encarga la revisión de esta evaluación, al Grupo de Evaluación Independiente –IEG-, entidad independiente que reporta al Directorio del BM sobre las evaluaciones de los Programas y Actividades financiadas por el Banco, asegurando de esta manera la integridad de las autoevaluaciones del propio BM y verificando que el trabajo desarrollado haya logrado los resultados esperados. El IEG evalúa anualmente del 20 al 25 por ciento de las operaciones de Préstamo del Banco, dando preferencia a aquellas que son innovadoras, grandes o complejas y a las que puedan generar lecciones importantes, entre otros criterios. En esta segunda evaluación, el Proyecto FONER I sube su calificación a "Satisfactoria", lo cual, dicho por el propio BM es inusual. Es por esta razón, que se realiza esta tercera evaluación - PPAR en la que se ratifica la calificación "Satisfactoria".

Teniendo en cuenta estos resultados del informe antes mencionado, el sector, en especial el equipo que llevó a cabo la implementación del programa, estamos satisfechos con la labor desarrollada y con el resultado de "Satisfactoria", que confirma la calificación anterior.

Nos complace que esta evaluación reconozca la pertinencia del diseño implementado resaltando el involucramiento activo de la Empresa Distribuidora (EEDD) desde un inicio. De esta manera se ha agilizado la gestión misma de los procesos para ejecutar las obras. Adicionalmente se ha logrado mayor eficiencia en el uso de los recursos del estado ya que las empresas en promedio aportaron alrededor de 25% de los costos de inversión de las obras desarrolladas dentro del FONER I.



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Av. Las Artes Sur 260
San Borja, Lima 41, Perú
T: (511) 411 1100
Email: webmaster@minem.gob.pe

Este modelo de intervención ha contribuido a ampliar la cobertura eléctrica en 105 mil viviendas rurales representando un incremento de 5.1% en la cobertura eléctrica rural. Esto a su vez ha contribuido a mejorar las condiciones de vida de los beneficiarios del Programa de acuerdo al Estudio de Impacto realizado en su oportunidad.

Teniendo en cuenta todo lo mencionado aún existen retos. Si bien este programa ha sido exitoso, existen riesgos que deben enfrentarse a fin de asegurar que este esfuerzo sea sostenible en beneficio de las poblaciones rurales atendidas.

Considerando las lecciones aprendidas que plantea el documento respecto a los usos productivos debemos mencionar que al cierre del proyecto se había logrado beneficiar a más de 21 mil unidades productivas familiares (UPF) a nivel nacional, las mismas que deberían replicarse a futuro con una participación activa del sector y en especial de las EEDD's. Concordamos con el informe en cuanto a que el papel del sector y de la EEDD debe ser una política permanente de promoción de los usos productivos de la electricidad a fin de garantizar la sostenibilidad de estos emprendimientos. En ese sentido se debe insistir en promover los usos productivos de la electricidad, como una política multisectorial, involucrando activamente tanto a las EEDD como a los sectores productivos, financieros locales, gobiernos Regionales y Locales.

Otro aspecto relevante del informe concierne a la instalación de sistemas fotovoltaicos (SFV's) para zonas rurales y aisladas. Al respecto si bien es cierto que este modelo ha funcionado bajo condiciones difíciles en las que se ha trabajado, necesita ser revisado permanentemente en dos aspectos: i) asegurar que se realice una capacitación permanente a los usuarios para la operatividad y buen funcionamiento de los equipos y ii) coordinar con Osinergmin y otras entidades del sector el desarrollo de alternativas tecnológicas que tiendan a reducir los costos comerciales de las EEDD's por operar SFV's en zonas lejanas.

Un tercer tema que si bien no es mencionado directamente en el informe, se desprende como consecuencia de la ejecución del Programa. Como se menciona se ha logrado extender la cobertura eléctrica en forma importante en las zonas rurales. Sin embargo ello conlleva una mayor exigencia de las redes de distribución que no están preparadas para soportar estas cargas adicionales. En ese sentido y de acuerdo a los reportes de Osinergmin sobre la calidad del servicio (indicadores SAIFI y SAIDI), se han identificado 83 sistemas críticos de los cuales 29 superan el 100% de las tolerancias establecidas para los indicadores mencionados, llegando algunos a superar el 200%. Por lo dicho recomendamos se evalúe la posibilidad de llevar a cabo un Programa que se enfoque principalmente en el reforzamiento y rehabilitación de la infraestructura eléctrica a fin de mejorar la calidad del servicio otorgado y de garantizar que las obras ejecutadas continúen operando.

Por último, sobre un tema de forma, quisiéramos precisar la fuente de algunos cuadros que se muestran en el documento y que deben ser correctamente referenciados.

En la página 11:

Dice "Adapted from: Consorcio Asociación Benéfica Prisma, Instituto Cuánto, and Macroconsult (2016, 31).

Debe decir "Consorcio Macroconsult S.A. – Instituto Cuánto (2016, 31)".

En la página 14:

Dice "Source: Consorcio Asociación Benéfica Prisma, Instituto Cuánto, and Macroconsult (2016, 20).

Debe decir "Consorcio Macroconsult S.A. – Instituto Cuánto (2016, 20)".

En la página 17:

Dice "Source: Consorcio Asociación Benéfica Prisma, Instituto Cuánto, and Macroconsult (2016, 58).

Debe decir "Consorcio Macroconsult S.A. – Instituto Cuánto (2016, 58)".





PERÚ

Ministerio
de Energía y Minas

"AÑO DEL BUEN SERVICIO AL CIUDADANO"

En la página 26:

Debe incluir como referencia:

Consorcio Macroconsult S.A. – Instituto Cuánto. 2016 "Servicio de consultoría para la evaluación socio-económica de resultados de sub-proyectos de electrificación rural", Lima, Perú: Ministerio de Energía y Minas.

Agradecemos de antemano la atención que se sirva dar a lo mencionado en este documento para de esta manera garantizar que los logros del Programa FONER I sean sostenibles a futuro en beneficio de las poblaciones rurales.

Muy cordialmente,



Ing. Hugo Sulca Sulca
DIRECTOR GENERAL
Dirección General de Electrificación Rural

2717412



"AÑO DEL BUEN SERVICIO AL CIUDADANO"

Lima, 20 JUN 2017

OFICIO N° 628-2017-EF/52.04

Señora
PATRICIA ORMEÑO
 Directora
 Dirección de Fondos Concursables.
MINISTERIO DE ENERGÍA Y MINAS
 Presente.-

MINISTERIO DE ENERGIA Y MINAS
 Dirección General de Electrificación Rural
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 Por 25

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Asunto : Informe de Evaluación de Desempeño del Proyecto Electrificación Rural - Contrato de Préstamo N° 7366 y Donación N° TF056023.
 Ref : Carta del BM de fecha 13.06.2017

Es grato dirigirme a usted, a efectos de referirme a la carta de la referencia, a través de la cual, el Banco Internacional de Reconstrucción y Fomento - BIRF nos remite el Informe de Evaluación de Desempeño del Programa Mejoramiento de la Electrificación Rural mediante Fondos Concursables, solicitando nuestros comentarios sobre dicho documento, a fin de reflejarlos en el Informe Final que será distribuido A la Junta de Directores del Banco Mundial.

Al respecto, agradeceré conocer la opinión de su Despacho sobre el texto del referido Informe de evaluación, cuya copia se adjunta, a fin de alcanzar oportunamente nuestros comentarios a dicha entidad.

Es propicia la oportunidad para expresar a usted los sentimientos de mi especial consideración y estima.

Atentamente,

ELIZABETH CÁCERES MERINO
 Directora General
 Dirección General de Endeudamiento y Tesoro Público

PARA:
 Patricia Ormeño.
 Por favor que salga sta
 Con oficio DGER 'a
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 Dirección General de Electrificación Rural
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