CASE STUDY

LUZ EN CASA

ACCESS TO SUSTAINABLE ENERGY IN RURAL COMMUNITIES IN PERU

itd UPM Innovation and Technology for Development Centre

FOMIN Multilateral Investment Fund Member of the IDB Group

This document reports on **ACCIONA Microenergía Perú's** experience between 2009, when we became operational, and 2013, when our company reached break-even, with 3,000 beneficiaries of electricity through solar home systems.

As of this writing, the number of beneficiaries had risen to 3,900, and we expect that number to continue to grow, meeting a basic need of many communities in isolated, rural areas and proving that delivering services to the disadvantaged is economically viable.

Getting here has not been easy. This document sets out the essential aspects of the **ELECTRICITY AT HOME PERU** project, the various phases involved in identifying a community as a beneficiary, the creation of Photovoltaic Electrification Committees, and the management and operational model.

It required rigorous data collection and systematisation by the Centre for Technology Innovation for Human Development at the Technical University of Madrid, commissioned by the Inter-American Development Bank's Multilateral Investment Fund. I would like to thank them for this project, which allows us to share our experience with the backing of the requisite academic rigour.

We would also like to thank the IDB/MIF for their support. They believed in our idea, and their support helped us achieve a degree of maturity on the basis of which we can confidently confirm today that the model works.

However, in addition to rigorous procedures to identify communities and beneficiaries, strict technical specifications for equipment procurement, the meticulous work involved in operation and maintenance, and our system for charging our customers, there is, above all, a human reality that we cannot ignore.

Our team in Cajamarca, whose daily dedication and, in particular, firm belief in what they were doing enabled them to overcome adversities and show many families in extreme poverty that their well-being matters and, in particular, that they deserve the same respect any supplier would show any client. Respect and mutual trust are essential components for the project's success.

ACCIONA volunteers, who spent part of their vacation to contribute their knowledge and experience to this project, and also those who silently dedicated hours of work to our project from their homes. More than 130 people whose generosity has helped improve the lives of so many people in the mountains of Cajamarca.

And, of course, the **ACCIONA Microenergía Foundation** team in Madrid. Together we dreamed about the possibility of developing a rural electrification project with renewable energies, and that dream has come true. And today we are in Cajamarca in Peru and in the mountains of Oaxaca in Mexico. From our base in Madrid, we followed our imagination, got involved, and created a service model.

All this was possible because we are part of Acciona, a construction, services, water and renewable energy company that is committed to sustainable development and is aware that companies must contribute their expertise to improve the lives of the communities where they operate. This commitment far transcends this project, the aim being to prove that building a business is one of the best ways to fight poverty and inequality.

Carmen Becerril
ChairmanACCIONA Microenergía
Perú

EXECUTIVE SUMMARY

The **Departament of Cajamarca** has 1.5 million inhabitants and is one of the poorest departments in Peru with 52.5% of the population living in poverty. The rural electrification rate currently stands at about 69%. One of the programs contributing to the electrification of the area is being carried out by the social enterprise **Acciona Microenergía Perú** (AMP in Spanish). AMP has opted for the installation of **Solar Home Systems** (SHS) with capacity to provide three lights and small consumption energy outlets for mobile phone chargers, radio or television.

The business model selected by AMP is a pay-for-service one. Users pay the social enterprise approximately 20% of the stipulated tariff. The remaining 80% comes from the Electrical Social Compensation Fund (FOSE in Spanish) which is applied to all users of the Peruvian electricity sector. AMP is responsible for the installation, operation, maintenance and management of the SHS installations and is certified by the Supervisory Agency for Investment in Energy and Mining (OSINERGMIN in Spanish) as a Rural Electricity System.

1.300 SHS were installed before 2012 and a further 1.700 in 2013, achieving a total figure of 3.000. This number has, according to AMP, enabled the achievement of financial sustainability.

The **ACCIONA Microenergía Foundation** (FUNDAME in Spanish) began this program in 2009 and is AMP's main funder to date. The initiative has a very low SHS failure rate and the defaults on payments are also very low, demonstrating the confidence that the local population has in AMP.

The **success of the program** is a result of awareness-raising among rural stakeholders, dialogue with national actors, the technical quality of the installations and their operation and maintenance, and capacity-building of users.

Methodology

This study is based on interviews, group meetings and field visits carried out in Cajamarca from 3-17 July, 2013 and, in Lima, from 7-9 July, 2013.

In Cajamarca, interviews were conducted with representatives of the actors involved in the program including: the Vice-President of Acciona Microenergía Perú (AMP), the AMP Manager, Supervisory Agency for Investment in Energy and Mining (OSINERGMIN), Ministry of Energy and Mines/General Directorate of Rural Electrification (MEM/DGER), AMP technicians, a Photovoltaic Electrification Committee (CEF) representative and various Solar Home Systems (SHS) users. In Lima, interviews were carried out with government representatives.

A literature review was also undertaken to examine conference papers, information provided by Acciona Microenergía Foundation (FUNDAME) and documentation on the institutional framework provided by MEM/DGER and OSINERGMIN, as well as relevant texts from the internet.

Abbreviations

AMP
Acciona Microenergía Perú

APCI
Peruvian Agency for International Cooperation (*Agencia Peruana de Cooperación Internacional*)

CEF
Photovoltaic Electrification Committee (*Comité de Electrificación Fotovoltaica*)

DGER
General Directorate of Rural Electrification (Dirección General de Electrificación Rural)

ESCO
Energy Service Company

FUNDAME
ACCIONA Microenergía Foundation (*Fundación ACCIONA Microenergía*)

FOSE
Electrical Social Compensation Fund (*Fondo de Compensación Social Eléctrica*)

MEM
Ministry of Energy and Mines (*Ministerio de Energía y Minas*)

OSINERGMIN
Supervisory Agency for Investment in Energy and Mining (*Organismo Supervisor de la Inversión en Energía y Minería*)

SHS
Solar Home System

CONTENT

1 CONTEXT

› GENERAL CONTEXT

Peru has a population of over 30 million people, 77% of whom are concentrated in urban areas[1]. The country is geographically diverse with an arid coast, the Andes in the interior and tropical areas bordering Colombia and Brazil.

25.8% of the population live below the poverty line (6% in extreme poverty) with the figure reaching 53%[2] in rural areas. The annual income per capita is US$10.900, placing Peru 111st in the international ranking of countries per capita income[3].

Peru's economy reflects its varied geography (mining in the mountains and fishing on the coast). With a cumulative annual growth rate of around 6%, it is currently one of the most dynamic

1 INEI http://www.inei.gob.pe/web/poblacion/
2 INEI National Household Survey, 2007 - 2012
3 Estimate for 2012. CIA (2013)

economies in Latin America, ranking eighth among the ten countries in the world with the greatest economic expansion[4].

Cajamarca Department

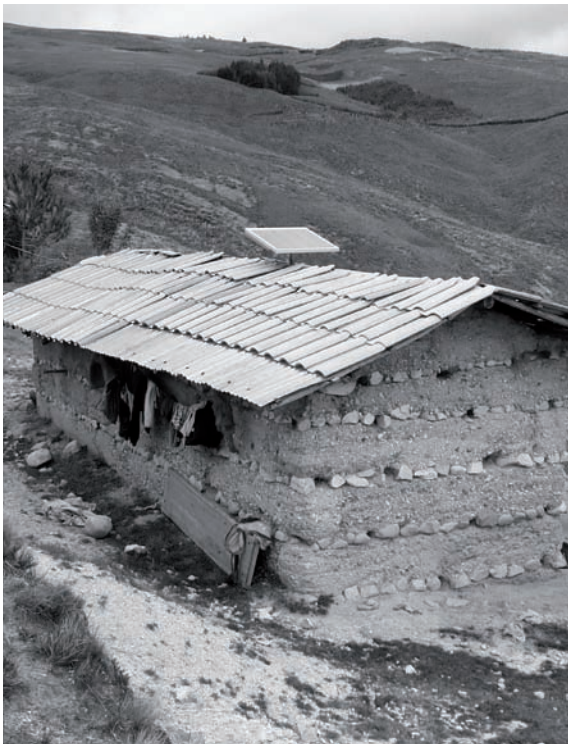
52.5% of the population lives in poverty (21.3% in extreme poverty)

69% rural electrification rate in Cajamarca

As a result of the commodities boom there has been a reduction in poverty from 50% in the middle of the last decade to 25.8% in 2012, with seven million Peruvians moving out of poverty. However, inequalities continue. In 2012, the Human Development Index (HDI) averaged 0.741 and the inequality adjusted HDI (IHDI) was 0.561, ranking Peru 77th in the world according to UNDP[5]. There is a wide poverty gap between urban areas, where poverty rates stand at 17%, and rural areas, at 53%. This gap is particularly wide in the Departments of Ayacucho, Cajamarca and Apurímac[6].

The **Department of Cajamarca**, with a million and a half inhabitants, is located in northern Peru in the western range of the Andes. It is located at an altitude of 3.000 meters and encompasses both mountainous and jungle areas. It is one of the poorest departments of Peru with 52.5% of the population living in poverty (21.3% in extreme poverty). This compares with a national average of 25.8%. Currently, the most important economic activities in the Department of Cajamarca are the breeding of livestock, agriculture and mining.

The program outlined here focuses on **access to electricity**, a sector in which there have been major national advances in the last decade. According to the National Institute of Statistics and Informatics (INEI in Spanish), between 2001 and 2011 electricity coverage in Peru rose from 72.1% to 89.7%. In the rural areas the increase was from 27.6% to 64.2%, while in the urban sector it was from 88.1% to 98.4%. In Cajamarca the rural electrification rate increased from 29.4% to 69% in the same period[7].



Two SHS installations in a rural household (Cajamarca)

4 "Perú: entre los 10 que más crecen, quiere ser primero en compartir prosperidad", June 28th, 2013 http://www.bancomundial.org/es/news/feature/2013/06/27/peru-comprometido-con-reducir-pobreza

5 http://hdr.undp.org/en/countries/profiles/PER

6 http://www.bancomundial.org/es/news/feature/2013/06/27/peru-comprometido-con-reducir-pobreza

7 Vázquez (2012)

› INSTITUTIONAL AND REGULATORY FRAMEWORK

Rural electrification in Peru is governed by Law No. 28749, the General Law of Rural Electrification of June 1st, 2006, and its Regulations, approved by the Supreme Decree No. 025-2007-EM of May 3rd, 2007. This law establishes the regulatory framework for the promotion and development of efficient and sustainable electrification in rural areas and remote or border towns. It also confers the Rural Electrification Department of the Ministry of Energy and Mines (DGER/MEM in Spanish) with responsibility for the national organization of rural electrification. This means that the Department must coordinate with regional and local governments, electrical distribution and rural electrification concession companies, other entities and National Government programs linked to the implementation of rural electrification projects and their management, operation and maintenance.

In general, management models do not consider how to deal systematically with battery replacement costs, repairs and maintenance, replacement of electronic regulatory devices and light bulbs, etc. in a sustainable and affordable way for the target population

The Law prioritizes private involvement in the goal of achieving total rural electrification. However, most private rural electrification initiatives using renewable energies do not provide more than one-off donations. As a result these initiatives are not sustainable over time as they do not establish economically viable business models. Moreover, most public initiatives have also failed to address the problem of sustainability. In general, management models do not consider how to deal systematically with battery replacement costs, repairs and maintenance, replacement of electronic regulatory devices and light bulbs, etc. in a sustainable and affordable way for the target population.

At the beginning of the ***Luz en Casa***[8] **program**, SHS electrification was faced with another challenge: electrification using non-conventional methods was not regulated by the Peruvian Government.

Representatives of the ***Luz en Casa*** program first met the President and CEO of OSINERGMIN, the regulatory body, in 2008 to address the issue of regulation of non-conventional electrification through renewable energies. Another meeting with the regulator and several subsequent gatherings with the MEM finally led to the publication of the Supreme Decree DS-089-2009-MEM on December 15th, 2009. This decree amended the Regulation of the General Law of Rural Electrification to include non-conventional rural electrification. OSINERGMIN was also tasked with establishing the tariff for photovoltaic systems.

8 Light at Home (in English)

The mechanisms used in Peru to **promote access to energy** include:

- The Rural Electrification Fund, financed by a surcharge on electricity rates and public funds that cover the costs of investment of electrification in rural areas.

- The Electrical Social Compensation Fund (FOSE), which consists of a cross-subsidy scheme whereby those who consume less than 100 kWh per month (56%) obtain a discount financed by those who consume more than this threshold. The FOSE applies two ranges of tariffs according to consumption: the first of 0-30 kWh per month and the second from 31 to 100 kWh per month. In the first range, a percentage is deducted (this can vary from 25, 50 or 62.5% depending on the sector in which the consumer is situated); while in the second, a fixed amount, measured in kWh and based on the current fee rate, is recovered. Subsidies vary depending on whether users are attached to the electrical grid or to an isolated system, and also on whether they are urban users or not due to the income differences that may exist between each of these sectors. OSINERGMIN determines the surcharges and allowances that correspond to the FOSE and oversees their proper application. Meanwhile, the distribution companies are responsible for making collections and applying discounts. At present over 60% of households with an electricity supply are aided by the FOSE[9].

Until 2010 these funds were not available to isolated systems using non-conventional renewable energies. In that year, the Ministerial Resolution 523-2010-MEM/DM was published to accommodate these systems. This was followed by a resolution determining the fee for stand-alone photovoltaic systems[10]. AMP contributed significantly to this process through its dialogue with OSINERGMIN and MEM. In April 2011, OSINERGMIN included AMP within the External Transfers Program, recognizing it as a Company Receiving Funds from the FOSE once it had met the requirements established by the Law. In May 2012, the General Electricity Directorate of the MEM awarded AMP a Rural Electricity Concession for the area of "La Lucmilla". A new procedure was also initiated for the Rural Electricity Concession in the District of Namora and San Pablo.

This process has been particularly complicated because the law that establishes concession procedures is based on traditional electrical distribution systems. These systems define a concession area limited by external boundaries within which all applicants must be provided with an electricity service. The usual procedure is to draw the boundaries around the distribution network. In order to avoid conflict with concessions that follow boundaries that cut across different villages and homes, AMP has chosen to define an area that coincides with the boundaries of the property to be provided with electricity.

9 OSINERGMIN (2011)

10 Board Resolution Supervisory Agency for Investment in Energy and Mining OSINERGMIN N° 206-2010-OS/CD

2 THE MODEL AND HOW IT WORKS

› BACKGROUND AND RATIONALE

AMP[11] was established in January 2009 as an initiative of the ACCIONA Microenergía Foundation (FUNDAME in Spanish), which was created by the company ACCIONA in Spain. To achieve its mission, FUNDAME created AMP as a **social enterprise** and non-profit entity, co-financing its costs until it reached a minimum number of installations to ensure its sustainability. Since 2010, AMP has been designated as a Non-Governmental Development Organization by the Peruvian Agency for International Cooperation (APCI in Spanish).

The Luz en Casa program designed by FUNDAME and AMP demonstrates the technical and financial viability of rural electrification using SHS

AMP's **aim** is to increase access to energy and water in rural populations that are not expected to be covered by the national grid in the coming years. So far their activity has focused exclusively on the provision of electricity services.

The *Luz en Casa* program designed by FUNDAME and AMP focuses on the provision of electricity to households in the Department of Cajamarca. The initiative aims to enhance the living conditions of users as the provision of energy increases the chances of generating income and improves household comfort and convenience, contributing significantly to education and health.

Luz en Casa provides electricity through Solar Home Systems (SHS) to households outside grid extension plans or to those that have not benefited from previous electrification in the area. This program, which was developed in three phases over the years 2010, 2012 and

11 Until March 2012 the initial name was Perú Microenergía.

2013, contributes to an overall objective of demonstrating the technical and financial viability of rural electrification with SHS. FUNDAME also runs another electrification program in the same operational area called *Luz Comunitaria*[12].

Member of a household (Cajamarca)

The **business model** chosen by AMP is the pay-for-service model (Energy Service Company or ESCO[13]). This model has been used since the late nineties for rural electrification programs with isolated photovoltaic systems[14].

The relationship between the Peruvian Government and AMP has enabled the pay-for-service model to be implemented at domestic level. The cross subsidy managed by FOSE ensures that those who use most electricity pay a higher tariff that compensates those who use less. In the case of *Luz en Casa*, FOSE compensates AMP with 80% of the cost, so users only pay 20% of this cost. This enables AMP to assume the costs of SHS installation, service provision and maintenance, and offer its users a tariff adapted to their economic circumstances.

AMP has adopted a service focus, an approach not often assumed by electrification programs operating in isolated areas. To ensure a reliable quality service, a technically robust solution has been put in place with quality components that are completely standardized and follow strict technical certification protocols.

The electricity service provided consists of basic lighting (three energy efficient lamps), communication and entertainment (cell phone charger, television or radio) for at least four hours a day. This is achieved by using a solar panel of 60-80Wp, a 100Ah battery and a charge controller. As a result, situations of battery overload or over-discharge, which drastically shorten the lifetime of the battery, are avoided. Of the 3.000 SHS, 2.400 operate using 80Wp.

A service challenge is to achieve greater flexibility in the installations. As things stand the OSINERGIM-regulated tariff for isolated systems allows the user to use up to five different types of

12 Community Light in English.

13 The terms "fee for service" and "Energy Service Company" are obviously not synonymous. However, in bibliographic references they are comparable with rural electrification programs with photovoltaic systems that use a 'pay-for-service' model.

14 EDRC (2003).

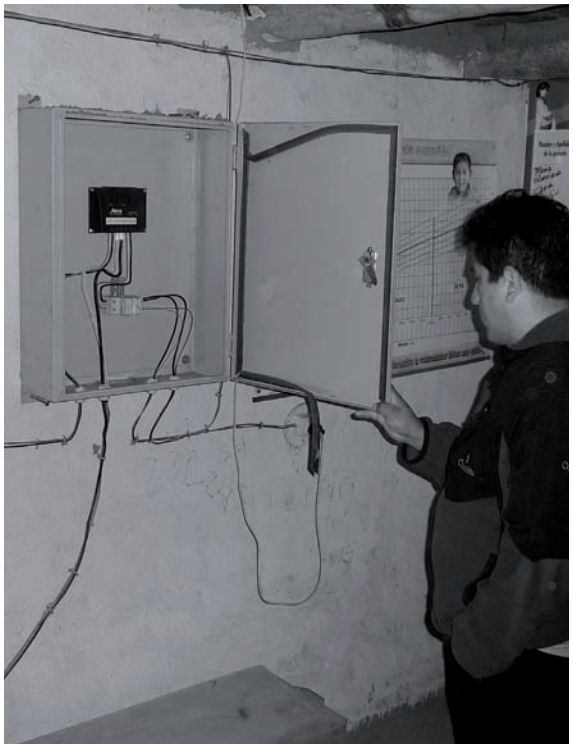
installation for their daily energy needs. In some cases customers have had two SHS installed because they need more lighting points, but more energy is not required in all cases. The installation of an SHS with greater capacity would reduce installation costs, save on the costs for a charge controller, wiring, support structure and battery box, and allow more efficient use of energy. It would also slightly decrease the service fee. However, these options require more charge controller and battery models, with a wider variety of cables and electrical protection elements. AMP thus believes that the advantages do not compensate for the additional complexity that such installations would involve.

The electric service provided consists of basic lighting (three energy efficient lamps with bulbs, communication and entertainment (cell phone charger and TV or radio) for at least four hours a day

The development of the program involves a **methodology** that begins by identifying rural communities outside electrification plans. AMP has invested huge efforts in understanding the particular circumstances of program users. This has involved an initial socioeconomic study to enable proper identification of the populations for whom the intervention is designed. Following this, fieldwork is carried out to raise awareness among host populations. Where there is enough interest, a Photovoltaic Electrification Committee (CEF in Spanish) is constituted which serves as the communication point between AMP and the community. Each CEF must have at least one woman as a member.

At the same time, AMP also meets with the District and Provincial Municipality to inform them about the program and sign an interagency cooperation agreement between both parties.

Sometimes it is complicated for AMP to identify potential customers for its successive phases of coverage expansion. Operating costs may greatly increase if installations are transferred due to the arrival of the conventional grid, or by focusing on customers least likely to gain access to the network, generally those that are also the most difficult to reach.



A round-the-clock technician from AMP inspects the system control cabinet. The characteristics of the cabinet and battery box are specified in the technical regulations of the Ministry of Energy and Mines

Once the paperwork has been processed and funding obtained, the tendering, contracting and installation of the SHS are carried out. The photovoltaic systems undergo a quality certification process to meet MEM regulations. The equipment specifications of AMP in the terms of reference for the tender process are highly reliable since the quality of the electrical service is a prerequisite for the operation of the system and determines the success of the program. In fact, choosing the best offer in the tender process is not based solely on economic criteria but techno-economic criteria that ensure the lowest cost over the lifetime of the system (20 years).

Households with photovoltaic systems (Cajamarca)

Prior to the installation of the SHS, both CEF members and users are provided with training. This training is important in clearly establishing the rights and duties of each party and providing information on the advantages and disadvantages of the electricity system, and how to proceed in case of difficulties. Intensive staff training is provided to CEF in Cajamarca on how to operate photovoltaic equipment, carry out preventive maintenance tasks (in this case limited to visual inspection and testing of the SHS), and undertake procedures for the management of the program (collection of user fees, payments to AMP, dealing with communication challenges, inspections, safety, rights and commitments to AMP). Users are involved via awareness-raising campaigns and included at the time of installation. This enables them to fully understand the new resource. Specific capacity-building is also offered to users selected as local technicians who, under the supervision of AMP, will be responsible for SHS installation and corrective maintenance.

In the first *Luz en Casa* program, 600 installations were subcontracted in a "turnkey" arrangement. Because the results were so poor, all the installations were re-checked and many were adjusted. In the second project, involving 700 installations, AMP assumed direct responsibility for the acquisition of equipment, distribution and installation. For this purpose, ten local technicians were trained and two supervisors were selected from the host communities involved in the program.

With the installation of 1.700 SHS at the end of 2013, a similar process has been followed. In this case, the only outsourcing has been the preparation of the SHS kits in Cajamarca. The relationship between the technicians and AMP is regulated by a professional service contract.

The supervision and the installation of the SHS are followed by the **operational phase**[15]. This phase includes the administration and maintenance of the service. AMP receives 10 Soles per month (about US$3.5) from each user which corresponds to less than 20% of the regulated tariff. 80% comes from FOSE funds. The CEF are responsible for collecting user fees, making payments at AMP headquarters in Cajamarca and providing customers with receipts. Customers can also pay directly or by bank transfer but very few people make use of these options. The payment process is expensive because, in many cases, it involves a person travelling from the community to Cajamarca and incurs a risk of theft. In some communities, support is given to cover the treasurer's costs with an extra contribution of between 0.5 cents or 1 Sol. AMP also waives their SHS tariff payments. To improve this situation, FUNDAME is exploring other payment processes such as micropayments using cell phones.

The CEF are also responsible for preventive maintenance. AMP provides them with the protocol and guidelines to carry out a visual inspection and operations check of the SHS under their responsibility every six months. Their reports are then send to AMP. If an error is detected, AMP carries out corrective maintenance, something that, until recently, was done from Cajamarca. If users observe any kind of fault they can also inform AMP directly without waiting for the periodic inspections carried out by CEF or AMP.

Following the communication of a fault, a repair order is generated. The user is first contacted by telephone in order to try and resolve the problem. If this is not successful a technician is deployed to resolve the issue. The process ends with the completion of a repair report which is introduced into the AMP database in order to be able to analyze faults in a holistic way. This process also enables the upkeep of an annual record of incidents.

Maintenance work to change the control board and the battery on the second floor due to security reasons

Now and again customers require unregulated technical services that are paid for by the customer. For example, during the consultant's fieldwork, an AMP technician relocated the control box and battery at the request of a client who wanted to move the equipment from the ground floor to the first floor of his house for security reasons. This kind of work is paid separately from the monthly fee and may be carried out by the technical entrepreneurs through a direct relationship with users.

15 Eisman (2011).

In order to expedite repairs more rapidly, FUNDAME and AMP are launching a series of entrepreneurial ventures in the program area. The intention is that technical entrepreneurs, operating within a microenterprise model, will provide a technical support service and sell equipment approved by AMP such as lamps, bulbs, cell phone chargers, power adapters, televisions, etc.

As the program grows, and in the current phase in which the number of installations has been doubled, the establishment of microenterprises to provide an efficient technical assistance service is becoming increasingly necessary. These small businesses can also contribute to reducing the costs of sending technicians to address problems that can be resolved locally.

AMP also intends for these microenterprises to assume responsibility for the only spare part not included in national regulations and contacts with users; the energy lamps. At present, only a few shops in Cajamarca sell bulbs that feed 12 VDC batteries. The offer is restricted to two models that differ hugely in quality and price. Naturally, the lower quality model is the one most purchased. As lighting is the most important service offered, these deficiencies are viewed as lack of a quality electrical service.

AMP has already taken the first steps to train technicians to provide maintenance services. Intervention orders will be received at AMP headquarters via cell phone and will then be directed to the corresponding technician. These technicians will be set up as micro entrepreneurs who are subcontracted by AMP to provide installation and maintenance as well as additional services to AMP customers: selling light bulbs, cell phone chargers, adapters and equipment (TV, DVD, radio).

Technical entrepreneurs are selected from among the local technicians who have carried out installations in the second and third phases of the program. The selection process consists of a recorded interview which is accessible to staff in AMP and FUNDAME. High value is placed on the support of family members, young people with a vision of the future for the areas in which they live, learning capabilities and initiative.

AMP periodically sends all its documentation to OSINERGMIN in order to receive funds from the FOSE. Unlike systems in which customers pay a fixed amount, the quantity that AMP receives for each customer varies slightly depending on the monthly fee published by OSINERGMIN. With a regular automatic review of network rates, tariff ceilings are established each month. This regularly changing rate (sometimes involving extremely small amounts) hampers management in remote areas as any change takes almost two months to be put in place[16]. In consequence, AMP has chosen not to pass on price increases to its customers. In any case, the rate they would have to pay at the time of writing is just over than 10 Soles a month (US$3.5).

16 Olivares (2011).

In line with **national regulations on unpaid bills**, if the client does not pay the fee within a period of two months after its due date, AMP may disconnect the service. Once the debt has been paid the service is reconnected. The charges for service disconnection or reconnection are roughly 4 Soles (approximately US$1.5) in the Sierra, far below the actual cost. Nonetheless, AMP carries out service disconnection to avoid the increase of defaults. When the debt extends over more than six months the user is definitively removed from the system and their place assigned to another user on the waiting list. So far no systems have been withdrawn for payment default reasons. AMP procedures for the management, operation and maintenance of the program are well-documented and this significantly facilitates their development, control and execution. AMP also publishes annual reports of its activities with a summary of audited annual accounts on its website.

› KEY ACTORS

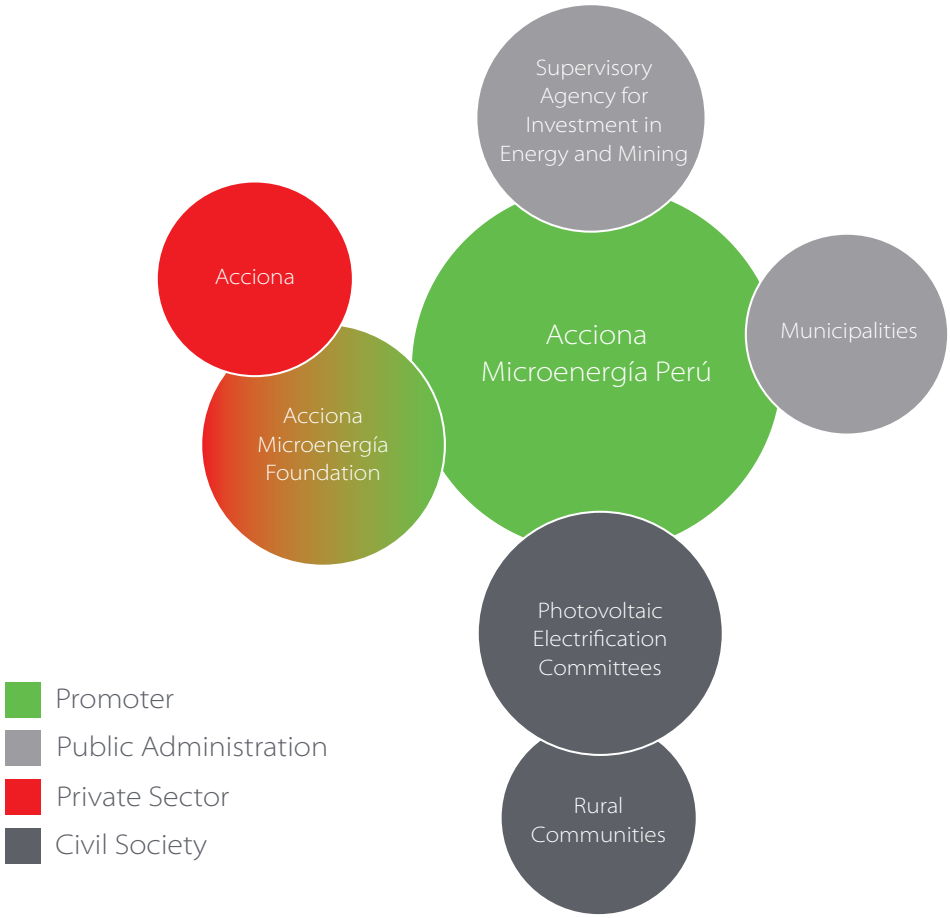


Figure 1. Relationships between the actors in the model

Acciona Microenergía Perú (AMP) Social Entreprise	AMP is a non-profit association that was established in January 2009 by FUNDAME. Although it was set up as an association, in order to incorporate other partners, it defines itself as a social enterprise. Its mission is to facilitate access to modern forms of energy, safe water and other infrastructure for Peruvian communities with low incomes or without the means to meet these needs. AMP contributes to the program with its local infrastructure, staff and network of contacts and relationships. It runs other programs such as *Luz Comunitaria-Cajamarca*, which provides basic access to electricity using photovoltaic systems for community centers in the areas where households are serviced by AMP. The goal is to reach 40 community centers in towns with the *Luz en Casa* program*.
Acciona Microenergía Foundation (FUNDAME) Business Foundation	FUNDAME is a non-profit organization that aims to facilitate sustainable access to basic services for isolated rural populations in developing countries. Its work is framed around three strategic areas: access to modern forms of energy, safe water and sanitation, and other basic infrastructure. The philosophy of the Foundation is to develop projects and interventions with strict financial sustainability criteria so that activities remain in place and, if possible, can be developed over time. To this end, it establishes an organization with a social enterprise structure in each of the countries in which it works. In the *Luz en Casa* program, FUNDAME carries out coordination and supervision, takes responsibility for fundraising, manages the procurement and supply of the main equipment necessary for international tenders, and serves as an observatory for the technological evolution of key SHS components, models and experiences of off-grid electrification. It also provides technical and management support across different business areas of the Acciona Group and among Corporate Volunteers.
ACCIONA Private Company	ACCIONA is one of the largest Spanish corporations working in the fields of infrastructure, renewable energy, water and services. As an international company with operations in five continents, ACCIONA's activities often take place in contexts of poverty and social conflict. In November 2008, as part of its social action policy, ACCIONA established the Acciona Microenergía Foundation.
Ministry of Energy and Mines (MEM) **Supervisory Agency for Investment in Energy and Mining (OSINERGMIN)** Regulator	Play an important role in the program through its political commitment to the prioritization of rural electrification and the development of regulations for non-conventional electrification. Very few countries in the world have developed a regulatory framework with these characteristics and a photovoltaic tariff. Continuous dialogue with the entities mentioned above has resulted in a positive regulatory environment.
Municipalities	At the district and provincial level, municipalities play an important role in the development of the program. Partnership agreements are signed with them to support the program and they report on electrification plans, call meetings of communities and their committees, and present them with relevant information, geo-reference house locations and repair access to beneficiary communities in order to facilitate the installation of equipment. They also assist the program by providing venues for meetings.
Communities **Photovoltaic Electrification Committee (CEF)** Users	The user has a primary role in the program by making payment for the service and actively participating in training. Users also participate in Photovoltaic Electrification Committees (CEF). At the end of 2013 there were 85 CEFs, all of which are recognized by a decree of the District or Provincial Municipality. The CEF is a key part of the management model. It is elected by an assembly of community members and this is reflected in the constitution of the Committee. The communities already have a strong tradition of working with this type of entity to address themes such as water, electricity, community service, etc. The CEF is composed of a President, Treasurer and Secretary and must ensure the equal participation of women. The functions of the Electrification Committee are as follows: ▸ Communication between AMP and users on all aspects of the program ▸ Inspection of the SHS in the area to ensure proper use ▸ Collection of subscription costs, transportation and deposition in banks ▸ Safety of the SHS

* https://sites.google.com/a/accioname.org/acciona-microenergia-peru/

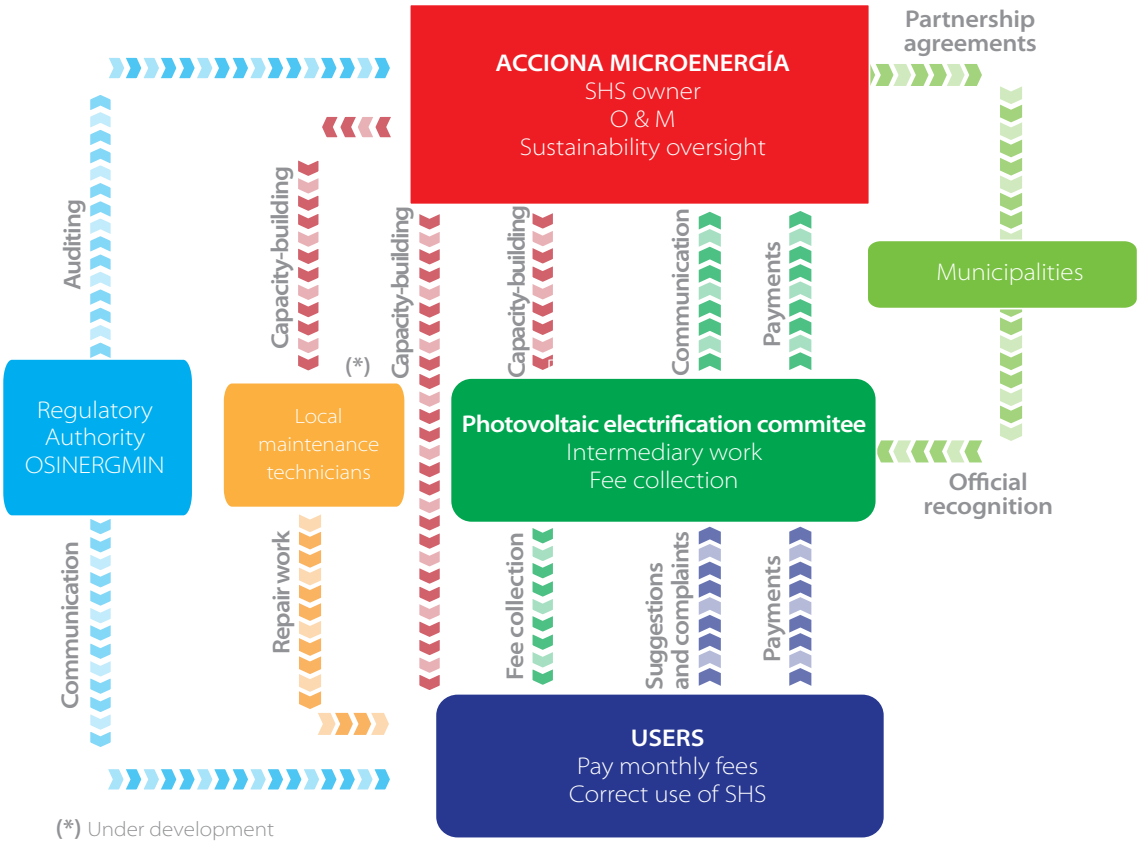


Figure 2: Diagram of the management model of the *Luz en Casa* program[17]

STRUCTURE AND GOVERNANCE

The sovereign governing body of AMP is the General Assembly of Associates which represents all the key associates and is constituted by FUNDAME, ACCIONA *Corporación* S.A. and ACCIONA *Desarrollo Corporativo* S.A. The AMP Board of Directors is the governing and oversight body. At the end of 2012 it was composed of a President, Vice President and Chief Program Leader, Executive Director and a Manager with no vote.

17 Source: Olivares (2011).

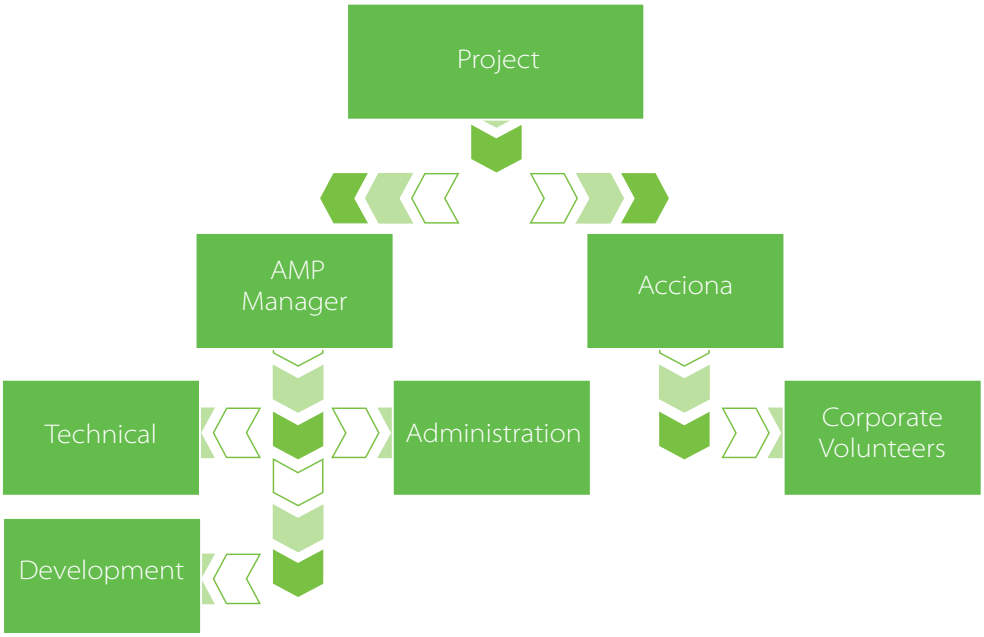


Figure 3: Organization chart for the *Luz en Casa* program[18]

AMP is responsible for the local management of the program. Its main task is implementation on the ground. AMP contributes to the program with its local infrastructure, its staff and its network of contacts and relationships. AMP's human resources are very limited with only four people in total - a manager, managerial assistant, accountant and technician. During the phases of installation or high activity, AMP hires additional professional support services. All services for the transportation of personnel and materials are outsourced. The program also relies upon corporate volunteering; in 2012 11 volunteers supported the program for 15 days after undertaking a month of preparatory training.

In AMP's organizational chart, technical tasks are carried out by FUNDAME. This has the advantage of allowing easier changes to the technology used in the various electrification programs. However, it is a situation that also limits AMP's technical capacity and reduces the possibility of feedback to FUNDAME on the electrical performance of the installations.

18 Source: AMP (2011).

- "We used to use kerosene or oil lamps so that our son could study but they affected his sight a lot. Now we can do at night the things that we don't have time to do at home during the day." Huamán Adriano Martinez, Chairman of the Electrification Committee of Peña Blanca and his wife, Luz Helena Reyes.

› INNOVATIVE ASPECTS

The results of this payment for service model are significantly better than those for similar projects, particularly in Peru. This success is reflected in the following innovations:

- In developing the electrification program, **critical actors** have been addressed such as the public administration, including legislative and regulatory authorities, and community users. Emphasis has been placed on the respective responsibilities each of these actors so that results achieve program objectives.

- The program has worked with the **cultural tradition** of the users to constitute the CEF, assigning them with specific responsibilities (security, inspection, collection and dialogue), signing a formal commitment with them and also giving legitimacy to the CEF through recognition via an edict from the district or provincial mayor.

- **User training** has focused on the commitment and obligations of users rather than on the SHS equipment.

- **The monthly fee that users pay is an affordable amount** in relation to their economic capacity. The previous total value of energy expenditure for the user, including lighting (kerosene, candles and lamps or fluorescent bulbs with batteries), use of the radio (mostly with small batteries) and the cost of charging cell phones was, on average, 16.4 Soles per month (about US$6). Prior to national regulation of the rate for isolated photovoltaic systems, the service fee was 15 Soles per month (around US$5.4).

- The use of **technological applications** to improve the model, including the use of SMS messages to transmit orders and complete repairs (currently being implemented), and exploration of the feasibility of using mobile money services.

- The **development of microenterprises** owned by the users in the area.
- Rather than focusing on a product (photovoltaic generators) or project, AMP has centered its focus on a **service approach to users** (access to electricity services).
- AMP has a strategy of **constantly learning from experience** to build upon and develop new approaches so that the model can be improved.
- The functions of the CEF such as payment management, inspection of the SHS, security against theft, and acting as an interlocutor between AMP and customers have been enhanced by the program. As a result they play a key program role.

FUNDAME has managed to launch a highly efficient **social enterprise model** that is **close to the community and to users**. It has incorporated operating practices similar to those of a modern service company (ensuring quality of supply, proper maintenance, etc.). A network of technicians who belong to the communities has been formed, many of whom have also become local micro entrepreneurs able to charge for service maintenance and sell small appliances such as light bulbs, etc. Furthermore, proximity to a technology company ensures constant technological monitoring.

One of the key success factors of the program is the **special attention given to fieldwork**. This has assisted knowledge of the particular environment and users, and the application of efficiency and sustainability criteria characteristic of a private business. As a result the perception by users is that AMP is serious about its work and delivers what it promises.

Two AMP technicians carry a battery for a household. The transport of batteries is a difficult task as they weigh about 50 kg (110 lbs.) and the region is between 3.700 and 4.000 meters (12.000 to 13.000 ft.) above sea level

› RESULTS

According to a **customer satisfaction report** produced by AMP[19] and corroborated during the fieldwork carried out by the consultant, there is complete user acceptance of the program. This is evidenced by low payment default and equipment failure rates which are the result of the quality of the installations and the maintenance strategy. In view of the fact that that there is no tradition of paying for services in the region and most AMP customers live in extreme poverty, this is particularly noteworthy. The average annual user default rate for two or more consecutive payments was 3.63%. Meanwhile the payment default dropped from 3.03% in 2012 to 0.19% in 2011[20].

The default rate during 2012 was 0.19%, while in 2011 it was 3.03%

At the end of 2012 there were 5.440 direct beneficiaries. About 1.300 of the SHS installed were in operation and the average time spent addressing 192 incidents was six days in 2012, as compared to nine days in 2011. As these time periods are highly dependent on the environment, extrapolations cannot be made for other projects or geographical conditions.

The most frequent technical difficulties are related to the batteries, the least reliable component of the SHS generally. If the SHS has a lifecycle of 20 years, the battery accounts for around 30% of the total cost. Some batteries from the first phase of the program have had quality problems a year after installation (approximately 3.3% in 2011). However, AMP believes that a 3.3% reduction rate in capacity during the first year of use is not problematic.

If the **energy costs** of a family prior to the program are compared with the current situation, a considerable decrease is shown. Table 1 provides a summary of the energy costs for families using traditional fuels (candles, kerosene, batteries and diesel generators) obtained from a survey of the population in the area covered by the program. The survey was conducted among 545 people (from a total population of 2.409 people) by AMP in 2009 for the development of the first project.

At the end of 2012 there were 5.440 direct beneficiaries. About 1.300 SHS are in operation and the average time spent addressing 192 incidents related to their maintenance was 6 days in 2012, and 9 days in 2011

19 AMP (2012).
20 AMP (2013).

DISTRICT	ILUMINATION	RADIO	CELL PHONE
CACHACHI	10.6	3.3	3
ENCANADA	11.9	3.4	2.8
BAMBAMARCA	9.8	2.8	2.3
AVERAGE	10.8	3.2	2.4

Table 1: Monthly costs in Soles per family for traditional energy resources, 2009.

Assuming that users have all three services listed above, the estimated total average cost is US$5.7. As the SHS monthly fee is about US$3.5 this is equivalent to a cost reduction of 39%. Studies on energy expenditure in Peru for traditional fuels, such as one conducted in the Department of Puno in 2011[21], show even higher costs. The average monthly expenditure per household cited is as follows: US$5 in candles, US$7.8 in kerosene, US$7.3 in small batteries, US$2.3 in large batteries and US$9 in petrol. It is important to note that not all these energy resources are used by all households or that access to electricity eliminates these costs totally. According to the study, average expenditure on these items in households with electricity is: US$1.3 in candles, $US5.5 in small batteries, US$4.2 in large batteries and US$2.8 in petrol. It can thus be concluded that there is a marked decrease in spending on traditional energy costs.

The **awareness-raising** work in villages, constant communication and, above all, AMP's fulfillment of its commitments has generated credibility among users and consolidated the model, with the active participation of the population as social development actors.

This approval is seen in the following objective indicators[22]:

- Additional assistance requests in the same intervention areas and neighboring communities.
- Generation of the practice of timely payment. The average rate of payment defaults is less than 1%. Similar suppliers in the area have declared a default rate of more than 27%.
- Compliance from the customers of their commitment to proper use of the SHS.

21 GIZ (2011).
22 Olivares (2011).

According to findings from a customer satisfaction report conducted by AMP among representatives of 25 CEF, as well as the positive evaluation of the service by **users**, the increase in family income due to a reduction in energy costs and extra time for productive activities are highly valued. In interviews with users conducted by the consultant during the fieldwork for this study, all confirmed the greater availability of time and the possibility of conducting activities such as spinning, sewing, cooking and studying at night as a result of better lighting.

Users have also commented on health improvements as a result of not having to use fuels such as candles, kerosene and, especially, petrol. These types of fuel cause optical and respiratory tract problems as well as the risk of accidents. Various interviewees recounted stories of minor fires, in some cases caused by children who had fallen asleep while studying.

In addition to direct benefits in terms of lighting, there have been changes in communication (cell phones are present in almost every home and many phone users charge their devices using the SHS) and entertainment as a result of having electricity at home. As well as a change in habits such as reading, and meetings with family and friends, there is also a move towards improving housing, cleaning, painting, repair and conservation work. These changes are significant because they confirm that access to basic electricity services is a catalyst for improving living conditions.

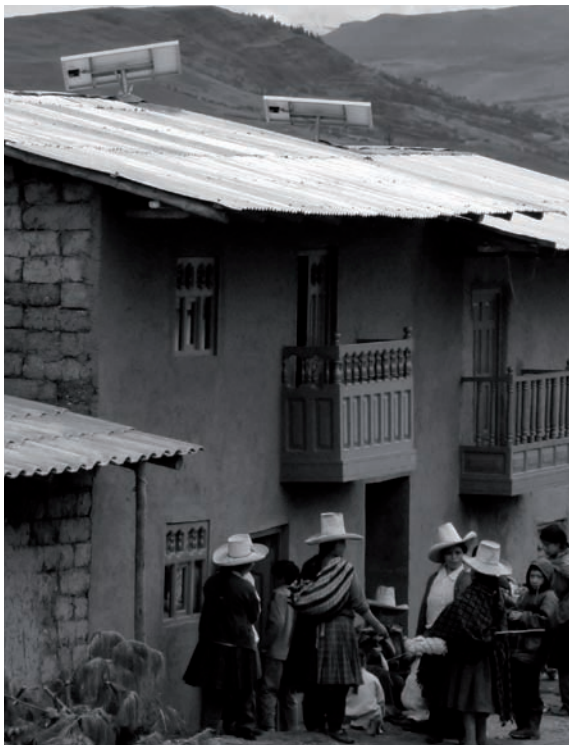
› SUSTAINABILITY

The supply of electricity to 3.000 families in 2013 has enabled AMP to achieve financial sustainability and balance income and outgoings. The projected operational costs are sufficient to support AMP's service costs and allow a small growth.

The supply of electricity to 3.000 families in 2013 has enabled AMP to achieve financial sustainability and balance income and outgoings

Two phases can be seen in the development of AMP's business model: The first corresponding to the 1.300 SHS installed by FUNDAME with a non-repayable grant. The second, corresponding to the 1.700 SHS installed in 2013 which were co-financed by a loan of US$ 900.000 from the Social Entrepreneurship Program (SEP) of the Inter-American Development Bank (IDB), to be repaid in ten years. In any case, the photovoltaic fee charged will enable the recuperation of the investment cost. In this way, AMP has achieved its objective of showing the viability of electrifying isolated rural communities in an economically sustainable and affordable way for poor families.

With the expansion of the electricity network in Peru, equipment and materials are being developed to support future growth in demand, especially as these components are very expensive. SHS systems, however, can be installed in the meantime. These systems are more in line with current demand and their inclusion in regulations also contemplates the possibility that the user may be able to acquire a SHS with higher energy capacity when demand has increased. As a result, it is not necessary to project the demand 20 years and then make the user pay for a higher capacity that they will not use. In many cases, this change simply requires installing additional equipment while in others it may require partial replacement of the equipment. This modality ensures that both investment and spending are always adjusted to real needs. Another characteristic of the SHS is that the costs of removal and reinstallation are small compared to connecting a household to the grid. This means that the SHS can be installed in a household and, when connection to the electric grid is possible, the equipment can be removed and reinstalled in another household without electricity.



Households with photovoltaic systems in Peña Blanca, San Pablo (Cajamarca)

The unitary investment for a SHS supply point is less than 2.000 Soles (US$700). This compares with an average unitary investment of more than 74.000 Soles (US$25.900) or the 11.000 Soles (US43.850) of marginal investment with network extension. Furthermore, maintenance costs are also lower.

To meet growing demand, AMP's strategy takes advantage of developments in lighting and electricity equipment focused on reducing consumption and maintaining performance, while also increasing the generation of electricity. The Peruvian tariff model for SHS regulates up to five different installation sizes which are determined by total photovoltaic generation power capacity: 58, 80, 160, 240 and 320Wp.

AMP has established a close nationwide dialogue with institutions such as local councils, OSINERGMIM and MEM since the start of the program. Local councils have to express support for the electrification program by signing an agreement with AMP. AMP has also been a major player in developing the rules and regulations for isolated electrical systems; in fact it was the first SHS company to qualify as a Rural Electricity Service with Photovoltaic Systems. This is important because rural electrification with SHS has very different characteristics to conventional electrification based on grid extension and these have not been taken into account in Peruvian electricity legislation or its regulation.

The results of the three years of program activity have been so positive that key public institutions are keen to reproduce the model in order to reach the Peruvian Government's goals of installing half a million SHS throughout the country by 2020.

FUNDAME has been the main funder of AMP, while the IDB, through the Social Entrepreneurship Program (SEP) granted it a loan of US$900.000, repayable in ten years, to increase the number of SHS in the program by 1.700 in 2013. A grant has also been provided from MIF/IDB of about US$330.000 for technical assistance.

House with a photovoltaic system in Herrejo Unanca, San Pablo (Cajamarca)

3 REPLICATION AND SCALE-UP

› POTENTIAL FOR WIDER APPLICATION

As it is currently conceived and organized, AMP's electricity service delivery model can be directly replicated in **similar** environments in Peru where an institutional and regulatory basis for the SHS has been developed. In fact, the Peruvian government's ambitious target of providing electricity to all rural areas, anticipates its use among more dispersed populations. This is an interesting opportunity for AMP and a challenge for extending the model throughout the country.

In **other countries** in the region, this model is replicable if host nations have subsidy mechanisms that enable the financial sustainability of the rural electrification program. The model has shown that it can work well in a specific environment with particular conditions. A fairly advanced initiative, developed by a commercial company, is already replicating the *Luz en Casa* model in the jungle area of San Martín. The Peruvian tariff framework for isolated photovoltaic systems also includes a provision for installations in forest and coastal areas, with a 10% higher rate than that for mountain areas.

FUNDAME is also developing the *Luz en Casa Oaxaca* program, which will provide electricity services to 9.000 families living in towns with less than 100 inhabitants in the state of Oaxaca (Mexico)[23]. The model is based on developing microcredit sales in which the user pays a monthly fee for up to two years. This is less than what they spend on alternative energy sources for lighting or power for their electronic devices, and provides users with substantial changes in the equipment supplied, without affecting the loans provided, in order to adapt the model to local conditions[24].

The *Luz en Casa* program has received recognition as a good practice from institutions such as Renforus-UNESCO, the World Business Council for Sustainability Development (WBCSD), Global Compact 2010, Alliance for Rural Electrification and the Sustainable Energy for All initiative promoted by the United Nations. Acciona and, by extension, FUNDAME, have been awarded the Codespa Prize 2011 and the SERES Prize 2012 for the *Luz en Casa* program. In its third celebration of the awards, the SERES Foundation acknowledged the innovative and socially committed nature of this program and Acciona's efforts to make *Luz en Casa* an economically sustainable program, ensuring its financial viability irrespective of the input from the company. The program was also a finalist in the first edition of Phaseum's "Off-Grid Experts Awards" in 2013 and Foronic's "Best Green Business 2013".

23 Acciona Microenergía Mexico webpage: https://sites.google.com/a/accioname.org/acciona-microenergia-mexico/
24 Eisman (2013).

› STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS

STRENGTHS	WEAKNESSES
▸ Appropriate capacity-building plan. ▸ Knowledge of the environment. ▸ Service approach. ▸ Clear regulations. ▸ Appropriate operation and maintenance strategy.	▸ Lack of qualified technicians. ▸ Lack of flexibility in installations. ▸ Difficulty in supplying spare parts. ▸ High operative and corrective maintenance costs. ▸ Costly management of fee collection. ▸ Unregulated customer services.
OPPORTUNITIES	**THREATS**
▸ Generation of microenterprises. ▸ Diversification in the capacity of the SHS. ▸ National Policy for 100% access to electricity in rural areas by 2020.	▸ Some problems in the functioning of the batteries. ▸ Unreliable information on plans to extend conventional power grids. ▸ Strong institutional demand for increasing the number of customers.

▸ Figure 4: SWOT Analysis

4 GRAPHIC REPRESENTATION

LUZ EN CASA

80 WP

ACCESS TO SUSTAINABLE ENERGY IN RURAL COMMUNITIES IN PERU

Acciona Microenergía Peru is a social enterprise that has implemented an innovative pay-for-service model. This model will allow them to reach economic sustainability, while offering quality energy to low income families through Solar Home Systems (SHS)

INVOLVED ACTORS ACCIONA MICROENERGÍA PERÚ (AMP) | ACCIONA MICROENERGÍA FOUNDATION | LOCAL AND NATIONAL PUBLIC ADMINISTRATION | MICRO-BUSINESSES | PHOTOVOLTAIC ELECTRIFICATION COMMITTEES (CEF) | RURAL COMMUNITIES

DEPARTMENT OF CAJAMARCA, PERU

- **1,507,486** PEOPLE
- **52.5%** POVERTY RATE
- **21.3%** EXTREME POVERTY RATE
- **30%** of rural households still WITHOUT ELECTRICITY
- **36%** in the number of rural households with access to energy (2001 - 2011)

COMMUNITY ENGAGEMENT

The community development process of AMP´s program begins by identifying rural communities currently excluded from the electrical grid in order to prepare for their participation in the program

Participation from the community is promoted through CEFs, responsible for coordinating all the different actors, including the final users

85 CEFs HAVE BEEN CREATED SO FAR

13 AGREEMENTS SIGNED WITH MUNICIPALITIES

QUALITY SERVICE

80 WP

5.91 DAYS AVERAGE WAIT FOR RESOLUTION OF PROBLEMS IN 2012

The SHS installed include 80 Wp solar panels that provide 3 low consumption lights and energy outlets for at least 4 hours a day

30 TECHNICIANS PROVIDING TECHNICAL ASSISTANCE TO 75 COMMUNITIES

Users are trained on proper use of the SHS, CEFs carry out basic system supervision and payment management and local technicians are trained in system installation and maintenance

BUSINESS MODEL

Families pay a monthly fee for the electricity offered, maintenance and equipment replacement for 20 years

For each SHS installed, the government´s Electrical Social Compensation Fund provides a price subsidy to AMP, who then offer consumers a final price adjusted to their level of income

3,000 SHS IN USE → **12,600** DIRECT BENEFICIARIES

39% REDUCTION IN AVERAGE ELECTRICITY EXPENSES PER FAMILY

+PRODUCTIVE HOURS +TIME FOR STUDYING

INCREASE IN ACCESS TO MOBILE COMMUNICATION

SUSTAINABILITY

- The Ministry of Energy and Mines has certified the SHS as an alternative for energy service in rural areas
- The default rate in 2012 was 0.19%, decrasing from 3.03% in 2011
- The price structure is based on a cross-subsidy that allows families with consumption levels below 100kWh/month a discount financed by those families who have a higher consumption
- In 2014 AMP will reach operational sustainability by providing service to more than 3,000 families

EXTENSION OF THE MODEL

- The government has launched a program that will install half a million domestic photovoltaic systems throughout the country
- AMP has played a key role in developing Peruvian legislation and regulation for isolated electrical systems
- Acciona Microenergía Foundation has developed an energy program that will install 10,000 SHS in the region of Oaxaca, Mexico

This publication can be downloaded in PDF format on the following link:
http://www.itd.upm.es/wp-content/uploads/2014/06/INFOGRAFRIA_EN_PERU_ACCIONA_AMP.pdf

5 KEY LESSONS

- **Knowledge of the environment**, training and awareness-raising among host communities, including local administrations, facilitates the implementation of this type of energy access model.

- **Involvement of communities** in the electrification program through CEF assists in mediating a dialogue between the program promoter, public institutions and users.

- The electricity service focus adopted by AMP as a social enterprise promotes the importance of the **technical quality** of installations and maintenance, as well as the use of best practices in program management.

- The program established **well-defined "rules of the game"** and incorporated regulations for management, development, and operation and maintenance procedures from the start of its work.

- **Close dialogue with public institutions** responsible for rural electrification and regulation has been vital for the success of the program.

- In the early stages of the program, the **leadership** provided by FUNDAME and AMP was crucial.

REFERENCES

- Allali, B. "TEMASOL: Providing Energy Access to Remote Rural Households in Morocco." GIM Case Study No. B093. New York: United Nations Development Programme, 201.1
- AMP. Manual del Programa Luz en Casa. AMP. March 2011.
- AMP. Informe de Satisfacción de Clientes (confidential). AMP. March 2012.
- AMP. Informe de Explotación 2011 (confidential). AMP, 2012.
- AMP. Memoria de actividades años de 2012. AMP. April 2013
- Bambawale, M.J., D'Agostino, A.L. & Sovacool, B.K. Realizing rural electrification in Southeast Asia: Lessons from Laos, Energy for Sustainable Development, Volume 15, Issue 1, March 2011, Pages 41-48.
- Eisman, J., Olivares, J., J. Moreno, A. Verástegui, A. & Mataix, C. "La electrificación con Pequeños Sistemas Fotovoltaicos Domiciliarios (PDPS) ¿un cambio de paradigma?". First International Conference on Universal Access to Energy Utilities, Lima (Peru), May 2013.
- Eisman, J. "Perú Microenergía: Un modelo sostenible de electrificación rural con energías renovables". En Tecnologías para el Desarrollo Humano de Comunidades Rurales Aisladas, de Real Academia Española de Ingeniería, 128-132. Madrid (Spain), 2011.
- Energy & Development Research Centre, A review of international literature of ESCOs and fee-for-service approaches to rural electrification (solar home systems), 2003. http://www.erc.uct.ac.za/Research/publications-pre2004/03EDRC-International_Escos_literature_review.pdf
- Energía Sin Fronteras. Modelos institucionales para la electrificación de zonas rurales aisladas.
- Energía Sin Fronteras, 2008. www.energiasinfronteras.org
- ESMAP. Ch 10: A case study on exclusive concessions for rural off-grid service in Argentina.
- Energy Services for the World's Poor, ESMAP, 2000.

- Meeting the Challenge of Rural Electrification in Developing Nations-The Experience of Successful Programs. D. Barnes, Editor. ESMAP, 2005.

- GEF. Final Evaluation: Electrificación Rural a base de Energía Fotovoltaica en el Perú – proyecto PER/98/G31. GEF, www.thegef.org, 2008.

- GIZ: Proyecto energía, desarrollo y vida: Resultados de la encuesta de percepción del beneficio, uso y Mantenimiento de las conexiones eléctricas. Conexiones domiciliarias e institucionales. Informe de resultados Puno. GIZ. February 2011.

- Mataix, C. & Borrella, I. (directors). Empresas que contribuyen al desarrollo humano. Seis casos prácticos en los sectores agroindustrial y de energía. Fundación Carolina. Serie Documentos de Trabajo nº 56, Madrid (Spain), May, 2012.

- MEM. Plan Nacional De Electrificación Rural. Periodo 2013 – 2022. Dirección General De Electrificación Rural. Ministerio de Energía y Minas de Perú. December 2012.

- Olivares, J. & Eisman, J. "Acceso universal a la electricidad"… ¿y Perú?. XVIII Symposium Peruvian Solar Energy and Environment (XVIII-SPES), Lima (Peru), 2011.

- Olivares, J. & Eisman, J. "Household Electrification in Peru". Amaray. November 2012.

- OSINERGMIN, Fundamentos técnicos y económicos del sector eléctrico peruano, 2011.

- Sovacool, B.K. A qualitative factor analysis of renewable energy and Sustainable Energy for All (SE4ALL) in the Asia-Pacific. Energy Policy 59 (2013) 393–403.

- Vásquez, A., García, R., Quintanilla, E., Salvador, J. & Orosco, D. Acceso a la Energía en el Perú: Algunas Opciones de Política. Documento de Trabajo No 29, Oficina de Estudios Económicos – OSINERGMIN, Peru, 2012.

The links included in this publication were all accessed in July 2014.

This report is part of the "Partnerships for Innovation in Access to Basic Services" consultancy project carried out by the Innovation and Technology for Human Development Centre at the Technical University of Madrid (itdUPM) for the Multilateral Investment Fund (MIF), a member of the Inter-American Development Bank Group (IDB).

The work on this study was conducted in collaboration with:

Acciona Microenergía Perú

July 2014

Technology for Human Development Centre - itdUPM
Avda. Complutense, s/n
28040 Madrid. Spain

Author: Miguel Ángel Egido Aguilera

Support Team:
Leda Stott
Xosé Ramil Ferreiro
Carlos Mataix Aldeanueva

www.itd.upm.es
itd@upm.es
@itdupm

Layout: Sara Romero Muñoz

Multilateral Investment Fund - MIF
1300 New York Avenue, N.W.
Washington, D.C. 20577

Basic Services for the Poor Agenda Team

Directed by Carrie McKellogg

Concept: David Bloomgarden, Celia Bedoya del Olmo, Ignacio Fernandez Admetlla

Project Team: Carlos Sanchez, Christina Lengfelder, Claudia Saenz, Svante Persson

WWW.FOMIN.ORG

www.facebook.com/**fominbid**
www.twitter.com/**fominbid**

itd UPM Innovation and Technology for Development Centre

POLITÉCNICA

FOMIN Multilateral Investment Fund Member of the IDB Group