

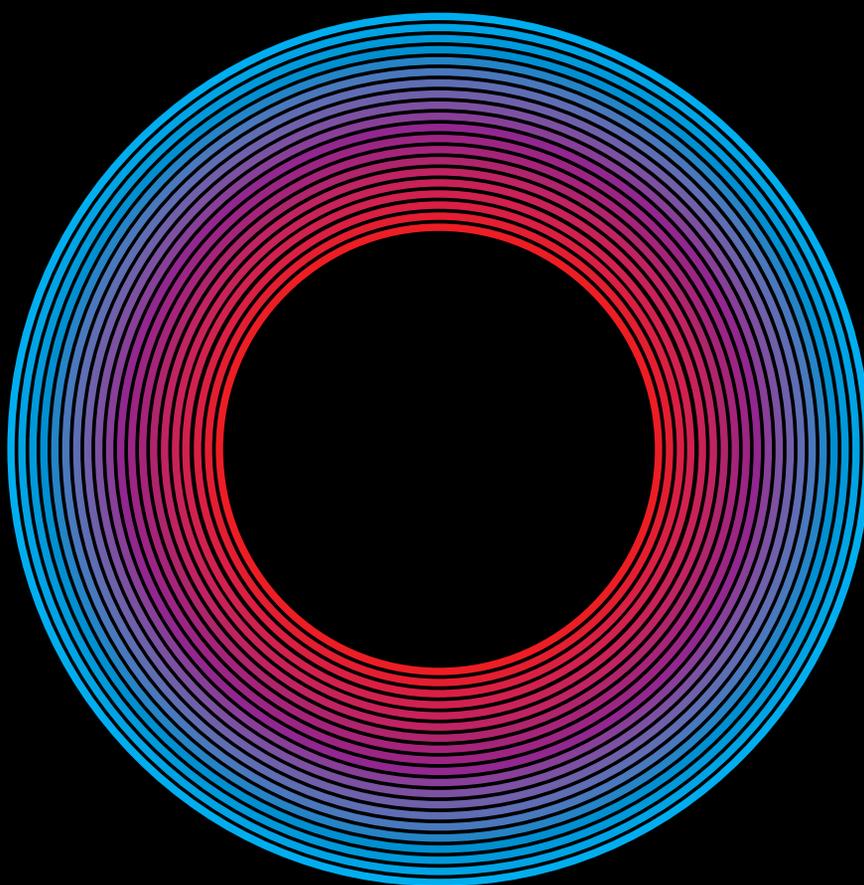
December 2014

# Amaray

Energy and development for rural areas

**SPECIAL EDITION**

**LIMA - PERU**



**LIMA COP20 | CMP10**

UN CLIMATE CHANGE CONFERENCE 2014



## Deforestation

More than 60% of Peruvian territory is tropical forest, the 4th most of any other country with this type of ecosystem in the world. These forests play a fundamental role in the subsistence of human communities, as well as in the stabilization of climate and the environment.

It is essential to adequately use these resources, since if a balance isn't found there could be catastrophic environmental effects that could also put many populations at risk.





# Pollution

Greenhouse gas emissions and their accumulation in the atmosphere is the cause of climate change and its consequences. In the world today, there are 2,6 billion people without access to modern stoves and 1,3 billion people that don't have access to electricity. In this context, the so called "energy poverty" has a harmful effect on the environment.

It is essential to take measures to mitigate these gasses, promoting access to energy for these populations and offering appropriate technologies to take care of their health and of the environment.





# Extreme Climates

In recent years, extreme temperatures have been recorded, affecting some of the most vulnerable populations. People dedicated to agriculture have been particularly affected, suffering health issues and the lack of technologies to take on these changes in climate.

It is essential to offer technologies for household comfort and productive uses to these vulnerable populations, who need sustainable solutions to adapt to climate change now more than ever.





Dear friends,

The public policy in the energy sector of Peru is oriented to provide sustainable access to energy, for the accomplishment of efficiency in the production and consumption of energy, for the necessary increase in competition in our economy, to augment the supply of energy and to move toward a new energy matrix.

We complement this policy, amplifying the energy border towards all Peruvian citizens, principally those who find themselves in vulnerable situations, like part of the Governmental policy of “inclusion for growth.”

The challenge is to bring energy to 2,2 million Peruvians of the rural zones through the extension of rural electric networks and unconventional solutions like the generation of wind energy, biomass, and solar panels to reach an electric coverage of 100%.

Likewise, through the Social Inclusion Energy Fund (FISE) no less than 1,2 million families at the national level obtain discount vouchers, while the large networks of natural gas pipelines are developed, complemented with the delivery of GLP cook stove kits or improved cook stoves to the vulnerable and most isolated population.

We work for the commitment that all citizens can have the opportunity to enjoy the benefits of clean energies. We are certain that from the private and public sectors we will all continue committed for the sustainable development of our country, with the best environmental standards for mining, diversifying the matrix and implementing energy efficiency, working for social inclusion, the transfer of technology, with continuing improvements in our projects and undertakings, programs and initiatives that contribute to the advancing pursuit in our harmonious path of development with the environment and preparing ourselves to confront the greatest challenges that climate change imposes on us.

My best regards,

**Eleodoro Mayorga Alba**  
**Minister of Energy and Mines**



Dear Readers,

COP 20 is the most important international meeting about climate change in the world. It applies to everyone and this year Lima, Peru, has the honor of hosting this vital meeting for the future sustainability of our planet.

As a country, we are committed to finding a worldwide agreement that reflects concrete actions to stop climate change and take on the consequences that it brings with it, affecting mainly the most vulnerable countries, like our own.

At the same time, we are dedicated to maintaining the level of development that our country has had in the last 20 years. The only way to do this is by being at the forefront of global economic trends, which means being at the vanguard of green economy and sustainable development. An essential part of this goal is to generate effective change in the use and generation of energy and promoting the adoption of clean and efficient alternative energy. Taking on the increasing demand for energy while at the same time not increasing emissions is no easy task but we have goals in place to do this. For example, as a country objective we are looking to increase the diversification of the energy supply and increase the use of renewable energy to 60%, as well as installing solar panels for half a million families in rural areas and develop eco-efficient initiatives in the public sector.

The Peruvian Ministry of Environment is encouraging these actions through the project “Planning to stop Climate Change” (PlanCC) that recommends concrete actions and achievable goals to achieve a clean development that is low in carbon emissions through technical, economic, and scientific analysis. This work has generated evidence for possible actions against climate change in energy, transportation, industrial processes, wastes, forests, and agriculture.

We would like to highlight the efforts made in this COP20 special edition -in coordination with the Ministry of Energy and Mines- that is looking to present current concrete initiatives to stop climate change through the use and production of energy. These efforts are a step towards a sustainable future in which we protect both our resources and citizens, giving us the opportunity to live a life protecting our own well-being and the environment.

My best regards,

**Manuel Pulgar Vidal Otárola**  
**Minister of the Environment**



Berlin / Alemania	CP1	1995	Nairobi / Kenia	CP12	2006
Ciudad de la Paz / Suiza	CP2	1996	Bali / Indonesia	CP13	2007
Kyoto / Japón	CP3	1997	Poznan / Polonia	CP14	2008
Buenos Aires / Argentina	CP4	1998	Copenhague / Dinamarca	CP15	2009
Bonn / Alemania	CP5	1998	Cancun / México	CP16	2010
La Haya y Bonn / Alemania	CP6 y CP6bis	2000	Durban / Sudáfrica	CP17	2011
Marrakech / Marruecos	CP7	2001	Doha / Qatar	CP18	2012
Nueva Delhi / India	CP8	2009	Warsaw / Polonia	CP19	2013
Milán / Italia	CP9	2009	Lima / Perú	CP20	2014
Buenos Aires / Argentina	CP10	2014	Paris / Francia	CP21	2015
Montreal / Canadá	CP11	2005			

**Peru at COP**

Since 1992, Peru is a member of the United Nations Framework Convention on Climate Change (UNFCCC) and is part of the Kyoto Protocol since 2002. As such, Peru participates in international negotiations and strongly supports the multilateral effort to achieve binding, ambitious and effective results by seeking consensus in the negotiating process.

As a country committed to sustainable national development Peru promotes low-carbon economic dynamics and contributes to the global effort to reduce emissions of greenhouse gases (GHG).

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Energy and development for rural areas

December 2014, N° 7

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**About the COP**

The United Nations Framework Convention on Climate Change (UNFCCC) was created in 1994 with the aim to reduce concentrations of greenhouse gases (GHG) in the atmosphere. The Conference of the Parties (COP) was designated as the supreme body of the Convention.

To date, 195 countries have submitted their instruments of ratification. They meet once a year for two weeks to review the implementation of the Convention and develop the negotiation process between the Parties on new commitments.

Lima will host the Twentieth Conference of the Parties to the UNFCCC from 1 to 12 December 2014. Peru will receive about 15,000 representatives of interest groups from 194 countries, such as international organizations, civil society, the private sector and various mass media, as well as Presidents and Ministers from around the world.

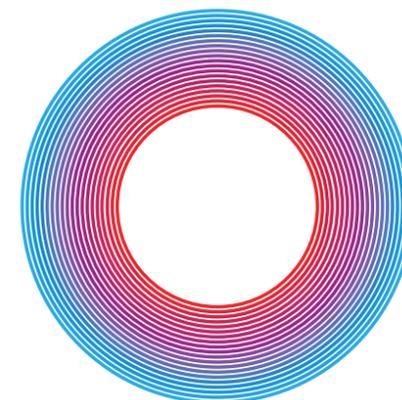
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[www.endevperu.org](http://www.endevperu.org)



**LIMA COP20 | CMP 10**

UN CLIMATE CHANGE CONFERENCE 2014

# FISE and the promotion of clean energies

So far FISE has benefitted about 890,000 families nationwide that now use GLP for cooking. According to a study by Osinergmin, these households, who previously used charcoal or firewood for cooking, have stopped emitting around 486,000 tons of CO<sub>2</sub>.

By **Victor Murillo**, Manager of the FISE Project, and **Erick García Portugal**, Manager of the Division of Projects and Studies of the same fund.

Worldwide, nearly forty percent of the population lacks modern energy services, depending on wood, charcoal and dung for cooking their food and heating their homes. Also, they do not have electricity to light their homes, schools and health centers; no refrigeration to preserve perishable food, medicines and vaccines; do not have systems for machining irrigation and other productive activities; and lastly, there is no media and information to articulate with the modern world and to create new knowledge. These shortcomings are encompassed in what is called energy poverty and people who suffer from sectors called vulnerable.

According to the Inter-American Development Bank (IDB), about 85 million people in Latin America and the Caribbean lack access to modern and clean fuels for cooking. In Peru about 7,3 million people are in such conditions. This practice negatively impacts the lives and health of the people whom inhale toxic fumes emitted by fuels. This is the main cause of lung disease and death among women.

Internationally, they are taking actions that are designed to ensure universal access to modern energy by 2030 for all inhabitants of the planet. Accordingly, the "Universal Access to Energy" focuses on two strategic objectives: achieving 100% access to electricity for lighting, communication and community services; and achieve 100% access to technologies and

fuels for cooking and heating, thanks to the improved cook stoves, liquefied petroleum gas (LPG), natural gas (NG), biogas (digesters), among others.

In Peru, according to the National Household Survey 2013, it is concluded that 36% of households classified as poor use firewood for cooking, and that 20,8% use dung or coal. On the one hand, 53,1% of the extremely poor use firewood as fuel for their food and 31,5% used dung or coal.

Also, other conditions such as remoteness and inaccessibility to localities, low purchasing power and reduced per capita consumption of vulnerable households, population dispersion and low population density, as well as lack of infrastructure, determined low economic profitability for the development of projects for the "Universal Energy Access" in the country.

Aligned to this context and considering the Plan of Universal Energy Access 2013-2022 prepared by the Peruvian government, which states that access to energy is a minimum condition for the development of communities, the Social Inclusion Energy Fund (FISE) was created with Law No. 29852 in April 2012.

This fund is established in order to promote the use and consumption of clean energy, and promote the replacement of fuel pollutants on human health and

the environment. This occurs through the mass of natural gas (NG) in vulnerable sectors, expanding the energy border using renewable energy, and promoting access to LPG in vulnerable urban and rural areas. The temporary administration of the FISE until 2017 is in charge of the Supervisory Board for Investment in Energy and Mines (Osinergmin).

At present, the FISE has been working on the social compensation and promotion for access to LPG, for which the "Coupon FISE" has been implemented. This coupon is delivered on a monthly basis to persons located in the poorest rural and urban areas of the country to buy a ball of LPG of up to 10kg with a discount of 16 soles (US\$ 5,5). In this way, people can access more clean energy for cooking their food and start generating a change in the energy matrix, positively impacting on the economy and health.

## REPORT OF RESULTS

According to a study by the Office of Economic Studies of Osinergmin, households that are currently benefiting from FISE and that before the project were consuming charcoal or firewood for cooking, would have emitted 486,000 tons of carbon dioxide

(CO<sub>2</sub>) if they hadn't changed their cooking fuel. Thanks to FISE, there has been an estimated 91% mitigation of emissions, with actual household emissions estimated now to be around 43,000 tons of CO<sub>2</sub>.

Moreover, mitigation of CO<sub>2</sub> emissions has had a relatively greater impact among the extreme poor households. The total mitigation of CO<sub>2</sub> emissions has reached 53% in the extreme poor households and 49% in non-extreme households. This is due to the fact that extremely poor households use more wood or coal.

To date, FISE has managed to benefit 90% of districts nationwide (1,647). To July 2014 889,878 families have benefited from the voucher FISE, which means that more than three million people have access to a cleaner fuel (LPG). Thus, FISE has aided Peruvians in gaining cleaner fuel for cooking food and improving the health of vulnerable families nationwide.

In addition to these actions, the FISE Administration has also developed a technical proposal to extend access to power for the population, called "Methodological proposal for achieving universal access to energy in Peru".

To date, FISE has managed to benefit 90% of districts nationwide.



A villager carries a discounted LPG tank thanks to FISE.

This proposal seeks to close the gaps in lighting, cooking, water heating, heating, information and communications, which may have a town in the country, having as main outlines the use of energy resources available and the most efficient technology, as well as the establishment of minimum technical standards and technology transfer to the residents for sustainability. His intervention protocol includes these guidelines and starts with the identification of the energy capacity of the site and determining the "optimal minimum energy combo" that can close their energy gaps.

The methodology is based on the "Energy Map", a technological tool that uses geo-located

information about the energy supply and demand nationwide, allowing recording, monitoring, consultation and evaluation of projects and energy resources. Because of this, it is possible to centralize all the information necessary to improve efficiency and transparency of public and private interventions to projects which are intended to improve the lives of vulnerable people.

This proposal not only seeks to bring up the energy, but also promote energy available and less polluting to the attention of basic human needs, the growth of their economic and productive activities, and improving quality of life.

the FISE has been working on the social compensation and promotion for access to LPG.



FISE

The project looks to help populations that lack modern energy services.

## FISE

The Social Inclusion Energy Fund (FISE) seeks to strengthen energy and social inclusion of vulnerable populations, improving their quality of life as it can replace the use of firewood for cleaner fuel (LPG). The Supervisory Board for Investment in Energy and Mines (Osinermin) is the current temporary administrator.

The FISE is a Social Compensation Program for the Promotion and Access to LPG, which means providing a subsidy for the purchase of a LPG tank up to 10kg through monthly delivery of a voucher (coupon) discount to homes in the poor and extremely poor sectors.

To improve efficiency and strengthen governance, the program has reengineered its operation based on the implementation of innovative solutions in information technology such as: Digital Voucher FISE, the Tukuy Rikuy and Interactive Map of LPG, with principles of good governance and citizen participation, transparency, efficiency and accountability.

[www.fise.gob.pe](http://www.fise.gob.pe)

# Solar energy in the process of rural electrification

Photovoltaic systems are an important alternative to provide power to rural population centers which, due to their remoteness and dispersion, cannot access electricity networks. Since 1996 the Ministry of Energy and Mines has driven this model, which allows people to light their homes, as well as access communications and entertainment, all through a clean technology.

By **Jorge Suárez**, Manager of the Office of Renewable Energy of the General Department of Rural Electrification of the Ministry of Energy and Mines, and **Miguel Ramos**, Specialist in Renewable Energy of the same unit.



A hybrid energy source installed in the town of Chulec, Janchiscocha, Junin.

Ministry of Energy and Mines

The extension of power grids has been and is still the main alternative to extend the public electricity service to rural communities of Peru. This technology allows us to provide the population of a permanent and continuous electrical service, being sufficient to meet the electricity demand in housing, utilities, street lighting, and allows the development and improvement of local productive activities.

However, a significant number of rural population centers cannot be electrified through grid

extension, because remoteness, difficult access, isolated and scattered houses. For them, it is mainly installing photovoltaic (PV), composed in its basic form from a photovoltaic module, a charge controller, battery and three lamps (plus cables, structures and accessories).

These systems can supply power independently to each rural dwelling with a voltage of 12 volts DC. It may be true that these systems supply less energy than the power grid does, however, these systems still offer benefits as they can supply

These systems can supply power independently to each rural dwelling with a voltage of 12 volts.



power independently to each rural dwelling, such as lighting, communications and entertainment.

The lighting is obtained by installing low-consumption lamps, replacing traditional forms of lighting, which are inefficient and harmful to health, such as using candles or lighters. It should also be noted that with the supply and installation of PV systems, takes place alongside the installation of electrical connections and low power consumption lamps, a factor that allows the resident to have the benefits of electricity since the beginning of the operation systems. Furthermore, these electrical connections are designed and installed in compliance with current technical standards and quality, which allows providing an effective and safe electric service in the home. Meanwhile, the artifacts commonly used by the resident are radios, televisions and mobile phone chargers.

**PHOTOVOLTAIC PROJECTS IMPLEMENTED**

The General Department of Rural Electrification of the Ministry of Energy and Mines (DGER-MEM) held its first projects to install PV systems in early 1996 under the Non Conventional Energy Program (PER/96/O28) under which around 1,523 solar home systems (SHS) were implemented. By the end of

2007 the Rural Electrification Program under the Photovoltaic Energy in Peru installed 4,200 SHS (PER/98/G31).

A part of the photovoltaic installations under both projects were transferred to the Electrical Infrastructure Management Company (Adinelsa) through the Rural Electrification General Law No. 28749.

Then, between 2008 and 2010, taking into account all the experiences of photovoltaic projects implemented by the DGER-MEM, the Regulations of the Rural Electrification General Law was modified, recognizing PV systems as "rural electric supply systems labeled non-conventional". Besides, it was solicited to the Supervisory Board for Investment in Energy and Mines (Osinermin), to set the corresponding Rural Electricity Rate. Thus, in August 2010 the fee was set for PV systems, marking an important development milestone for the design, implementation and commercial operation of these systems as a technology validated to electrify rural areas that are unable to be connected to conventional electricity networks, positively impacting the sustainability of the program.

**A second step, to successfully install the remaining demand of 500,000 PV systems required to December 2018, thus reaching 100% electricity coverage.**

Between 2012 and 2014, the DGER-MEM installed 14,953 SHS in various departments of Peru that are being operated by different concessionaires and Adinelsa. In addition, 158 PV systems for higher power (1-4kWp) were implemented for the electrification of facilities for community use and public services such as schools and health centers.

To date, the DGER-MEM has conducted approximately 20,000 photovoltaic installations representing approximately 2MWp power for the electrification of rural areas. This represents about 4% of the total required to meet the existing demand for electricity nationwide, estimated at 500,000 for 60,000 rural localities that currently do not have the possibility to be electrified by conventional power grids.

**ENERGY THROUGH ALTERNATIVE PATHWAYS**

Looking to reach these remote places as quickly as possible, they have developed a legal basis upon which bids can be made through public auctions so that private investment can be placed into commercial operation and the first essential step of 150,000 PV systems by August 2016; and a second step, to successfully install the remaining demand of 500,000 PV systems required to

December 2018, thus reaching 100% electricity coverage.

The selection process will culminate in March 2015 with the signing of an investment contract between the MEM and the awarded companies, to take charge of the design, installation, operation, maintenance and replacement of photovoltaic systems for a period of 15 years.

There are also plans to use technology to implement PV systems or hybrid photovoltaic power plants in rural populations and in those that have some degree of concentration of homes or to replace electricity generation in rural villages using small generators.

In that perspective, definitive studies for two projects in the department of Puno are being developed and similar projects for border districts in the departments of Loreto and Amazonas.

Similarly, the working on developing new small hydro and wind projects is going on, so that Peru's potential for clean, non-polluting, renewable energy can be used, thus contributing to conservation of the environment.

A beneficiary next to a solar home system.

# Promoting productive uses of electricity

In 2006 the UPE program, which has been considered as a proposed business model for productive social inclusion was born. It generates employment and adds value from the identification of productive chains that can exploit the availability of electricity.

By **Edgar Eduardo González**, Main Specialist of Productive Uses of Electricity from the Ministry of Energy and Mines.

In order to increase access to electricity in rural areas of Peru, the Ministry of Energy and Mines (MEM) created the program "Improving the Rural Electrification by Grant Funds" (FONER). With the Supreme Decree No. 100-2006-EF of July 6, 2006, the Government of Peru approved the operation of external indebtedness agreed between the Republic of Peru and the International Bank for Reconstruction and Development (IBRD Loan 7366-PE). In this context the project for promotion of Productive Uses of Electricity (UPE) was considered.

Currently, the load factors and the use of installed capacity in rural areas of Peru are low. The maximum power demand usually occurs at night, while daytime consumption is minimal, therefore electricity in rural areas has contributed to improving the welfare of the rural population, with immediate benefits associated with lighting and the use of television and radio.

The UPE program has contributed to assisting low-income emerging economies, acquire skills, introduce new activities or business opportunities, modernize traditional methods to increase production, adding greater value, improve living conditions in rural communities, and generate more revenue for the company providing electric service.

In Peru, according to the National Institute of Statistics and Informatics (INEI), in 2007 there was a rural population of 6,6 million, of whom it is estimated that by 2013, 70.2% lacked electricity, being one of the lowest coefficients of rural electrification in Latin America. Coupled with limited access to other infrastructure services, the lack of electricity and of

access to health and education, result in low quality of life and limited opportunities for optimal economic development. This reality needs to invest in the provision of basic infrastructure such as electricity, as part of the agenda for national development.

Note that the implementation of UPE program has contributed to improving the environment by eliminating emissions of greenhouse gases from burning oil based fuel and therefore the disappearance of chemical residues from oil changes, filters, etc.; replacing them with clean energy, such as electricity. In addition, the producer has the possibility of saving, because the cost for electricity consumption is less than that incurred by the use of oil needed to generate an equivalent amount of energy.

Additionally, favored the formalization of communities around the centers of production, encompassing many productive fields, such as:

- **Agriculture:** Pumping stations; modern irrigation (sprinkler or drip); collection and processing centers (fruit, cereal, coffee, roots); and grain mills.
- **Animal Husbandry:** Centers for meat and dairy processes; stables, heated sheds; cooling systems, blending and food processing; centers for breeding, fattening and tannery.
- **Metalworking and woodworking:** Equipment for welding; saws, lathes and sanders.
- **Other areas:** forestry, farming, handicrafts, tourism, education, among others.

## BARRIERS IDENTIFIED

The implementation of UPE program has faced many barriers on the side of the distribution companies and on the demand side of the Family Production Units (FPU) in rural areas, including micro and small enterprises.

On the side of the distribution companies, the following barriers have been identified:

- The selection criteria for rural electrification, which does not explicitly include charges for actual or potential productive uses.
- Some isolated systems, particularly isolated municipal networks that do not allow electric service available 24 hours a day.
- Limited service quality caused by interruptions and voltage fluctuations.
- Delays in administrative responses to requests for new supplies or to increase the contracted power.
- The rate structure causes difficulties for the initial connection and expansion of installed capacity.
- Distribution company staff inadequately trained to promote productive uses of electricity.

As for the potential increase in demand for electricity by the FPU, the barriers identified were:

- Lack of knowledge of the possibilities for improving productivity that provides the electrical power.

- Lack of access to financing for the acquisition of electrical equipment and connections.
- Uncertainty or difficulty regarding the availability of primary materials or access to more developed markets.
- Lack of knowledge about the procedures used by the distribution companies.
- Limited number of rural FPU.
- Increased risk aversion on the part of the rural FPU.

## WORK TEAMS AND BUSINESS MODEL

The intervention model used consists of financing, by MEM, consultancies developed by working groups composed of a team leader and finance specialists, the technical and commercial areas, marketing, supply chains and field workers, who make business plans of enterprises and have a commitment to put into operation these plans at the end of the consultancy. Based on this study, the Family Production Unit (FPU) invests in equipment and electrical connections that allow them to use the service. Thus, under the FONER project, farmers invested about 28,8 million soles (US\$ 9,9 million), generating social inclusion in a model of successful intervention. The program promotes productive activities that create jobs and give added value to the products obtained from the use of electricity in the process, thereby increasing the profitability of products and contributing to the improvement of living conditions of rural producers.

Under the FONER project, farmers invested about US\$ 9,9 million, generating social inclusion in a model of successful intervention.

## THE GENERAL DEPARTMENT OF RURAL ELECTRIFICATION

In May of 1993, through the Supreme Decree No. 021-93-EM, the Executive Directorate of Projects was constituted, as the dependent body of the Ministry of Energy and Mines (MEM), and was charged with the execution of energy projects. Afterwards, in May of 2007, through Supreme Decree No. 026-2007-EM disposed its fusion with the Project of Rural Electrification Improvement, through the application of competitive funds, creating the General Department of Rural Electrification (DGER) as the nationally dependent body of the Vice-Ministry of Energy, competent in rural electrification, in charge of coordination and planning with the regional and local governments, and programs, projects, entities, institutions, and investors interested in contributing to elevate the coefficient of rural electrification.

The DGER administrates the assigned resources for electrification, with the exception of the destinations to the promotion of private investment; elaborates the studies, executes the works that are assigned to them and realizes the transfers for their administration, operation and maintenance to the concessionary companies of electric distribution of the public property or to Adinelsa.

[www.dger.minem.gob.pe](http://www.dger.minem.gob.pe)

Pedro Gamio, Ex Vice-minister of Energy and Coordinator of Energy for COP20

# “We need to generate opportunities for the citizen, wherever he may be”

Stresses that the access to energy makes a difference in the rural zones, where it improves the quality of life and generates opportunities for the population. Moreover, the new technologies allow a combination of all of this with the protection of the environment. He notes that since 2004, with the use of natural gas, Peru has reduced CO2 emissions by a quantity that is equivalent to about 15 times the green areas of Metropolitan Lima.

By Carlos Bertello, editor of Amaray Magazine.



Pedro Gamio in an office of the Ministry of Energy and Mines, in Lima.

## WHAT IS THE ENERGY PANORAMA IN THE RURAL SECTOR?

The rural sector is a priority for the Peruvian State. We can speak of an aggressive investment policy for access to energy, which already has more than four governments and has been becoming more intensive. The General Rural Electrification Law (LGER), from June 2006, created a contribution of the electricity market for rural electrification for a fund to be managed by the Ministry of Energy and Mines. This enabled the increased investment for the expansion of power grids, reaching amounts of annual investment of around US\$ 200 million.

However, there is still much to be done, there is an insurmountable economic and geographical barrier, which is generated when the cost per household connection exceeds a certain amount, and does not allow viable electrification from the laying of networks.

## WE UNDERSTAND THAT ELECTRICITY SHOULD GET TO ALL...

The General Rural Electrification Law believes that electricity is a public service, which generates a better quality of life and opens opportunities. Therefore, it is intended to have no citizen in Peru who does not have this benefit because it is a right. In that sense, renewable technology systems, for example solar photovoltaic, have lowered their cost and represent an alternative to bring more families electricity service in their home.

In general, each project goes through a cost-benefit analysis, discovering which technology is appropriate for each individual area, which enables the quickest arrival possible of electricity to thousands of isolated populated places. The technology cannot be imposed, instead, the technology is a response to a survey of the area. Therefore, the solar-photovoltaic recipe is not always the most efficient solution, but serves many isolated places and we can say that there is about 30% of the rural population to whom we still must attend, taking into account isolation, dispersion and the different cultural realities of Peru.

## AND REGARDING THE PROGRAM FOR ACCESS TO GAS FOR COOKING?

LPG (Liquefied Petroleum Gas) is nearing a million Peruvian households receiving a benefit of a coupon for a free gallon of LPG. This has a major impact in areas that fall within a range of up to four hours away from the road, that is to say, where the distribution of the product and the ability to pay is viable. However, this does not work in very remote and poor places, where also the ancestral customs for cooking do not include the use of gas.

In this sense, there is a serious health problem that occurs from improper traditional cooking in the home. Very humble families cook in the

floor with wood or dung, which produces high pollution and impairs the health of the entire family. The model of the improved cook stove confronts this reality, using a chimney and a more efficient combustion system that reduces up to one third the amount of biomass used. We have installed 600,000 improved cook stoves, but the challenge is to reach 3 million homes.

## WHAT OTHER PROGRAMS DOES THE STATE CARRY OUT?

The state develops several major projects such as “Juntos”, but we are referring only to the energy topic. The FOSE (Social Compensation Electricity Fund) is a subsidy that is given to families who consume a very small amount of energy -less than or equal to a consumption of 100 kWh/month-, this represents a positive factor for the access to electricity. This subsidy reaches rural populations by BT8 rate, which is a type of reduced rate for users of solar photovoltaic systems.

For example, in Cajamarca, to maintain and operate solar panels for 4,000 families, it requires the resident to pay for this service. However, this amount is less than the actual cost, as the FOSE covers 40 soles (US\$ 14), while the resident pays the remaining 10 soles (US\$ 3,5). This helps to gradually improve the conditions of these isolated populations, hand in hand with other state programs that provide opportunities for the rural population.

## ACCESS TO ENERGY BOOSTS THEN SOCIAL DEVELOPMENT...

The most important element is the help of energy in building social capital. That is to say, this infrastructure provides basic services that have to do with quality of life and it creates conditions to promote education and improve working and productive opportunities.

Human rights include social and economic rights. Therefore, we need to generate opportunities for the citizen, wherever he may be. In Peru there is still a very big gap and we must make a special effort to improve the quality of life in remote areas. It is social justice.

## HOW IS THE ENERGY SECTOR CONFRONTING THE PRESERVATION OF THE ENVIRONMENT?

Peru has taken a huge leap since 2004, when natural gas entered the national economy. For example, it has reduced CO2 emissions between 2005 and 2013, with an equivalent level to implement an area of about 15 times the green areas of Metropolitan Lima in 2011. This means that natural gas, which replaces diesel, has substantially reduced the emission of greenhouse gases. To date, this product is used for 40% of the electricity generation in sectors such as industry, transport (200,000 users) and households (250,000 users). But gas is not eternal and we must use it efficiently. Therefore, it is necessary to use more renewables in electricity generation.

“The most important element is the help of energy in building social capital”.

An important element is the promoter framework for renewable energies. A new call for alternative energy projects has been announced, so that there will be more water and wind energy projects, as well as other alternative energies. Also, we are searching for the completion of the Legislative Decree No. 1002, which indicates that 5% of the energy markets in the country should be alternative energy, excluding hydropower generation which we should also promote.

**WE WILL BE THE HOSTS OF COP20. WHAT GOALS WILL BE SEEKED TO ACHIEVE?**

There are two levels. Internationally, draft a binding agreement that can be defined at the meeting in Paris and the birth of the “Green Fund” to finance projects that confront climate change. On the national level, build a domestic agenda and shared vision, which means coordinated work with every sector such as the academy, the private sector and the whole civil society. The energy sector has a roadmap proposal until the year 2025, which we seek to be part of a national agenda against climate change.

**HOW IMPORTANT ARE THESE ACTIONS FOR PERU?**

If we act today, we face a scenario that would affect 4% of the gross domestic product (GDP); but if we wait until 2030, consequences and social and economic costs may rise substantially and if global temperatures rise by more than 2°C, a quarter of Peru’s GDP could be endangered, with an increased number of natural disasters. Being a country vulnerable to climate change, the most affected activities would be agriculture and fishery. Furthermore it could affect the food chain and the health of people, water scarcity and increased frequency of the “El Niño” Phenomenon could be generated. We cannot solve the problem alone, but we can be better prepared.

We have to change our way of relating to nature, which is the source of our well-being and progress. Likewise, citizen empowerment is a key part of the strategy. This is achieved through information and education, so that people become aware of the issues that their future is at stake.

“Peru has taken a huge leap since 2004, when natural gas entered the national economy”.

# Energy service markets to reduce greenhouse gases

The sustainability of energy services technology involves developing a strategy in which the various social initiatives consider their target audience as a potential customer, who they must comprehensively address.

By **Ana Isabel Moreno**, General Manager of the Energising Development (EnDev Peru) Project of the German Cooperation, implemented by GIZ, and **Carlos Cabezudo Moreno**, Energy for Cooking Advisor of the same project.

As indicated by the International Energy Agency (IEA) in the "World Energy Outlook 2011", it is estimated that 1,300 million people, 19% of the world's population, lack access to electricity in the world and 31 million of these live in Latin America and the Caribbean (7%). Similarly, 2,700 million use biomass for cooking or heating (39%), of which 87 million are located in Latin America (19%).

For example, the use of wood in open fires or traditional cook stoves, generates a daily average family consumption of 10 kg (eucalyptus wood), emitting 6,6 metric tons (MT) of CO<sub>2</sub> each year. Instead, an efficient technology as the “improved cook stove” consumes half of firewood, reducing GHG emissions to 3,3 MT per year.

**DEVELOPMENT THROUGH THE MARKET**

According to the United Nations Development Program (UNDP-2005) there is a relationship between the consumption of modern energy and the human development index. Indeed, countries that develop, make improvements in energy, thus generating a reduction of greenhouse gases.

Confronting that which is described, is it possible that the poor can access these modern energy services through the market? Solutions of this kind exist. For example, from the development of “inclusive energy services markets”, families that are at the base of the pyramid can be incorporated to the value chain, either as producers or distributors.

Similarly, we have the hybrid value chains. These are commercial alliances between companies and organizations of civil society, in order to ensure the

Most of these people live in rural areas, in poverty or extreme poverty conditions, vulnerability and social inequality. They have no social assets (education services, health services, decent housing, etc.) to adequately meet their basic needs. Also, their monetary income is less than two dollars a day. These are the people who are in the so-called “base of the pyramid”.

Moreover, this situation is compounded by the lack of access to energy supplies (electricity, fuel and mechanical energy), and in most cases where access is achieved, it is of poor quality and it pollutes the environment and causes health problems, contributing to the emission of greenhouse gases (GHG), these being precarious energy services for lighting, cooking, water heating and heating, that do not reach minimum standards.

The hydroelectric center in Yanango is a massive project that provides electricity to the country.



Ministry of Energy and Mines

**MINISTRY OF ENERGY AND MINES**

The Ministry of Energy and Mines (MEM) is the central governing body of the energy and mining sector and is an integral part of the government’s executive branch. It aims to develop and evaluate, in harmony with the general policy and government plans, policies nationwide on sustainable development of mining-energy activities. It is also the competent authority on environmental issues related to mining and energy activities. Its mission is to promote sustainable development of energy and mining activities, encouraging private investment in a competitive global framework, preserving the environment and facilitating harmonious relations within the sector.

The current Minister of Energy and Mines is Eng. Eleodoro Mayorga Alba, assuming responsibilities from February 25, 2014 to date.

[www.minem.gob.pe](http://www.minem.gob.pe)

sustainability and popularization of products that are aimed to promote social inclusion and economic citizenship, and whose success is measured in terms of generated profitability and social impact.

A third strategy is called “social enterprises” proposed by the NGO Ashoka: “using market mechanisms, that is, offering a good or service for which then a payment is received that covers the costs and generates surpluses, from which greater benefits are provided to sectors of society that are currently excluded. That is, a social business is a means, not an end in itself”.

A fourth way —found from the experience gained by the Energising Development (EnDev Peru) Project of the German Cooperation, implemented by the GIZ— is the development of local entrepreneurs, this means strengthening their business management skills and technology, so that they can position their business in regional markets.

#### APPROPRIATE TECHNOLOGY AND SOCIAL PRACTICES

Each of these strategies show successes and lessons learned. In that direction, we realized in the EnDev Peru Project that for the consolidation of a new market around products or even new energy services

(such as improved cook stoves or photovoltaic systems) are not sufficient for trade promotion, nor the incorporation of the population in the value chain or the social impact of business, but also skills must be developed in the use, maintenance and adoption of these technologies through different education and communication strategies.

Therefore, the project determined that for the incorporation of new technologies in vulnerable family populations various aspects converge, ranging from the technical and organizational, to cultural and individual. In this perspective, as indicated by Julian Salas in his book “Diffusion and technology transfer in the field of Latin American popular habitat” of 2002, the promoted technologies are not simply a physical tool, but are embedded in social and cultural practices.

The concept of appropriate technology holds that its origin is sociological, because it constitutes the response to a response seeking to solve social problems that affect, in one way or another, in the standard of living of the population, the efficiency of compliance of routine obligations and even in changing habits and customs, to adapt to new life forms favored by technological progress and access to energy.

The concept of appropriate technology holds that its origin is sociological.



Local handymen in the middle of constructing an improved cook stove.



Young men from the town of Chingol, in Cajamarca, were trained for the sale of photovoltaic products.

In this sense, the experience of EnDev Peru has been to incorporate symbolic and cultural concepts generated around the use of the new technology. Concepts such as modernity, dignity and prestige by having a clean, beautiful and healthy environment, have enabled people give to these technologies new social values and therefore accelerate its adoption process. This implies, to offer technology, not as a product for the “others”, or to say, for the poor, but in a totally opposite manner, it is necessary to offer these products to “clients”, in the same way any other product on the market is offered. Thus, we see a way to ensure that the market is sustainable.

In summary, there are precarious and inefficient energy services that do not meet minimum standards

and that contribute to the emission of greenhouse gases. These are regularly used by the poor. In contrast, access to modern and clean services through various marketing strategies, such as inclusive business, the hybrid value chain, social business and local entrepreneurship at the base of the pyramid, is possible.

Significantly, by not taking into account the symbolic and cultural aspects of the offered energy technologies in new markets, or to say the wishes of the “clients” and not reinforcing the training for the use and maintenance of these modern technologies, the market may not be consolidated and result in continuing the emission of gases and pollutants to the atmosphere and the environment.

# Experiences of local enterprises

The energy service markets are an interesting job opportunity for young people in rural areas who can be trained in the construction and maintenance of improved cook stoves, as well as to provide basic services as electricians.

By the EnDev Peru Project Team.

## IMPROVED COOK STOVES IN APURÍMAC

This story takes place in the city of Andahuaylas, in the Apurímac region. It describes the experience of a young entrepreneur with vision, who starts a relationship with the Energising Development (EnDev Peru) Project of the German Cooperation, implemented by GIZ, to join the process of installing improved cook stoves. This allows him to position himself in the local market, capitalizing on the knowledge acquired until turning it into a business opportunity. Furthermore, the entrepreneur becomes aware of social responsibility, perceiving that improved cook stoves are a way to improve the health of families in Andahuaylas and also the care of the environment.

In October 2008, the project EnDev Peru contacts the young Fritz Buleje, owner of an informal workshop of metalworking. From the successful delivery of requested test pieces, a first agreement for the construction of 400 metal chimneys is established.

“The task was not easy”, said Fritz, because the work was done manually. “The circumference of the hood had to be cut with scissors and making 100 chimneys took us a week. We finished with injured hands, but managed to pass the first test, providing the number of pieces in time”, he says.

Despite the difficulties, through an internship in Arequipa, Fritz manages to develop new skills that allowed him to build parts with less effort and understand the process of modernization to optimize resources.

“I understood that if I want to grow up, I have to invest in technology”, he says. Thus, he decided to invest in buying a bending machine, a folding machine, and a dye to build hoods for chimneys.

“Every beginning is difficult. There was not a shortage of problems to begin working with the new tools. But at last the product was produced as it should be!”, stresses Buleje. He adds that “being able to observe the satisfaction of a mother, seeing that the improved cook stove does not generate smoke, is very rewarding”.

So, based on this new experience, Buleje makes the decision to form a company, having the vision and intention to expand its ability to sell improved cook stoves. EnDev Peru strengthens this idea and so, by the end of 2009, the company CHANKA TEC is created.

In one year, Fritz specializes not only as a supplier of metal parts for improved cook stoves, but also as an installer, allowing him to offer a complete service. Also, his company participates

“I understood that if I want to grow up, I have to invest in technology”, says Fritz Buleje.

in the first public tender called by the Provincial Municipality of Andahuaylas and manages to win the construction of 400 improved cook stoves.

## SAFE ELECTRICAL CONNECTIONS IN CAJAMARCA

In the town of Chingol, in the Cajamarca region, electricity arrived in 2013. However, despite the advantages of having electricity, most households also show the precariousness of their electrical connections, because unfortunately there was no qualified personnel to ensure a secure connection for families, it was the same untrained people providing electricity services to the families.

Seeking to counter this reality for all of those families that sought a quality standard, there was Tito, a young man from the community that was trained to install secure electrical connections by the Safe House Rural (SRH) Program, an initiative from the EnDev Peru Project of the German Cooperation, implemented by GIZ.

A villager said that once there was electricity he contacted one of the young people trained by SRH to perform secure electrical installations. “Tito has

done for us the electrical installation. Connections are secure and he did exactly what we asked of him. Furthermore, should we have issues, he has told us to call him”, he says. Also, in terms of materials, EnDev Peru was responsible for the villagers’ access to quality products at discounted prices. “For us it has been a comfortable price”, he adds.

“The German Cooperation looked for young entrepreneurs who want to get involved with the process of electrical installations, because in the farms and fields they do not know how to and there is a need for trained people with this skill. We are from the area and when our service is needed, we can make a quality connection and solve electrical problems”, said Tito, a young electrician in the town.

He seems satisfied with his work. He is scaling knowledge and seeing how to continue on this path, where he sees the possibility of a profession that allows him to grow economically. “Electricity is everywhere and, here in Cajamarca, it is growing every day”, he says.

Tito and Michelle are two young entrepreneurs who offer electrical services in rural towns of Cajamarca.



Similarly, Michel, another one of the young electricians trained by EnDev Peru tells us his experience. “Today I see this as an economic opportunity, considering the advantages and that work on the farm (agriculture) is harder. And this is one more benefit we can give the people”, he says.

He also highlights the potential for further growth through the pico photovoltaic systems. “It's a business that is offering a new advantage for people who have no electricity and we are trying to grow the market”, he adds.

In this regard, the program allowed young people to learn alternatives technologies such as pico photovoltaic systems, and they also saw the opportunity to earn extra money working as independent sellers, especially because they are in constant contact with people from places that do not yet have electricity.

In perspective, the SRH program has changed the existence of these young men, who now can live from this economic activity, combining the electrical installations with the sale of photovoltaic systems. However, both mention that they have not entirely left the life in their farms, keeping an interesting balance that also respects their local customs.

The SRH program has changed the existence of these young men, who now can live from this economic activity.



José, a farmer of the village of Huauya, in Ancash, also serves as a local electrician.

### ENERGISING DEVELOPMENT PROJECT

The Energising Development (EnDev Peru) Project aims to facilitate sustainable access to basic energy services, especially in rural populations from four lines of action: energy for cooking, energy for lighting, energy for productive uses and energy services through microfinance.

In Peru, the project has been working since 2007, being executed by the German Cooperation, implemented by GIZ. It is part of an initiative in 23 countries funded by the Federal Republic of Germany, the Netherlands, Norway, Australia, the UK and Switzerland, which aims to provide sustainable access to energy services to 14 million people up to year 2015.

[www.endevperu.org](http://www.endevperu.org)

# FASERT, a contribution to renewable thermal energy

Next year will see the execution of ten projects to provide energy to 12,750 families in rural areas through improved cook stoves and biogas digesters, which in addition to improving quality of life, will prevent the emission of 25,5 kilotons of carbon dioxide a year.

By **Fernando Acosta**, Specialist in Renewable Energy of FASERT, and **Carlos Cervantes**, National Technical Coordinator of the same project.

Access to modern energy services is a key to the welfare and the development of populations. It is estimated worldwide that one in five people live without access to electricity and at least 2,700 million use traditional biomass for cooking and heating their homes.

While the level of access to electricity in Peru is high, with coverage rates in urban and rural areas estimated at 95% and 70% respectively, there is still a long way to go to meet the thermal energy needs of the population, especially in rural areas. According to the National Institute of Statistics and Informatics (INEI) 7,3 million Peruvians still rely on traditional biomass for preparing their food and heating their homes.

Renewable energies, because of their low energy density, are ideal candidates to serve the potential market that represents the lack of access to energy in the rural sector. Using renewable primary energy to provide useful heating energy through the Thermal Renewable Energy Technologies (TRET), either for applications for domestic, social or intervening in any productive use process, can help transform the lives of the poor.

### ENERGY SERVICES IN RURAL AREAS AND THE MARKET APPROACH

Traditionally, energy access projects promoted by the public sector, civil society and even from international

cooperation, have focused on the implementation of technologies, this means, without integrating a vision of market, causing failures in the adjustment, social and economic ownership of that same technology. The market approach is to develop a strategy that promotes technology validated in the field, developing formal marketing schemes and adaptive payment schemes, cultural characteristics and needs of customers, strengthening the capacities of all actors involved in the value chain. Its implementation involves dealing with certain challenges:

1. Lack of public policies to the lower social strata that allow developing alternative and energy efficient markets with long-term vision.
2. Schemes of inadequate financing for the target population, technologies with high price, low affordability and low incomes of poor families.
3. Distant geographic areas, inadequate communication pathways and complex and diverse socio-cultural environments, which increase product distribution.
4. Little or no local production of technologies, lack of working capital and suitable materials, and selling price that does not reflect the actual cost of production.

Faced with these challenges, the development and strengthening of energy markets should include the following:

1. Strengthen supply, training local providers to improve the quality of their products, developing marketing strategies and provide adequate after sales service.
2. Encourage adequate demand with appropriate strategies to introduce technology, not to create false expectations, and formalize commitments and guarantees on the basis of the product to be received.
3. Having a simple and direct promotion strategy, focusing on potential customers and local distributors of technology.
4. Develop financial products according to the reality of the target population, targeting both supply and demand.

#### FASERT

The Fund for Sustainable Access to Renewable Thermal Energy (FASERT) is an initiative launched by the Inter-American Institute for Cooperation on Agriculture (IICA) and the German Cooperation, implemented by GIZ.

The fund was born of the need to propose alternatives for reducing poverty, promoting economic growth in rural and peripheral urban areas through the scale development of modern thermal solutions of renewable energy such as improved cook stoves, solar water heaters, biogas digesters and systems that improve energy and thermal efficiency through market mechanisms.

In this way, it seeks to stimulate the market and actively contribute to the strengthening of technical and financial capabilities of all the actors involved in the value chain of the TRET.

To achieve its objectives, FASERT has been conducting open calls to public, private and civil society institutions, so that they can present their projects to access the TRET grant funds. The categories of projects to receive funding are three:

1. Stimulation of TRET market focusing on the domestic sector.

2. Spreading of TRET by supporting the sustainability of initiatives conducted by the public sector.
3. Productive uses of energy.
4. Additionally, in order to contribute to ensuring the development of a market with proven technologies, FASERT seeks to intervene by providing technical assistance aimed at contributing to the development and adoption of technical rules and standards for quality, safety and efficiency of TRET, as well as market positioning of this technology as a viable means for promoting alternative sustainable ways of life.

#### RESULTS ACHIEVED

To date, as a result of its first call for project financing, FASERT has selected ten initiatives to be implemented during 2015. The total cost of the projects amounts to \$ 2,5 million, being 52% funded with input of FASERT

and the remaining with counterpart resources. This set of initiatives will:

1. Provide access to energy for cooking to 12,750 families in rural areas through biodigestors and improved cook stoves, helping to improve their quality of life.
2. Prevent the emission of 25,5 kilotons of carbon dioxide each year.
3. Promote access and efficient use of energy in 50 productive units of the brick craft sector.
4. Develop innovative and compliant financial products, according to the revenue profile of the rural population, enabling them to access the various TRET in favorable credit conditions.
5. Strengthen TRET providers and commercial marketing chains in the regions of Cajamarca, Cusco, Ayacucho, Arequipa, Lambayeque and San Martín.

FASERT has selected ten initiatives to be implemented during 2015.



The solar water heaters are a modern solution for access to thermal renewable energy.



Improved cook stoves are one of the energy access solutions promoted by FASERT.

#### INTER-AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE

The Inter-American Institute for Cooperation on Agriculture (IICA) is an international organization specialized in agriculture and rural well-being of the Inter-American system, with more than 70 years of institutional life, whose mission is to encourage and support the efforts of Member States to achieve agricultural development and rural welfare through international technical cooperation of excellence.

[www.iica.int](http://www.iica.int)

[www.fasert.org](http://www.fasert.org)

# Sembrando, a program that increases the quality of life in rural areas

It is a comprehensive project that begins with the implementation of improved cook stoves, and continues with the construction of latrines and the supply of seeds to boost the family garden, as well as health training to families in areas of extreme poverty.

By Ricardo Maraví, Executive Director of the Work and Family Institute.

According to its approach and strategy, the “Sembrando” (sowing) program, implemented by the Work and Family institute (ITYF) attacks comprehensively the determinants of chronic malnutrition and poverty. Each family in the areas of action receives inputs for an improved cook stove, a latrine and garden seeds. In addition, they are trained in health, hygiene and nutrition (hand washing and consumption of boiled water).

In this context, improved cook stoves are essential tools. First, it helps to combat chronic malnutrition, reducing acute respiratory infections by removing contaminating smoke from inside the house, and also faces acute diarrheal disease, since it facilitates access to boiled water at home. Second, the quality of life rises, improving the house to become more enlightened spaces, smokeless and clean walls. Third, a reduction of environmental pollution to save 50% of cooking fuel (wood or biomass), thereby reducing deforestation and carbon dioxide emissions.

The program seeks to serve the population of communities that have rates of poverty and lack of basic services.



In the other hand, latrines fight parasitoids and from the family garden (an area of 3m x 1,5m) vegetables are grown high in vitamins and minerals, achieving diversity and improvement of the nutrition to the people.

Intervention districts are targeted based on poverty rates, malnutrition, and lack of basic services, serving 100% of the population to these communities. To start, the work is coordinated with regional and local authorities and interagency cooperation agreements are signed. The program in detail is exposed to the district and communal authorities, and the commitments and duties of the authorities and families are established.

Furthermore, a network of community promoters (volunteers) is organized at a rate of one for every 25 families, chosen by them. Then, the promoters are trained in the objectives and activities of the program, the importance of hand washing, drinking only boiled water, maintenance and use of improved cook stoves, so they can replicate

this knowledge to families in their charge and lead fulfilling commitments. In that sense, families make their bricks and materials for the process of building an improved cook stove, which is crafted in part by the same families, while the other part is made by master builders, who guarantee that these new cook stoves have the right dimensions.

When families have already built a improved cook stove and latrine, the seeds for the home garden are delivered, deworming campaign gets done, micronutrients that reinforce nutrition spread, additional items are included to encourage hygiene practices and exclusive consumption of boiled water, buckets are delivered with lid and spout, "take all" cups so that children can take to school boiled water, hygiene kits, dispensers for hand washing; and finally the families of each community who have best met these tasks and improved the “look” of their cook stove space, are rewarded. Similarly, a special recognition is also done to communities who have responded more positively.

The program gives families access to improved cook stoves which save 50% of the firewood and reduce pollution.



## SUSTAINABILITY AND CARBON FINANCING

The sustainability of the program is based on four factors: training for local and municipal authorities, developers, teachers, schools and families; coordination with health and education sectors; the formation of a network of community promoters; and a system for monitoring post-deployment.

In this regard, access to funds from the sale of carbon credits generated by the improved cook stoves have helped finance the monitoring and replacement of damaged parts, since it was necessary to replace 50,000 clay heat-resistant combustion cameras of low resistance to thermal shock, for more resistant cast iron cameras.

Specifically, in agreement with the company Microsol that has developed a system for improved cook stove to access certification and subsequent sale of carbon credits, called “Qori Q'oncha” program, which has achieved three certification processes to generate carbon credits. Furthermore, it has completed the audit of a fourth certification process and has begun work for the fifth.

All this has allowed for this 2014's Sembrando program to extend its work to 10,000 more families, with funding from the revenue generated by the carbon credits.

The program attacks comprehensively the determinants of chronic malnutrition and poverty.

# Sustainability to cope with climate change

Since the Qori Q'oncha program was created eight years ago, it has certified 100,000 improved cook stoves, which have stopped issuing 490,000 tons of carbon dioxide. This work, turned into “carbon credits” has been sold to companies committed to the environment, from which more than \$ 4,5 million have been received, primarily for program sustainability.

By Microsol team.

The Conference of the Parties (COP20) on climate change is a special time to expose the Peruvian experience on rural energy. To Microsol, after eight years of existence, it is time to take an overview. There is a lot of road traveled and many more challenges to face. The truth is that the issue of improved cook stoves has had an extraordinary development in Peru over the years and is a great satisfaction to have contributed our bit to these initiatives.

The world is becoming more and more interested in this technology, which helps to solve the many problems we face today. This is no coincidence, because energy efficiency is perhaps the fastest contributor to the fight against climate change and all related technologies, improved cooking is best destined to the most vulnerable households. It can be considered as the anchor point to achieve full access benefits to clean energy.

After eight years of implementing the “Qori Q'oncha” program, which became the first program of carbon credits worldwide, we have more than 100,000 improved cook stoves that have received annual visits to check their continued use. Therefore, they have stopped issuing more than 490,000 tons of equivalent carbon dioxide. These savings, certificated in the form of carbon credits and sold to companies committed to the environment and communities, represent a total of more than \$ 4,5 million for our partners.

Among our partners we counted on public institutions and private highlights the work of Work and Family Institute (ITYF), which is responsible for the majority of Peruvians efforts in terms of installation of improved cook stoves and has been a pioneer in carbon markets. With more than 70,000 certified improved cook stoves to date (this is no finisher) the institution has implemented, by the “Sembrando” program, an ambitious comprehensive strategy to combat chronic malnutrition; but, above all, has a long-term perspective by which, with funding from the carbon credits, has already replaced over 50,000 ceramic or cement elbow joints with other much more resistant iron ones. It is probably one of the first times in the history of social programs in Peru, that an institution returns to communities and provides a self-funded maintenance service. This maintains a renewed partnership with local governments and, of course, with communities, now that they feel more committed to the program.

Properú, the Regional Government of Arequipa through the COPASA project, the Regional Government of La Libertad, the Regional Government of Moquegua and the Regional Government of Tacna are other institutions that go along the same path by which, in the name of Microsol, we thank you very much for your confidence. The German Cooperation, implemented by GIZ, the United Nations Development Program (UNDP) in Peru and the National Training Service



The network of community promoters are organized at the rate of one for every 25 families.

## WORK AND FAMILY INSTITUTE

The Work and Family Institute (ITYF), a nongovernmental nonprofit organization (NGO) founded by Ms. Pilar Nores, has designed and implemented the "Sembrando" (sowing) program to steadily improve the quality of life, reduce child chronic malnutrition child and poverty of the high Andean population, promoting the use of certified improved cook stoves, latrines, home gardens, training in health, hygiene and nutrition; and the development of community irrigated seedlings to enhance the productivity of crops.

Beneficiaries, local authorities and community, along with a network of local promoters who are organized and able to achieve sustainability, participate actively in the implementation.

The improved cook stove takes the smoke out of the house and reduces wood consumption, which improves family health and reduces environmental pollution. Pollution reduction is measured and certified, generating a carbon credit per ton avoided by using the improved cook stove. Subsequently, the funds generated from the sale of these bonds can fund the project's sustainability and serve more families.

[www.ityf.org.pe](http://www.ityf.org.pe)

[www.sembrando.org.pe](http://www.sembrando.org.pe)



Annabelle Avril

for the Construction Industry (SENCICO) are also organizations that have contributed much to this program and we want also thank them for their valuable support. With all of them we continue to innovate, particularly developing modern monitoring systems, using numerical technologies.

This is an achievement, within the many obtained by an alliance of public and private partners, which have advanced in important and complementary topics such as building a favorable legislation to invest in improved cook stoves, a technical standard for quality assurance, an inter-ministerial leadership, an international presence in Peru in recognition of this work and a consecutive participation in major international events related to the subject.

**SUSTAINABILITY STANDS OUT**

If we highlight all of this together, perhaps the issue that is most pleasing to Microsol, is that now we all come together and converge around a fundamental point, often forgotten, that is sustainability. In this sense, we have developed a new methodology for evaluating improved cook

stoves projects, which we hope will be useful to the entire "estuferos" (stover) community, the way we are called by our Mexican colleagues. We believe that while we have had successes in the implementation of improved cook stoves, and yet missing many to be implemented (in Peru we barely cover 10% of the actual needs), we still have to work to ensure that these cook stoves are to be used properly and for a long period of time.

While we knew that there could be no sustainability without installation first, we also understood when starting our activities in 2006, that if we weren't working towards sustainability as an objective from the outset, it wouldn't succeed. This powerful message, after an initial period of installation, was on everyone's mouth. For either through the evaluation of the potential of new models to match the specific needs of new regions, the practices of good use and maintenance, monitoring of multidimensional impacts, or the implementation of a market for replacement parts, we are all focused so that the achievements of which we can be proud now, also last through time.

The use of wood for cooking becomes more efficient from use of improved cook stoves.

**THE COP20 AND A RESPONSIBLE FUTURE**

Today we can say that we are ready for more, to include more technologies within the program and thus provide quality and durable technologies for users who need it most in Peru. Opens a new path, but will have its surprises and barriers, it remains a challenge to face with enthusiasm, and with a network of committed -and hopefully also visionary- organizations.

We will also be pleased to collaborate with new institutions that have developed valuable experiences in the world and that will gather this year in Lima due to the COP20. Likewise, we hope that more and more companies join the effort to invest in the Qori Q'oncha program and to continue betting and supporting more families, growing the program. Together, taking advantage of the

international exposition offered in the COP20, we can demonstrate that we are all part of a circle of synergies, which aims to develop the country.

We also hope that the Peruvian Government will continue to engage with the dynamics of the implementation of programs based on results, without forgetting to leave a space for innovation. This is our goal, this is the change we want to see in social programs, and we are pleased, once again, to contribute in this regard.

Likewise, this is what we wish to negotiators: think long term from now and take from now what is necessary to ensure a safe and dignified future for all measures: an ambitious climate agreement that takes into account the responsibilities and differentiated realities.

The world is becoming more and more interested in this technology, which helps to solve the many problems we face today.



Until 2014, the implementation of improved cook stoves barely covered 10% of the population nationwide.

**MICROSOL**

Microsol is a social enterprise that accompanies and supports developers of appropriate energies projects, taking advantage of the opportunity offered by the carbon market to ensure its sustainability.

Its mission is to provide developers of social projects, efficient and fair access to the carbon market, in order to achieve high social and environmental impacts in the long term.

Also, the company vision is to strengthen, thanks to innovative financial mechanisms, public and private institutions dedicated to realizing human development.

[www.microsol-int.com](http://www.microsol-int.com)

# PAFE III: Electric frontier extension challenges

JICA supported this program with \$ 259 million, invested in three stages. The project included not only the installation of electricity in remote areas, but also the training of users in order that they can also use it for productive purposes.

By **Kengo Akamine**, Resident Representative of JICA Peru, and **Jesús Gibu**, Senior Sectorist from the same institution.

Japan's cooperation in Peru goes back more than 40 years ago, when the Peruvian government requested the Japanese government funding for the construction of the transmission line Lima-Chimbote for approximately \$ 16 million. To date, concessional loans to Peru amounted to 3,800 million dollars, with various sectors where they have implemented these projects: water and sanitation, road construction, irrigation, environment, installation of hydroelectric plants, rural electrification, among others.

Precisely in the field of rural electrification, JICA plays an active search for the rise of rural electrification coefficient in a joint effort with the Ministry of Energy and Mines (MEM), and regional governments. In the 90s, electrification nationwide was 56% and electrification in rural areas reached only 7%. This classified Peru in the last places of electrification level in the region.

The MEM undertook an intensive program to expand the use of electricity throughout the country, starting the Expansion Program of the Electric Frontier (PAFE), which was funded by JICA. In its first stage, the PAFE I received about \$ 93 million from Japanese cooperation, which served for the electrification of villages in twelve regions. Subsequently, JICA provided funding for the PAFE II (second stage) for an approximate amount of \$ 121 million, benefiting electrification in eight regions. Finally, with a fund of about \$ 45 million the PAFE III (third stage) was implemented that, unlike the two programs above, allowed the regional governments of Cajamarca and Loreto, to become the executioners of their own projects

as part of the decentralization process that sought the central government.

As the first and second stages of PAFE, JICA proceeded to the "Ex-Post" evaluation which, among other things, determines whether the project was "relevant, efficient, effective, sustainable and of impact". The main findings showed that the increase in the coefficient of electrification at the district level was significant, due to the development of Small Electrical Systems (SES); however, it also showed that they were short financially because their own revenues were insufficient to cover the costs of operation and maintenance, creating a serious financial problem to energy distribution companies. Also, unit energy consumption (kWh/month per user), in almost all SES, were quite small. On average, consumption was between 12 and 24 kWh/month, but in some cases even lower unit consumption of between 7 and 12 kWh/month were recorded.

Another important conclusion is that there was an orientation program or training to villagers about the benefits of using electricity and its relation to the costs of use. For example, the inhabitants of these villages did not know about the benefits of the Social Compensation Electricity Fund (FOSE), mechanism that reduces rural electricity rates by more than 50%. As a result, the perception was that most users assume that the electricity tariff was very expensive, when in fact the use of alternative energy (batteries, kerosene and firewood) is more costly and burdensome than the use of electricity supplied.

In this context, where the resident did not know of the real advantages of electric service, they chose to restrict their consumption to a minimum, reducing significantly the potential benefits generated by having an electric service. Also, this was a serious risk to the sustainability of the project.

Given these results, it was observed that people didn't know the benefits of electricity and its introduction didn't sufficiently contribute to improving the living conditions of the population, nor the development of productive activities. Therefore, it was decided to include lessons learned from PAFE I and II in the implementation of PAFE III.

## ACTIVITIES IN PAFE III

First, JICA finalized technical assistance for regional governments of Cajamarca and Loreto (area where the PAFE III is executed), with the purpose of raising the population's perception of the benefit of electricity.

The target population was identified and differentiated groups with different demands were recognized. For each group, specific strategies worked on dissemination plans, call and possible solutions. A market analysis was performed to

assess which products in the area had high demand and potential to make developments. The work was made closely with the regional governments of Cajamarca and Loreto, local governments, institutes of technology, distribution companies, among others. This interagency work enabled a better relationship with the main stakeholders of the project and facilitated the convening of meetings and carry out action plans. It was found that the population would feel more motivated to consume electricity if the messages were directed to an application for productive purposes or improvements in their living conditions.

## BARRIERS IDENTIFIED

Within the diagnosis of existing small businesses, the lack of limited electricity use was found only at night and only for lighting, and a low level of equipment awareness and machinery that could be used in their business.

## ACHIEVEMENTS

Through the use of electricity, demonstration workshops for mothers were offered, using blenders and local fruits. These workshops trained them to prepare fruit juices promoting healthy eating in regions where children have a high record of malnutrition. In Loreto there were 1,066 participating mothers and 1,260 in Cajamarca.

Based on market research in each region, practical training courses were designed to generate economic activities.

A mother is trained in textile manufacturing, after receiving electricity in her home of the Loreto region.



Youth participation in courses of home electrical installations, in order to form electrical technicians in rural areas was encouraged. The instruction consisted of 40-hour practice-oriented workshops. In Loreto 315 youth were trained and 274 in Cajamarca.

Based on market research in each region, practical training courses were designed to generate economic activities by using small electrical equipment. For the equipment selection it was considered for them to be low cost, easy maintenance and low power. Courses in carpentry, processing of cassava, rice mills, frozen fish, crafts with seeds, dairy process improvement, textile manufacturing was performed, among others.

In Cajamarca 610 people participated in workshops on productive uses, while in Loreto 669 were trained.

#### EXPERIENCE GAINED

The experience of the PAFE projects indicates that, as a fundamental part of future rural electrification projects, it requires incorporation into their training components to the population and local authorities to show the benefits of electricity and promote its productive use from the proper use of energy. JICA is committed to continue working together with Peru in the development and improvement of the quality of life of the rural population through energy use benefits, environmentally friendly.

As a fundamental part of future rural electrification projects, it requires incorporation into their training components to the population.



In Cajamarca, an artisan does work efficiently because of the access to electricity.

#### JICA, A BRIDGE BETWEEN JAPAN AND DEVELOPING COUNTRIES

The Japan International Cooperation Agency (JICA) is a Japanese government entity that assists and supports developing countries. JICA is responsible for the policy of Official Development Assistance (ODA) of the Government of Japan, based on a fair and broad perspective, from assistance schemes such as technical cooperation, concessional loans and financial cooperation non-refundable, acting in an integrated manner.

In 2012 the total ODA from Japan was approximately \$ 18,603 million, a figure that makes it one of the largest agencies of the world's bilateral cooperation. JICA has presence in over 150 countries and has approximately 100 offices abroad.

[www.jica.go.jp](http://www.jica.go.jp)

# Renewable electricity generation in the region San Martín

The project started in the community of Marisol for the use of a hydro-kinetic turbine that enabled to use the water stream to generate clean energy to illuminate the people and provide electricity to watch TV, listen to radio and recharge cellphones. The next step is to have WiFi Internet.

By Rafael Rengifo del Castillo, Manager of the Regional Department of Energy and Mines of the Regional Government of San Martín.

A strategic alliance has been decisive for the Regional Government of San Martín: work with the Energising Development (EnDev) project from the German Cooperation, implemented by GIZ. From this synergy, it has been possible to promote various energy projects of small scale but high impact for rural electrification, experiences that could be replicated nationwide.

One of the first important steps in this alliance has been developing and adopting energy management tools of medium and long range, allowing opening the way for the promotion of renewable energy for rural electrification, including, the definition of a regional energy policy, conventional electrification plans and renewable rural electrification plans.

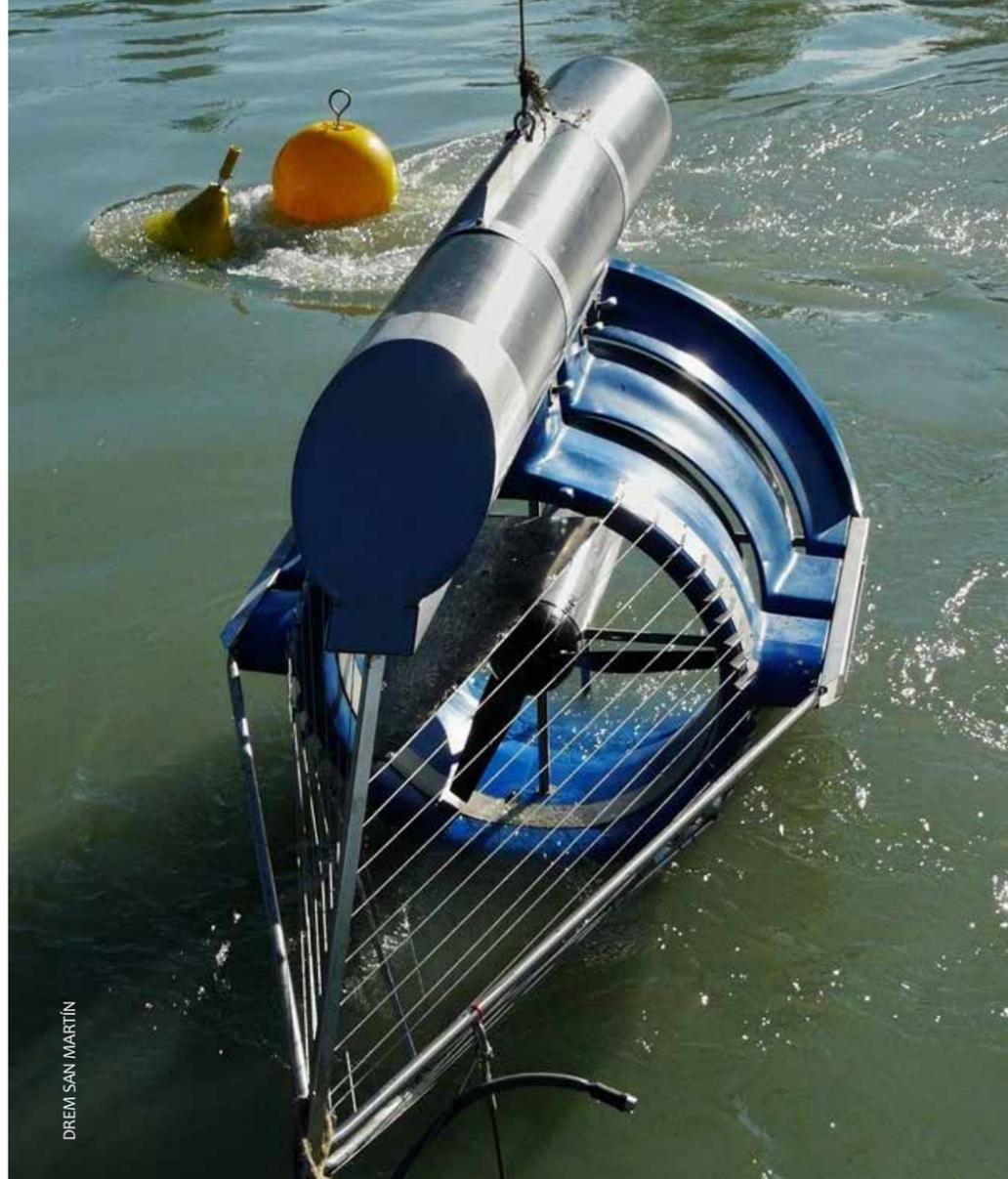
In the department of San Martín, public and private investment promotion in development projects of electricity generation have been made from renewable energy resources in small scale as an alternative to meet energy supply to population groups located in very remote areas of the urban-centers and urban-rural. In formulating the Regional Electrification Plan with Renewable Energy Resources, it was considered exploitable resources (in greater proportion) the water and sun. Therefore, hydro-kinetic and photovoltaic generation projects have been prioritized.

The Regional Department of Energy and Mines of San Martín (DREM-SM) has posted on its website management documents formulated for increasing energy coverage in rural areas of San Martín, an element that has attracted many companies willing to implement pilot projects to validate the operation of new technologies in areas with the environmental characteristics of San Martín.

One such company is the German Smart Hydro Power (SHP), which brought a proposed hydro-kinetic turbine for rivers and canals, easy to install and operate in remote areas. The DREM-SM detected isolated areas that were bordered by rivers and who met the conditions for the best performance of the turbine, the depth required for installation and proximity to the town directs connection to domestic distribution networks. In this context the village of Marisol was selected.

#### HYDRO-KINETIC GENERATION

Marisol is a town in the district of Pachiza, province of Mariscal Cáceres, on the banks of the river Huayabamba. The path for visitors departs from the city of Tarapoto, following by land on a paved road until Juanjuí City (capital of the province of Mariscal Cáceres). It is a journey that takes about two hours; and from there, Marisol has to be accessed by boat, sailing the waters of the Huayabamba for about four hours.



DREM SAN MARTIN

The hydro-kinetic turbine leverages the speed of current Huayabamba River in San Martin.

Marisol's population is engaged in agriculture, being the main crop cocoa and subsistence products; moreover, artisanal fisheries, animal husbandry and hunting of wild animals for consumption. They feature an educational institution, a community center, a church and small shops where the staples are offered. Overall, in the town more than 100 people are current residents.

Once located the town to be benefited, a cooperation agreement was signed between the Regional Government of San Martín (RGSM), SHP, the EnDev-GIZ project and the town's people of Marisol. The RGSM undertook to formulate and execute the works of distribution networks and household connections to the meter; SHP, meanwhile, took responsibility for donating, installing and commissioning the hydro-kinetic turbine equipment; and EnDev-GIZ agreed to provide support and advice on customs clearance and transportation of the equipment to the town. Meanwhile, the population agreed to contribute with unskilled labor and some places to facilitate the installation of the turbine as well as offering a powerhouse, where the generator connection with domestic distribution networks is controlled.

#### INSTALLATION AND BENEFITS OF THE INTEGRATED SYSTEM

The hydro-kinetic turbine harnesses the kinetic energy of the speed of a stream. The turbine generator set has a length of 3,13 meters, a width of 1,6 meters and a height of 2,01 meters. The generator produces an output power of 250-5000 Watts and has a rotational speed of 90-230 rpm. The tested device has a rotor comprising three blades and a hydraulic rotor with diameter of 1 meter, with a shaft coupled directly to the generator. The weight of the entire device is 380 Kg. In turn, the velocity of water in the river Huayabamba varies from 1,3 m/s (low water) to 3 m/s (strip), so that the turbine would have a generating range between 500-5000 Watts.

After two attempts in the assembly of the turbine, a final model established a system of protection for the river floods, stages which the river floods cultivated areas upstream sweeping along wooden trunks and logs that hit the turbine damaging its proper function. For this reason, in the first attempts, the turbine was hit, damaging the generating system.

After two attempts in the assembly of the turbine, a final model established a system of protection for the river floods.

However, the model currently operating in the town of Marisol, has an anchoring system to the shore and a manual protection that moves the turbine to the riverside in periods of floods with palisades, and so, after this flood it returns to normal position to continue to generate energy. To do this, the locals, who know the different events that occur in the river during the year, support it. This system requires only one person for management and operation.

Also, knowing that Huayabamba river's behavior could result in some cases to stop the turbine to generate power for the duration of the drag of the palisade, the company SHP has implemented an integrated hydro-kinetic system along with a photovoltaic generation system and a diesel generator for emergencies, in order to ensure a steady electricity supply to the population of Marisol. Under this scheme, energy supply is guaranteed by the resources of water and sun energy stored in the battery bank located in the powerhouse, who has been used for power at night. Furthermore, the system is automated (smart grid) for a dual hydro-kinetic and photovoltaic generation. In other words, the river

turbine produces the base energy, but when the energy is low to satisfy the local demand, energy is provided by the integrated photovoltaic system. In both cases, the energy produced is stored in the battery bank, which is designed to store up to 25 kWh. Meanwhile, the excess energy is dissipated through a bank of resistors.

On the other hand, besides the regular use of lighting and communications (television, recharge cell phones, radios) that gives the population to electricity, within the project the WiFi installation is programmed, which will serve to monitor the operation of the equipment remotely from Germany and providing internet service to the school of the town. Also, the DREM-SM will accompany the project providing guidance for the productive use of energy and the establishment of a management model for sustainability of the project, which must be mainly done by locals.

Currently, the electricity generation system has 31 users connected to the network, which include an educational institution, a church, six shops and 21 homes.

Currently, the electricity generation system has 31 users connected to the network.



Archive ENDevGIZ

A villager from the village of Marisol has electricity in his local shop, thanks to the power generated by the turbine.

#### REGIONAL DEPARTMENT OF ENERGY AND MINES

The Regional Department of Energy and Mines (DREM) of San Martin region, is responsible for the implementation and execution of public policy at the regional level, on sustainable development of mining-energy activities to improve the quality of life population, boosting public and private investment. It is also responsible for implementing, guide, monitor and evaluate the actions that the sector must assume, according to the functions transferred by the Ministry of Energy and Mines.

[www.dremsm.gob.pe](http://www.dremsm.gob.pe)

# Light at home, right of all Peruvians

ACCIONA Microenergy Peru has led basic energy through solar home systems to more than 15,000 people living in 3,900 dwellings in rural Cajamarca. Thus, they have improved their quality of life with a wager that also is friendly to the environment.

By Jessica Olivares Magill, Manager of ACCIONA Microenergy Peru.

Cajamarca is located in the northern highlands of Peru, at an altitude of over 3,000 meters above sea level on average, with a million and a half inhabitants, of which over 70% are below the poverty line and one of the lowest rates of electrification of the country. For this region ACCIONA Microenergy Peru (AMP) bet, since 2009, for the implementation of its Rural Electrification Program with Photovoltaic Systems "Luz en Casa" (Light at home).

Today, after six years, AMP has shown that, despite difficult environmental conditions in communities with very distant homes, with difficult paths for access, with severe weather half the year and low media access, there is a solution that is viable and proven sustainable, being a service-based approach centered in the development of citizenship rights and duties, and not creating dependency.

Since then, it has been attending a number of beneficiaries that have led to this social enterprise to achieve a balance and economic self-sustainability: 3,900 homes, more than 15,000 direct beneficiaries, including school children, and real possibilities for replication and scale under similar conditions. There are 15,000 Peruvians who have dramatically improved their living conditions by facilitating their access to basic energy by installing solar home systems, improvements in lighting quality and displacing

alternative, polluting and unsafe means such as candles, kerosene and oil, replacing by spotlights of the latest technology and allowing the possibility to load cellphone at home and use devices such as radio and television, for about four hours a day.

A private company with a social approach that has achieved in short term to take out of darkness a significant number of Peruvians postponed from Government plans. Why not think then what could be achieved if efforts will join the public administration, the private sector and civil society? Having energy in houses is a right of all, the alternative is demonstrated and it is time to set a common goal: "Luz en Casa" light for all Peruvians.

#### SUCCESSFUL MODEL

The model chosen by AMP is the cession use and collection of service fees. This means that ownership of the systems is always in the company, which gives its use to the recipient in exchange for assuming commitments and the monthly payment of a fee (regulated by Osinergmin) and ensures the safety of the equipment and its proper use. The stay current in the payment of dues ensures users the technical staff in the event of an incident in a regular period of time, and the replacement of each component at the end of its useful life.

It is a multi-actor model where the community organize themselves through a Photovoltaic Electrification Committee (PEC) and that has also promoted the development of small enterprises by forming local technicians, the same ones that attended the workshop in the installation and maintenance of the PV systems and now provide their services formally.

Communication between the actors is permanent, but mostly transparent; to comply with the commitments made by AMP has generated credibility and trust. Also comply with sanctions (outages, retirement of systems from misuse or lack of security) is essential for sustainability. Bad practices spread fast and should be cut from the start.

#### THOUSANDS OF SATISFIED USERS

A recent report on the study of "Luz en Casa" prepared by the Center for Technology Innovation in Human Development at the Polytechnic University of Madrid, commissioned by the Multilateral Investment Fund of the Inter-American Development Bank (MIF-IBD), states that "the positive assessment made by users of the service, the increase in additional income for families by reducing energy consumption and, therefore, the use of additional time for productive tasks (...) is added. Users highlight the greater availability of time and the possibility of overnight activities such as spinning, sewing, cooking and study, to have much higher quality lighting. Another benefit is notably improved health through elimination of

It is a multi-actor model where the community organize themselves through a Photovoltaic Electrification Committee.



candles, kerosene and, particularly, oil. These fuels generate eye problems and respiratory apparatus further risk of accidents”.

Also, AMP considered an additional factor: despite being people without a culture of payment for services and to be considered in the percentile of poverty and extreme poverty, the rate for delay in payment in 2013 is estimated at 0.28%, a fact reflecting the high degree of satisfaction with the provided service. In 2013, MIF-IDB conducted an experimental measurement of impact on the action by AMP. The results published

in “From candles to the light. The impact of rural electrification” shows other important aspects. “Access to electricity through solar home systems has had effects on the use of time and positive impact on children of school-age: in homes with solar panels children spend more time doing homework and this has resulted in more years of schooling (primary) and a higher proportion of children enrolled (secondary). The intervention model is affordable for customers and the generated savings cover the monthly fee for the service”.



ACCIONA MICROENERGY

A woman from El Rejo de Unaca, in Cajamarca, signs a contract with the program.

#### ACCIONA Microenergy Peru

ACCIONA Microenergy Peru (AMP) is a private initiative that began in 2009 with the intention of demonstrating the viability of isolated rural electrification by photovoltaic systems, economically sustainable and affordable to very low-income families. Today, this goal is a reality achieved through an innovative model of provision of electric service.

Currently, through its program “Luz en Casa” (Light at Home), AMP provides the public service of electricity to more than 15,000 low-income Peruvians in isolated rural communities of Cajamarca’s northern sierra and has been selected by different institutions (UNESCO, MIF-IDB, WBCSD, ARE, Global Compact, ...) as one of the best practices for isolated rural electrification.

[www.accioname.org](http://www.accioname.org)

# PowerMundo, a commercial network that reaches farther and farther

This company coordinates a network of manufacturers, suppliers and retailers to bring clean technology to families and businesses in rural communities. An example is the case of Emerson Tapullima, in San Martin, who was one of the first to sell solar lamps in his store, which has served to improve his life and those of his neighbors.

By Rubens Camposano, Communications Officer of PowerMundo.



Children of the Cajabamba province in Cajamarca, light to study with a pico photovoltaic system.

Archive EnDev-GIZ / POWERMUNDO



Archive EnDev-GIZ / POWERMUNDO

Imagine that you would always have to brighten your home with a lighter. Many people who have no access to the electric network use candles, batteries and oil as the main source of illumination, which is dangerous and hazardous to health use.

The Gómez family lives in a remote village in Cajamarca and spends about 40 soles (US\$ 15) or more for energy each month, representing about 10% of the average household income.

There are many safe products that could respond efficiently to the energy needs of rural communities and at the same time allow them to save money, improve health and preserve the environment.

The challenge is to increase distribution channels, make awareness campaigns, and develop funding options to allow many Peruvian families living the same reality that the Gómez family, to acquire healthy and products that allow to economize.

PowerMundo coordinates a network of manufacturers, suppliers and retailers to reach families and businesses that need access to this clean technology, featuring:

1. Distribution of quality and affordable products to the economy of our customers.
2. Marketing strategies that can raise awareness of innovative products and inform about their benefits for in communities.
3. Funding and business training for our agents in rural areas, as well as financial opportunities for final customers.

With this business model, innovative opportunities for rural communities open up. However, the distribution of products becomes more difficult as business networks try to get further away from the cities. This barrier is being overcome thanks to the technical support of the Energising Development (EnDev) project of

A villager shows one of the products she has brought to provide light and charge her cell phone.

the German Cooperation, implemented by GIZ, and the Renewable Energy & Energy Efficiency Partnership (REEEP), since the support from these institutions has established a distribution network in several remote communities. An example of this is the local shop of Emerson Tapullima, located in the town of Pucallpa, in the San Martín Region, where besides the staples, photovoltaic lamps are sold. Emerson has been one of the first to sell these products in his area, where the so called “Pico PV” photovoltaic systems are becoming more and more popular.

Moreover, to have more sales, he provides microcredit to clients of the community, to whom often he has even made barter for chickens or cocoa, as payment. “I want

everyone in the village have sunlamps, some neighbors do not even have lighters, living in the dark. I want everyone to live better”, says Emerson. He adds: “The business has been profitable, so I bought a bike to go further and sell more products”.

PowerMundo works directly in Peru and with partners in other countries in Latin America to increase access to clean technologies and meet the basic needs of remote areas. Lately, the company has been one of the 10 winners of the Energy Innovation Competition (IDEAS) organized by the Inter-American Development Bank (IDB). This award will help reach more communities, create new revenue streams and expand access to renewable energy.

With this business model, innovative opportunities for rural communities open up.



POWERMUNDO

The pico photovoltaic panels systems are easy to position thanks to its small size.

## POWERMUNDO

PowerMundo is a social enterprise that offers clean technology products from solar, renewable energy, friendly to the environment. Moreover, these technologies protect the health of people, replacing polluting fuels. Likewise, the products fully meet the lighting needs, communication and welfare of people who buy these equipments, which also represent a savings opportunity, being practical to use and install. All this enables disadvantaged populations to have these technologies.

[www.powermundo.com](http://www.powermundo.com)

# Solar Mini-grid in the ecological farm of Samaca

By replacing the traditional diesel pumps with an irrigation system based on solar energy and a wind turbine, in addition to expanding the area of agricultural production, these technologies have managed to save more than 30,000 liters of polluting fuel per year, which has avoided the emission of 82 tons of carbon dioxide into the atmosphere.

By **Heinrich Berg**, CEO of the company DeltaVolt.

The “Fundo” (farm) Samaca located in Ica region, between the coastal district Ocucaje and the seaside, has modernized the structure of its irrigation drip system by using a solar mini-grid, expanding their agricultural production to 50 hectares.

In Samaca there is no connection to the national power grid and the energy required is produced locally. Consistent with the objective of the farm of producing high quality organic products and in view of its excellent location, with a very favorable solar radiation, a 96 kWp photovoltaic system was installed primarily to meet the energy needs for irrigation of all the arable land.

The task of the pumps powered by solar energy is to transport the water to an elevated reservoir allowing gravity drip irrigation. The advantage of this model is that the storage of water at a certain height reduces the need to store the electricity produced in batteries.

This procedure completely replaces the diesel fuel pumps installed previously, and it is estimated that the energy produced annually is 179,000 kW. In this regard, the potential savings are more than 30,000 liters of diesel per year, thus avoiding emanate to the atmosphere 82 tons of carbon dioxide (CO<sub>2</sub>).

The installed system supplies enough electricity to run the irrigation system of the farm.

320 solar units were installed with a high output guarantee of 25 years.



DELTA VOLT

## SOLAR PHOTOVOLTAIC SYSTEM

The autonomous photovoltaic system type “isla” (isolated island) consists mainly of photovoltaic modules, inverters, controllers, chargers, batteries, and an internal distribution network. All this is interconnected via junction boxes with their fuses and switches, and annexed to a ground connection. In addition, a monitoring system continuously measures the energy generated, weather conditions, and can detect and warn of irregularities or failures.

The installation location was determined by several factors, including: the availability of the terrain, the distance to the main consumers, an area free from flooding, avoiding the shadows, minimizing the distances between components, and having adequate access and protection.

Crystalline silicon modules were selected for their long life, since they have proven reliability over decades (guaranteed 80% of the performance after 25 years of use). Also, the absence of toxic elements is another positive factor for choosing silicon modules.

An important factor to prevent energy leak, was to choose large modules, of 300 W with 72 cells, to reduce the number of wires and connections which have by themselves a reduction in efficiency.

In total, 320 modules from the company Canadian Solar, which have a good performance even under adverse conditions -including high temperatures-, were installed. Their installed capacity is 96 kWp, being certified modules (IEC 61701), resistant to corrosion in salt environments and against so-called PID (Potential Induced Degradation), this means a loss of voltage which may occur especially in humid environments.

## BATTERIES AND WIND TURBINE

Although the use of irrigation pumps is mainly during the day and the consumption of electricity generated is direct, some need for batteries is left to compensate for variations in electricity generation (e.g. because of the passage of clouds) and to have the necessary power for starting the three-phase pumps. Also, the batteries allow energy supply to other consumers of the farm, requiring lighting at night.

In Samaca there is no connection to the national power grid and the energy required is produced locally.



DELTA VOLT

It is worth mentioning that in general the batteries are the weak part in photovoltaic systems. They often have the shortest life of all components, contain toxic elements and represent a large part of the investment. And recycling is mandatory in view of environmental care.

In that sense, it is necessary to maximize battery life and change as little as possible. This involves using high quality batteries and optimizing their use to avoid extreme shock, ensure that temperatures not exceed 25° C, and load according to the parameters specified by the manufacturer.

On the other hand, it has also been advantageous to integrate to the mini-grid, a wind turbine Bergey of 7,5 kW, to establish a hybrid model, because in Samaca the wind can reach more than 10m/s and lasts until midnight.

It should be noted that system maintenance is minimal and is reduced to cleaning the panels

and control the water of the batteries. However, it is essential to regularly access the monitoring system, therefore its data is continuously recorded on a digital memory.

#### IMPLEMENTATION STRATEGY

The installation of the mini-grid was conducted in close collaboration between the Fundo Samaca, the company “Consortio Energético de Huancavelica” and DeltaVolt.

Also, the work was divided among all stakeholders, so that both the farm staff (technicians and employees) as well as all other actors were involved, and so empower the local staff for a maximum management of the system, be a participatory learning process.

Additionally, a general introduction to solar energy, as well as events and complementary training was conducted as needed, especially on AC/DC high voltage networks.



The work covered training for operation and maintenance of the system by the staff of the farm.

#### DELTAVOLT

The company Delta Volt SAC (DeltaVolt) was founded in June 2010 in the city of Arequipa, in order to help improve and diversify the energy situation in view of the large areas in Peru without access to main electricity networks. This lack of coverage represents great economic and social losses, limiting the development of many areas.

Its founders are Heinrich Berg (CEO) and Hubert Salas (Assistant Manager), being both active members of the Peruvian Association of Solar Energy and the Environment (APES) and the International Solar Energy Society (ISES).

[www.deltavolt.pe](http://www.deltavolt.pe)

# Rural energy planning for isolated areas

The experience developed in the province of San Pablo, in Cajamarca, for public and private institutions to better coordinate initiatives bringing electricity to remote populations has been very encouraging. So they have managed to identify and develop 46 projects with renewable energy that could increase electricity coverage by 44.2%.

By **Rafael Escobar, Ivo Salazar, Javier Trigoso**. Energy, Infrastructure and Basic Services Program of Practical Action, Regional Office for Latin America.

In Peru, of the nearly 30 million people, more than 3,3 million have no access to electricity services, most of them living in isolated rural areas and of low population density. This reality is expressed in coefficient of approximately 71% of electrification in rural areas. Low population, a high level of dispersion and with few economic resources, characterizes rural communities without access to electricity. Therefore it becomes difficult to be incorporated into the plans of electrification by conventional grid extension systems.

Almost two million households in rural areas use firewood as a kind of energy for cooking. In addition to these needs, especially in the Andean rural areas, people require access to heating and hot water, elements that would improve their health and reduce the number of deaths from cold temperatures they face.

There are efforts by the General Department of Rural Electrification of the Ministry of Energy and Mines (MEM-DGER), regional governments,



In several rural localities in Cajamarca, the possibility of providing electricity from photovoltaic systems was identified.

municipalities, NGOs and private companies to meet the electricity demands of the population. However, there is no common ground and sometimes these initiatives overlap. For this reason, Practical Action, in the view to providing access to energy in remote areas, has developed a process of "Participatory Energy Planning", involving governments and local leaders with beneficiary communities, getting very encouraging results.

#### RURAL ENERGY PLANNING IN SAN PABLO

San Pablo is one of the 13 provinces of Cajamarca region that expresses a sharp energy poverty and very low electricity coverage, basic requirements to form part of the process of Participatory Energy Planning, a methodological proposal that seeks to improve access to energy in areas not included in the plans of the government or private enterprises.

The planning starts by identifying the key actors in communities and on local, regional and national government. Then, an assessment of the demand and the potential available to communities from their natural resources for future application of clean technologies by renewables is made. Subsequently, a period of resource assessment to identify technologies that can be used to meet existing and future demand begins.

In parallel, an awareness program and training to families, leaders, local authorities, technicians and officials of the governments in technical, social, environmental, economic and legal aspects about renewable energy is developed.

Note that this structure is supported on broad participation of government agencies, private companies, civil society and fundamentally the same community.

Planning under the "bottom up" approach allows:

- Sort intervention agencies and organizations that promote rural energy solutions in the province (working platforms in the energy field).
- The assessment of needs and energy potential, achieving a demand profile.
- Identify local economic potential through some productive chains, from energy use to achieve improved household income.
- Design a process of technical training of local governments, so that in the future they have the responsibility to implement and monitor the implementation of the plan.
- The formulation of a program of solutions including energy costs of installation, operation, maintenance and management services to implement.



Boys in the village of Canchis, in Cusco, with a photovoltaic system installed above 4000 meters.

- Develop a financing scheme for renewable energy projects, shared between government agencies and international cooperation.

The initiative began in 2007, a period with a bleak picture in terms of access to electricity. For example, in the Tumbadén district, province of San Pablo, in Cajamarca, only 6.6% of households had access to electricity. Thus, the process has required a one-year work, which includes the methodological development and the identification of needs and energy potential in the area.

After this period, we were able to conclude the design and formulation of the energy plan to be executed in the coming years. This involved the development of projects using hydropower, solar, wind and biomass. Also, the main production chains and community services such as schools and health posts requiring electrical service were identified.

#### RESULTS AND OUTLOOK

After a job that demanded internal and external coordination with local governments and sectoral institutions as well as community work based on capacity building at the level of local authorities, it was possible to identify a set of projects using the natural resources of the area. Thus were identified and formulated a total of 46 projects with renewable energy, the same that have been incorporated into the Participatory Energy Planning. The cost is US\$ 3,344,304 and would increase the provincial electricity coverage in 44,2%.

Implementation of the plan has been possible through a partnership between local governments and international cooperation organizations like Engineers without Borders from Barcelona, the Generalitat Valenciana from Spain, Green Empowerment, Lutheran World Relief, The Christadelphian Meal a Day Fund of the Americas, the Organization of American States (OAS), together with the local governments of Tumbaden and San Pablo.



The planning starts by identifying the key actors in communities and on local, regional and national government.

The hydroelectric power plant of Conchán, in Cajamarca, is part of strategic planning for energy access in rural areas.

#### PRACTICAL ACTION

Practical Action is an organization of international technical cooperation, contributing to the sustainable development of poor populations through research, application and dissemination of appropriate technologies, being present in the world since 1966 and in Latin America since 1985.

The organization has implemented over 400 projects and works directly in over 45 countries worldwide, with offices in Kenya, Zimbabwe, Rwanda, Senegal, Peru, Bolivia, Sudan, Nepal, India and Bangladesh; and extending its work in countries in Africa, Asia and Latin America.

In Peru, his work is present in the departments of Ancash, Apurímac, Cajamarca, Cusco, Huancavelica, Ica, Junín, Loreto, Puno, Lambayeque and San. Martín, developed in close coordination with local organizations, municipalities, NGOs and educational institutions, counting supported by a variety of donors of international cooperation.

[www.solucionespracticas.org.pe](http://www.solucionespracticas.org.pe)

# Renewable energy practices in the Andean region

The EEP program is promoting 19 projects in Andean countries through tendering grants to help improve the living standards of rural people through access to clean energy. Here are four of them, demonstrating that it is possible to make significant changes.

By Nurymar Feldman and Gherson Linares, EEP Program.

Today, farmers and their families in the Andean region see their future with greater optimism thanks to access to new forms of clean energy. This was revealed by the various initiatives supported by partner institutions of the program Energy and Environment Partnership with the Andean Region (EEP) of the Inter-American Institute for Cooperation on Agriculture (IICA), showing that rural welfare through the use of renewable energy in Bolivia, Colombia, Ecuador and Peru is just around the corner, with highly surprising results. Improving the living conditions of families and greater opportunities to increase revenue by development model according to climate sustainability is promoted. Here we share some of the experiences and testimonies.

## MILK PROCESSING WITH SOLAR ENERGY

In the towns of Andagua and Huancarama, located more than 4,000 meters above sea level in the province of Castilla, region of Arequipa, Peru, the use of renewable energy for the operation of two cheese plants, has contributed to raise the level of competitiveness in the processing of dairy products in the area. This experience, which has been validated in both its technological aspects and construction, is a complete autonomous management model in the community, that could work anywhere with similar climatic characteristics.

Both plants are managed by associations of farmers who have received guidance and technical assistance from the NGO Association of Promotion and Development “El Taller” (The Workshop), thereby

increasing milk production now reaching 300 liters daily, factor that has allowed obtain an average of 35 pasteurized cheeses, for which 75% of the total energy they used was sun. These results have facilitated the increase in income of dairy producers by 10% per sale, and the application of best practices in the majority of producers, thereby avoiding the atmospheric emission of 3,46 tons of carbon dioxide per year.

Norma Quispe, a member of the Association of Producers Virgin of Occopata and worker at the plant, explains the cheese processing with the use of renewable energy: “Here we control the acidity so that the cheese does not result porous, making it down to 18°D (degrees Dornic). The milk temperature can reach 72°C by solar energy. When low to 35°C sodium chloride is added to achieve the milk curd. This is how our plant works with advanced technology, without wasting electricity. Moreover, it is free of contaminants”, says Quispe, demonstrating the technical skills she acquired and its partners working in the operation of the plant.

## SOLAR DRYER FOR COCOA

In the area of tropical crops, efficient use of renewable energies in the cocoa post-harvest has been improving grain quality through solar drying and storage systems for isolated communities in Carmen de Emero, located in the town of Ixiamas and in San José de Pelera, in the town of Guanay, department of La Paz, in Bolivia. In cases like these, the Wildlife Conservation Society (WCS) is the entity in charge

of monitoring and providing technical assistance to small farmers and rural collectors of indigenous communities such as Lecos Larecaja and Tacana, who are already planning access to special markets, which will improve their income from the sale of cocoa.

“Before we took 6-7 days to dry our cocoa, but with this technology (the cocoa) dries only in three days and comes out of good quality. Thus, little by little our cocoa is going to get better”, says Robert Luque, cocoa producer in San José de Pelera. Also, Letty Machacado, Guanay producer says: “Cocoa is my future. I'll make a living out of it with the help of solar energy”.

## ENERGY EFFICIENCY FOR PANELA

In this light, it is possible to achieve optimization of energy efficient burners to process panela (brown sugar), widespread in Colombia as natural sweetener, through the efficient use of biomass (chaff, sugar cane pulp) and waste heat recovery.

This will contribute to solving environmental and socioeconomic problems of Colombian panela agro-industry, with the support of the National Federation of Panela Producers (Fedepanela). They expect the results serve as input to replicate the experience in other panela areas of the country and of the region.

## SOLAR WATER HEATING AND MICROFINANCE

Significantly, access to renewable energy is not only useful for improving production processes, but also to achieve better living conditions. This occurs in the provinces of Chimborazo and Cotopaxi, in Ecuador. Here, the Ecuadorian Fund Populorum Progreso (FEPP) has helped improve the living conditions of hundreds of villagers living in the Andean Páramo (moorland) about 3,400 meters above sea level, through the use of solar energy to heat water for showers in schools and community centers.

Today, the use of hot water by families of the Páramo has quickly improved hygiene, an element that has contributed to a significant decrease in respiratory infections and other diseases. With these results, a line of credit in renewable energy called “Credi-Ecológico” has been launched, by the Cooperative for Savings and Credit Co-development, to implement systems of solar water heating and photovoltaic electricity generation in homes of these locations.

An essential element for promoting the use of hot water in schools from renewable energy is the participation of students and teachers. So says Edison Silva, coordinator of FEPP: “For us, environmental education is no longer just in books or movies, but part of our daily practice. Now renewables in the Ecuadorian Páramo are part of the education system”, he says.

Access to renewable energy is not only useful for improving production processes, but also to achieve better living conditions.



The production of cocoa is one of the projects pushed by a funding from EEP.



These initiatives are part of the portfolio of sample projects that the EEP Program is co-financing through a tendering regional grant fund. So far, there have been 19 projects implemented by partner institutions of the program, seeking to validate and replicate good practices to achieve significant changes that are committed to rural welfare through productive development and improvement of quality of life in the Andean region. Therefore, the program aims to strengthen such initiatives so that more communities,

farmers, and small and medium enterprises can achieve the energy benefits in the context of a fair and inclusive economy.

Thus, in order to continuing to support the market for renewable energies in rural and peri-urban areas, the EEP Program is going to launch in late 2014 a new tendering call for a Regional Fund, to support new business initiatives that promote the energy value chain with direct impact and potential for replication in different areas of the region.

Isidro Aguilar and Flor Renilla show cheeses produced in the town of Andagua, in Arequipa, from the use of renewable energy.

## EEP

The Energy and Environment Partnership with the Andean Region (EEP) of the Inter-American Institute for Cooperation on Agriculture (IICA), with funding from the Ministry of Foreign Affairs of Finland, has been working in Bolivia, Colombia, Ecuador and Peru since early 2011.

Seeking to improve the quality of life of vulnerable populations to climate change in the Andean region and that also live in scattered and inaccessible geographical areas, the EEP Program works in improving rural habitat for families to improve their living conditions through the renewable energy use in homes, schools, health centers and other services. It also focuses efforts to promote productive development, supporting local enterprises that promote renewable energy technologies and services, which are used to enhance the value chain of products with market demand.

[www.AEAAndina.net](http://www.AEAAndina.net)

# Ecoefficient practice of artisanal brick makers

The Cusco community of San Jerónimo learned that using appropriate technology for artisanal brick production not only reduces pollution, but also gets them better results and thus increases their profits, improving in this way their quality of life.

By Swisscontact team.

Ismael Orcocohuaranca Huaman, owner and president of the Association of Producers of Bricks and Tiles "Sucso Aucaylle" in the district of San Jerónimo, Cusco, was the first brick maker in the town to build a downdraft furnace with the aid of the Program (EELA). He has also been a pioneer in the use of fans for furnaces. These actions have led to improved production and make it more efficient.

"The downdraft furnace allows the fire and hot gases to stay in the combustion chamber as long as possible; which better distributes the heat and helps produce more uniform batches. I have reduced the cost of production. Before 1,200 soles (US\$ 410) were spent on production, now with improved technology, only the half is spent. In addition, the downdraft furnace needs just 480 soles (US\$ 165) in fuel", Ismael says.

He recognizes that the quality of its products has improved. "In the downdraft oven I have no losses of bricks and they all come out uniform, with the same color. Besides, the bricks have been reviewed by the National Training Service for Industry and Construction (Sencico) and they complete the requirements to be used in construction".

"Before, for every 3,000 blocks sold, my income was 1,200 soles (US\$ 410). Now, I can make 1,800 (US\$ 620). With these gains I could improve conditions for the education of my children. Three of them are professionals and the last is prepared for college. I purchased a vehicle for my mobility, I converted the extruder to a higher capacity model, installed a groundwater catchment for my bricks,



and have modified and improved the rest areas", he adds.

With the adoption of this technology, San Jerónimo now has a leading role in the Technical Bureau of Brick Makers, where they discuss environmental issues and topics of interest to producers. "Knowing that we as bricks makers are part of the change makes us proud. We were visited by other brick makers from various regions of the country and even from Ecuador, Bolivia, Mexico and Central America. They specifically saw the work I did in my oven, how to use the fan, and how to cook without producing smoke", says Ismael.

Artisanal brick makers in the district of San Jerónimo, in Cusco, have been able to modernize their operation thanks to an initiative by Swisscontact.



Finally, in relation to climate change, he emphasizes: "I am very happy with the intervention of the EELA project because not only are we improving our production with the use of more efficient technology, but also helping to reduce pollution generated by our bricks by reducing greenhouse gases".

**THE PROGRAM EELA**

In Peru, the production of handmade bricks made through traditional means lacks efficiency. The production uses fuels that have a high environmental impact with low energy efficiency. This contributes significantly to emissions of greenhouse gases (GHG), air pollution and deforestation. Additionally, brick makers are informal, not identified by the State, and are excluded from public policy.

Moreover, the situation exemplifies the economic and technological barriers that the brick makers face, such as lack of access to formal credit and lack of appropriate technology. Despite these problems, this sector is an important activity that creates jobs. It is estimated that there are over 2,000 artisanal brick makers that generate between 30% and 50% of national output, emitting about 730,000 tons of carbon dioxide every year. In this context comes the program "Energy Efficiency in Artisanal Brick Makers of Latin America to mitigate Climate Change" (EELA), financed by the Swiss Agency for Development and Cooperation (SDC) and executed by Swisscontact in seven Latin American countries.

Given this reality, the overall objective of the EELA program is to contribute to climate change

The production of bricks through appropriate and efficient technologies reduces the environmental impact of this activity.

mitigation and improve the quality of life of artisanal brick makers through the promotion of appropriate and energy efficient technology in artisanal brick ovens.

Technology certified by Swisscontact allows a reduction in fuel consumption and GHG emissions by 30%; and increases revenue by about 10%. It

also influences relevant organizations to assume policies that promote integrated management models in energy efficiency, appropriate to the conditions of artisanal brick makers, and which are in line with national regulations. By building capacity amongst the brick makers, they are able to enjoy higher profits and improve the quality of their lives.



With the adoption of this technology, San Jerónimo now has a leading role in the Technical Bureau of Brick Makers.

This technology guarantees successful learning experiences which are later sought by other brick makers in the region.

**SWISSCONTACT**

Swisscontact was created in 1959 as an independent foundation by famous Swiss scientists and economists. It is dedicated exclusively to international cooperation for development and conducts its own projects and is commissioned by international donors. Since its inception, it has had a close relationship with the private sector.

Their projects are based on sustainable growth, driven by an innovative private sector, improving incomes in less developed areas, and involving disadvantaged people as active participants in the market.

Swisscontact's work focuses on four main areas: vocational training, promotion of small and medium enterprises, financial services, and efficient use of resources. Thus, Swisscontact creates favorable conditions for entrepreneurship so that the private sector -as a pillar of all development- is competitive, socially responsible, and respectful of the environment.

[www.swisscontact.org.pe](http://www.swisscontact.org.pe)

[www.redladrilleras.net](http://www.redladrilleras.net)

# Renewable energies for Peru from CER-UNI

Since its inception at the beginning of the 60s, the institute has participated in the development of a large number of research projects designed to bring sustainable energy to remote Andean communities.

Por Rafael Leonardo Espinoza Paredes, General Director of CER-UNI.



The center does investigations to optimize the implementation of renewable energy technologies in Peru.

Since 1980, the Centre for Renewable Energy and Rational Use of Energy, from the National University of Engineering (CER-UNI) conducts research, develops, manages and administers projects. Additionally they promote, train, and advise other similar activities, making renewable energy technologies available to the people of rural Peru. It also conducts evaluations of technical and economic performance, experimental analysis, energy audits, preventive and corrective maintenance of renewable energy technologies, and develops relevant educational material.

The center's main purpose is to promote the use of renewable energy through the development of appropriate technologies. To promote these technologies involves doing basic Research and Development (R&D), as well as promotion, training, dissemination, and technology transfer.

Furthermore, within their vision is to be the national governing body for development, innovation and transfer of science and technology in the field of renewable energy, efficient use of energy, and related branches. Being committed to the development of the country and promoting the use of renewable energy technologies through research, development and technology transfer is its mission.

The CER-UNI is organized on the basis of the existence of three activity lines that are available to those who are required to implement solutions: 1) Research, development, innovation and technology transfer. 2) Studies, projects and services. 3) Promotion, dissemination and diffusion. The center conducts research to optimize deployment of renewable energy in Peru.



CER-UNI

It does this through a team of skilled professionals and with the help of students from UNI and other universities such as Jorge Basadre de Tacna; San Cristobal de Huamanga (UNSCH) of Ayacucho; San Antonio Abad (UNSA) of Cusco; and San Agustín (UNSA) of Arequipa. Furthermore, the center coordinates the use and development of infrastructure required for activities that align with the goals and objectives of CER-UNI.

## MAIN ACTIVITIES

1. Special courses in solar energy.
2. Participation in conferences and symposia in the national and international field of physics, mechanical engineering, and renewable energy.
3. Active participation in the Ibero-American Science and Technology for Development Program (CYTED) through thematic networks and projects.
4. Development of projects of applied research, innovation, and technology transfer.
5. Promotion of regional organizations for research and technological development of renewable energies.
6. Various publications associated with their activities.
7. Professional services in specialized development and evaluation of technology for renewable energy projects, particularly solar; verifying the technical specifications

for components of photovoltaic systems and certification of their performance; studies of energy efficiency for family, commercial, public and industrial use environments.

## GOALS FOR THE NEXT FIVE YEARS

1. Prioritize the research and development in solar photovoltaic, photo thermal, wind, and biomass applications.
2. Effectively design and manage research projects, development and innovation, and information and transfer of renewable energy projects in the field.
3. Contribute to the development of the market with activities to promote use of renewable energy sources and technologies.
4. Have a laboratory equipped and certified to test components and systems that harness renewable energy.
5. Contribute to the training of students in renewable energy careers, employing them in pre-professional training, and coordinating the delivery of courses in universities.

## MAJOR PROJECTS

1. Sustainable Electrification in Isolated Rural Communities, with the aim of increased productivity in the communities of San Jose and San Francisco Aunt of Raymina in Ayacucho (OEA 2004 - 2008).

Making wool mattresses for insulation in the community of San Francisco de Raymina, in Ayacucho.

The center's main purpose is to promote the use of renewable energy through the development of appropriate technologies.

2. Thermal Comfort in Housing Communities located between 3,000 and 5,000 meters (FINCyT 2008).
3. Implementation of multi-output Educational System in the community of San Francisco de Raymina in Ayacucho (GVEP 2009 - 2011).
4. Research Project CYTED, Renewable Energy and Information and Communication Technologies for Ecotourism in protected areas in Latin America, under the direction of Miguel Egido from UPM and in partnership with 10 Latin American groups (2011-2014).
5. Applied Research Project and Interconnection in Behavior and Testing of a photovoltaic system of 3.5 kW to Internal Network Power Consumption of CTIC-UNI (CER UNI 2012-2013).
6. Emerging with the sun. Developed with the University of Jaen in Spain (2013- 2015).
7. Technology transfer to face extreme weather events transforming a high Andean rural community in a sustainable production system with renewable energy (CONCYTEC-FONDECYT 2014-2016).

It does this through a team of skilled professionals and with the help of students from UNI and other universities.



The center started a bioclimatic touristic guesthouse as part of an applied research project.

### The CER-UNI

The National University of Engineering (UNI) started its activities in the field of solar energy in the early sixties, operating under the framework of the former Institute of Energy of the former Faculty of Mechanical and Electrical Engineering. This activity was cut short in 1969 and subsequently resumed UNI research and development in their former Departments of Physics and Mechanical Power, forming a research department in each one.

The Centre for Renewable Energy and Rational Use of Energy from the National University of Engineering (CER-UNI), was created in 1986 using this 20 years experience and took shape as a multidisciplinary research program in the field of renewable energy and rational use of energy. From 2000 to date, CER-UNI has been researching renewable energies and energy efficient technologies.

[www.cer.uni.edu.pe](http://www.cer.uni.edu.pe)

# Thermal comfort for households in cold climates

The community of Orduna, Lampa, at 4650 meters, has been chosen as a model to determine the best way to build safe and healthy homes using local inputs that protect the environment to achieve economically sustainable results.

By **Sofía Rodríguez Larraín**, Professor and Researcher of the Department of Architecture of the Pontificia Universidad Católica del Perú (PUCP) and Coordinator of Earth Center INTE of the PUCP.



The research looks to improve the architectural conditions of homes in rural Andean regions.

Andean rural housing and improvement of habitats are now priorities of the Peruvian Government. The National Council for Science and Technology (Concytec) through competitive financing, solicits university researchers seeking proposals for scientific studies.

The study team consists of researchers who specialize in rural architecture, bioclimatic design, and engineering from the Departments of Architecture and Engineering, and the research group Earth Center INTE of the PUCP. The initiative has been one of the winners of the convocation in 2013: "Technologies to face extreme weather events in highlands".

The project started in February 2014 and will end in January 2016. The Concytec funding amounts to 500,000 soles (US\$ 172,000), with PUCP contributing 233,000 soles (US\$ 80,000). It also

has the participation of the Peruvian Ministry of Housing, Construction and Sanitation, which plans to implement the proposed solutions.

The research team's proposal is based on improving comfort and safety through the study and development of construction techniques applied to different elements of rural housing. For technology transfer is planned to be a training of "technical promoters in safe and healthy housing" as well as the formation of local enterprises which will carry out the proposed solutions.

To do this, knowledge of the existing conditions, culture and local construction techniques is needed, as well as projections and desires of the new generation of inhabitants of the highlands. Heirs to the community tradition will be confronted to global challenges and to the consequences of climate change.



**GENERAL FRAMEWORK**

Poverty, extreme poverty, and dispersion generate a rural population which is highly vulnerable to social problems and climate change, that generates extreme events such as frost and cold fronts, with the Andean localities above 4,000 meters hardest hit. According to the Population Census of the Peruvian National Institute of Statistics and Informatics (INEI) of 2007, 35% of the housing stock in rural areas (653.082 dwellings) have deficiencies in the quality of housing due to the materials with which they were built (walls, ceilings and floors), overcrowding, and the lack of basic services (water, sewer and electricity).

The experimental field research project is being carried out in the community of Orduña, in the province of Lampa, department of Puno, at an altitude of 4650 meters, part of the highland natural region called “puna” and in the border to the “janca” natural region. This region is classified as a "cold tropical highland climate". The rugged terrain, high altitude, proximity to the equator, and distance from the ocean, creates a rugged, windy and very cold, climate on winter nights.

The economy is based on raising alpacas which are used for their meat and fur coats. Most families own a plot of grassland, between 50 and 300 alpacas, and one or two rustic cabins built of stone and mud with tin roofs, whose occupancy varies throughout the year depending on breeding of the alpacas. They are isolated, very rudimentary houses with structural, thermal and spatial deficiencies without electricity, water or

sanitation. In addition, each family has a room in Orduña where community meetings take place.

The pastoralists tend to move toward the nearest villages of Pinaya and Santa Lucía, the district capital, and to Juliaca, due to the need to educate children, trade, and find additional jobs for the family, such as mining or construction.

**RESEARCH PROJECT**

The research has focused on the study of building techniques, conducting surveys in five different cabins, where measurements of surface of the indoor and outdoor temperature were taken, which allowed to better understand thermal performance. The results obtained clearly show that, despite the existence of internal gains due to the presence of people, the temperature values in the bedrooms are between 0-3°C, and that heat losses are due mainly to the poor insulation materials, their high conductivity, and poor air seal. Thus, the earthen floor and roof of corrugated tin are the main elements through which heat is lost by conduction. The stone wall, although a large mass, is not being a good insulator (average thermal conductivity of 1,53 W / m°C).

General guidelines of intervention would suggest insulating the ceiling with light insulating elements, hermetically sealing the building, waterproofing and adding insulating elements to doorways and windows, and incorporating insulating elements to the walls to elevate the internal temperature.

The rural population above 4,000 meters is highly vulnerable to climate change. Their main activity is raising alpacas.

This investigation seeks to develop a method of transferring and applying bio-climatic and earthquake resistant technologies for homes in the high Andes.

The project includes the addition of natural heat capture systems like skylights or the like, and reducing nighttime ventilation through underground ducts. The insulating materials used for the experiment are made from locally sourced materials like totora (reeds from Lake Titicaca), mud, straw (ichu), and sheep’s wool.

As for earthquake prevention, the buildings will be reinforced with ring beams at the tops of the walls along with synthetic mesh screens. The new earthquake resistant technology was generated by teams at PUCP.

**CONCLUSIONS**

This investigation seeks to develop a method of transferring and applying bio-climatic and earthquake resistant technologies for homes in the high Andes. With the formation of “technical promoters of safe and secure homes” and the support of the Ministry of Housing, it is hoped that the improvement of rural housing, security, and health will permit the initiation of local business ventures around the manufacture and application of validated technical solutions.

**EARTH CENTER**

Earth Center (2013) is a multidisciplinary research group belonging to the Institute of Natural Sciences, Land and Renewable Energy (INTE) of the Vice-rectorship for Research of the PUCP, which is attached to the Department of Architecture and Urbanism of the university.

The group is dedicated to the investigation of Earth Architecture in regards to its cultural, technological, and social aspects. Being a member of the UNESCO chair of Earth Architecture, Constructive Cultures and Sustainable Development, they promote the use of local resources for education and research.

One of the main objectives is reducing risks in the home and to develop research projects and spread knowledge through training workshops, talks, and university education.

**RESEARCH TEAM**

**Architects:** Mercedes Alvaríño, Silvia Onnis, Martin Wieser, John Reiser, Susana Biondi, Cecilia Jiménez, Rocío Castillo. **Engineers:** Julio Vargas Neumann, Carlos Sosa. **Thesis:** Silvana Loayza, Frederique Jonnard. **Internships:** Leticia Rodríguez Portugal, Alan Vela, Alberto Bautista.

[www.inte.pucp.edu.pe](http://www.inte.pucp.edu.pe)

# Technological innovations in renewable energy for the rural sector

The Support Group for the Rural Sector promotes the development of energy projects, for both domestic and productive use. The "River-generators PUCP", working in rural electricity generation and the "Warm Clean Houses", which aims to solve the problem of frost in the highlands, are two interesting examples.

By Miguel Hadzich, Coordinator of GROUP PUCP; Sandra Vergara and Jorge Soria, Researchers of the same unit; and Urphy Vásquez, Coordinator of the Research and Projects Area of INTE PUCP.



One of the technologies applied by the research team was a linear solar concentrator for tea production.



The River-generators PUCP are an alternative for electricity production in rural Andean communities.

Since 1992, the Rural Sector Support Group (GROUP PUCP), an operational unit of the Department of Engineering and member of the Institute of Natural Sciences, Land and Renewable Energy (INTE PUCP), has been carrying out development projects for rural communities related to applied scientific research, technology transfer and innovation, dissemination and promotion of appropriate technologies, and activities of environmental conservation. The GROUP PUCP's main objective is to improve the lives of the rural population of Peru in regard to energy production and housing.

In recent years, the unit has also focused on developing applied research projects based on renewable energy for productive uses, including two emblematic household technologies that aim to raise the quality of life of families in the rural sector of Peru: the "River-generators PUCP" for rural electricity generation and "Warm Clean Houses" to solve the problem of frost in the highlands. Next, four technological innovations will be presented, two of them in the field of productive uses and two in the field of domestic use.

## SOLAR THERMAL ENERGY FOR PROCESSING BLACK TEA IN CUSCO

The project seeks to meet the energy demand for a black tea processing plant, which today uses firewood and get the heat necessary for the process of drying because they are not able to access other fuel sources in the area.

A pilot plant with linear parabolic concentrators that heat the air that travels inside the black tube has been installed. This air is then injected into a drying oven at a temperature of approximately 100°C. The pilot plant and processing plant will work as a hybrid system reducing the amount of firewood consumption by 10-15%. The concentrators have a solar tracker to maximize efficiency and heat

during the day. The complete technology has been produced in Peru.

This applied research project has been developed in coordination with AGROINKA SAC, with funding obtained through the Fund for Research and Development for Competitiveness (FIDECOM).

## SOLAR CHOCOLATE: AN ALTERNATIVE FOR THE DISTRICT OF HUYRO IN THE REGION OF CUSCO

This project proposes a novel technological development as it looks for a way to process cocoa using only solar energy (thermal and photovoltaic) which would make it an ecological friendly process. The plant has machines designed to select, peel, and grind. The plant has also a Scheffler solar condenser for the toast process with an area of 8m2, which can reach temperatures of 400°C.

It is intended to be an alternative to cacao farmers in the Peruvian jungle so they can give an added value to their products. Also, it allows for them to better take advantage of the nutrients which the cocoa has to better feed their children.

The applied research project is being funded by the Fund for Innovation, Science and Technology (FINCyT) in order to disseminate and promote the technology wherever cocoa production exists.

## RIVER-GENERATORS PUCP

Currently, many rural areas of the country do not have electricity. The River-generator PUCP is a technology based on a traditional design of waterwheels using modern materials and manufacturing processes, which harnesses the energy generated by streams, canals, or rivers for household electricity. The generator will transform the wheel's movement into electrical energy, which is stored in a battery for eventual transfer to households.

The unit has also focused on developing applied research projects based on renewable energy for productive uses.

The project "System of energy interconnection with River-generators PUCP in Andean rural communities" is a proposal of GRUOP PUCP, with funding from the European Union, which will benefit more than 700 families in 32 communities of Cusco and Huancavelica with electricity for household use.

**WARM AND CLEAN HOUSE K' OÑICHUYAWASI**

The K' oñichuyawasi initiative is a set of technologies suitable for rural housing: hot walls, improved cook stoves, and roof insulation systems for frost protection in high Andean areas.

The hot wall is a special lined plastic structure placed outside the housing, which works like a greenhouse. This technology receives sunlight which it converts into heat, allowing warm air to enter the house through holes at the top, and returning the cold air through the bottom holes.

The improved cook stove efficiently uses firewood or dung to maximize the circulation of hot air to cook and expels the smoke from the home.

The insulation system has a roof composed of a screen with a layer of plaster, which serves to keep the room warm, which complements the refraction of doors and windows to prevent heat from escaping the home.

It is estimated that the implementation of these technologies can increase the temperature of the home up to 10°C and greatly reduces indoor air pollution which equates to a substantial change in the lives of the inhabitants.

To date, more than 600 families, as well as schools and hospitals, in rural areas have benefitted from the project. Financing has come from Christadelphian Meal a Day Fund of the Americas, International Federation of Red Cross Societies, Starbucks Foundation, Youth Foundation, ONG Salgalú and the Academic Department of Social Responsibility (DARS) of the PUCP.



Researchers test the efficiency of a parabolic solar concentrator for cacao production.

**GROUP PUCP**

The Rural Sector Support Group (GROUP PUCP) is an entity of the Department of Engineering and is a board member and executive of the Institute of Natural Sciences, Land and Renewable Energy (INTE) from the Pontifical Catholic University of Peru (PUCP).

INTE is a research institute and promoter of sound environmental practices along with renewable energy. It was created on March 7, 2011 and comes from the integration of three entities that have a wide array of experience in environmental topics: The Institute for Environmental Studies (IDEA), founded in 1994, the Center for Applied Geography (CIGA), formed in 1984, and the Rural Sector Support Group, formed in the year 1985. INTE is assigned to the Office of Research of the PUCP and is currently comprised of 18 research groups.

[www.inte.pucp.edu.pe](http://www.inte.pucp.edu.pe)

[gruporural.pucp.edu.pe](http://gruporural.pucp.edu.pe)

# Traditional cook stoves, where health and the environment are at stake

Until March more than 340,000 improved cooks stoves were installed across the country. In addition to improving health, they also reduce environmental pollution.

By **Roberto Accinelli Tanaka**, Director of the Institute of High Altitude Research and Professor of the Alberto Hurtado Faculty of Medicine, Peruvian University Cayetano Heredia.



The collection of firewood is traditionally done by women who suffer from smoke inhalation by using artisanal cook stoves on a daily basis.

One of the things that exacerbate the greenhouse effect is the use of traditional cook stoves which use combustible biomass. They don't just deprave natural resources but they also increase greenhouse gasses by eliminating trees which serve to capture carbon dioxide emitted to the atmosphere.

When we had the opportunity to interview residents in rural areas of Peru, the common response was: "No! Those trees that you see doctor, my dad had those and my grandfather too! There are plenty! They will never go away!" It is impossible to encourage these people to use another type of energy, and they add: "The wood gives the food a rich flavor!"

When we have sought to implement improved cook stoves in Peru and other countries in the southern hemisphere we have enjoyed little success due to regional and national authorities' failure to see such a project as an effective way to combat climate change.

In Peru, the situation began to change when our group won in 2005 the "Gold Pacific Award for Development and Medical Research" from the research project "Effects of biomass fuels in the respiratory system: Impact from the chance to improved cook stoves", as the best paper published in a Peruvian medical journal during the previous two years. The spread of the problem in the mass media of the country, and its simple solution, allowed the leaders of civil society to take an interest in the situation.

In this study, funded by the German Cooperation, implemented by GIZ, we assessed the first improved cook stove model designed by engineer José Bernilla, with support from GIZ and built in homes in the community of Ayamachay, Inkawasi district, province of Ferreñafe, department of Lambayeque. Besides, GIZ economist Klas Heising was a key player in proposing this solution.

**IMPROVED COOK STOVES AIM THE PUBLIC OPINION**

Later, in the year 2006, Pilar Nores Bodereau, president of the Institute Work and Family (ITYF), launched the program "Sembrando" that works to improve the economic and social situations of families in extreme poverty that live over 2,500 meters.

The program, among other elements for families in rural areas, includes the Inkawasi-Sembrando improved cook stove model. Additionally, Sembrando presented a successful Peruvian telethon where Peruvians could see the damage cause by traditional cook stoves and the benefits of the improved cook stove model.

With the participation of many different entities of Peruvian society, the campaign "Half a million improved cook stoves for Peru without smoke" was launched. It closed in December 2011 with 225,575 improved cook stoves installed and certified by the National Training Service for Industry and Construction (SENCICO), promoting a total of 22 different models of improved cook stove, which reduced from 90 to 98% the levels of indoor air pollution by (CO and PM2.5) and a 30 to 62% reduction of firewood use. This campaign was awarded 1st place at the international Partnership for Clean Indoor Air conference.

The installation of improved cook stoves has continued and by March 2014 the number has reached 340,632. In addition, the program

Sembrando installed around 100,000 cook stoves which are estimated to save the emission of 1,5 to 2 tons of carbon dioxide each year. Therefore, ITYF was the first NGO in the world to receive carbon credits as a result of their work with improved cook stoves.

**A THREAT TO HEALTH AND THE ENVIRONMENT**

When our group began working more than 30 years ago to combat the negative effects of traditional cook stoves, we thought it was a problem without an immediate solution.

Upon being interviewed, one in two men and more than 60% of women who use traditional biomass would say that they are sick. This is because the biomass particles are suspended in the smoke, which then enters the lung, where the defense cells (macrophages) incorporate them and end up triggering the release of numerous products which causes severe inflammation. This explains why children have sleep apnea, and why adults have cardiovascular diseases. There is a whole range of threats to human health: respiratory infections, asthma, chronic obstructive pulmonary disease (COPD), cancer, tuberculosis, conjunctivitis, cataracts, burns, and dermatitis.

It was rewarding, but at the same time excruciating to listen to the words of one old woman who received one of the first certified improved stoves installed in Peru: "Thanks! But why did you guys not tell me before about these cook stoves? I don't cry,

Traditional cooking methods can generate harmful effects for people's health and the environment.

don't cough, and my nose doesn't itch". In all the studies that we have conducted, we found the same thing: Symptoms associated with diseases diminish or disappear.

**A PROGRESSIVE CHANGE**

It is important to mention that for poor families living in the outskirts of cities, the cost of the wood is very high, as they pay up 40 soles (US\$ 14) monthly, while in rural areas the cost is related the time spent collecting it. Therefore, for people in urban areas, it is easier to subsidize the use of gas, which is cleaner and less harmful to people's health. This is exactly what is being implemented by the Social Inclusion Energy Fund (FISE) "Cook Perú", whose goal is to

benefit 700,000 families with a two burner liquefied petroleum gas (LPG) stove and subsidized their gas.

Today, Peru can proudly display the change from traditional biomass stoves, to improved cook stoves, progressively being made throughout the entire territory. Finally, it is worth mentioning that we have presented an experience in which we have collaborated with national authorities, regional and local, as well as all civil society organizations with their research on damage caused by traditional stoves and the benefits that improved cook stoves or LPG bring. In addition, we can add that to the average citizen, health is more important than environmental degradation.

Our group began working more than 30 years ago to combat the negative effects of traditional cook stoves.



Respiratory problems are one of the diseases that populations exposed to excessive smoke suffer from.

**INSTITUTE OF HIGH ALTITUDE RESEARCH**

The Institute of High Altitude Research (IIA) was started with the Peruvian University Cayetano Heredia on 22 September 1961. Its first director was Professor Alberto Hurtado, winner of Houssay Prize of the Organization of American States (OAS). The IIA focuses its research on the influence of altitude on biological, physiological, clinical, psychosocial and epidemiological processes.

The institute was a pioneer in Peru to study the damage caused by traditional biomass stoves and how it is reversed when improved stoves are installed. Its contribution of benefitting the lives of people at high elevations is reflected in over 1,000 publications. Its members have won several awards, as Dr. Eduardo Pretell, who received the Reina Sofia and the Abraham Horwitz Award for his work, which allowed the eradication of endemic goiter.

[www.upch.edu.pe/upchvi/iaa](http://www.upch.edu.pe/upchvi/iaa)



IIA UPCH

# Green microfinance for access to energy

With the support of partner institutions, in 2010 two microfinance companies in various regions of Peru are promoting microcredit for the purchase of green, environmentally friendly energy that can be applied both to homes and businesses.

By **Carla Palomares**, Project Manager (ADA), and **Ángel Verástegui Gubler**, Renewable Energy and Microfinance Advisor of the Energising Development Project (EnDev Peru) of the German Cooperation, implemented by GIZ.

Touristic guesthouses in the district of Chivay, in Arequipa, have access to solar water heaters through microfinance.



ADA / FELIX SORGER

Villagers can come to local microfinance agencies to manage the acquisition of green technologies.

In Peru, about three million people (about 10% of the population) have no access to electricity, a situation even more critical in rural areas, where 30% are in this predicament and almost a third of the population uses wood for cooking, especially in the areas above 3800 meters. This energy gap, besides being a hindrance on social development, is extremely harmful to the environment.

On average, a family cooking with traditional stoves consumes about 10kg of wood per day, emitting the equivalent of two tons of carbon dioxide (CO<sub>2</sub>) to the atmosphere each year. Also, a family without access to electricity uses on average five gallons of diesel to light traditional lights, which equates to burning nearly two million gallons every year on a national level, an amount that could take you around the world 2,500 times in a car.

Faced with this urgent need to energize populations left in the dark at an affordable cost while respecting the environment, microfinance institutions (MFIs) play a fundamental role as they have key advantages to help reach the target population: they have extensive network in rural and urban areas, they know the needs of low-income people and have experience proposing tailored financial products. In this case, this specific offer consists of microcredit which encourages the use of technologies that work based on renewable energy or which are energy efficient.

## FIRST EXPERIENCES IN GREEN MICROFINANCING IN PERU

Since 2010, the Luxembourg NGO Support for Autonomous Development (ADA) in collaboration with the Energising Development Project (EnDev Peru) of the German Cooperation, implemented by GIZ, and German consultant MicroEnergy International (MEI) which offers technical support, began an initiative that facilitated

through microfinance the purchase and use of green technologies.

Giving financial and technical support to two Peruvian MFI, Fondesurco and Caja Huancayo, financial products are offered that allow the acquisition of environmentally friendly technology, such as solar water heaters, improved wood-burning ovens and solar coffee dryers.

To do this, we worked with a model through which MFIs and technology providers establish a close relationship where each has specific roles and interests where both are satisfied. MFIs develop the business model, from identifying suppliers, customers, and adapting to meet the needs of those people and technologies, as well as design and delivery of tailored financial products. Technology providers provided quality equipment and ensured supply chain logistics (distribution, installation, maintenance and after sales service).

Since clients credit payment depends on the proper function of technologies, MFIs monitor the process to ensure the quality of service provided. To do this, a specialist trained within each MFI, evaluates these green technologies that can be offered through microcredit. Also, providers are constantly coordinating with the MFIs for a proper running of the supply chain.

The MFI and provider work together to boost demand for these technologies, because if it is true that these products meet the needs of customers, they are not always integrated directly to local customs, especially in rural areas. Therefore, one of the key factors for success are campaigns for potential clients and training of business advisors in MFIs, so that depth knowledge of the technology and its benefits can be brought to the microenterprises, showing that the quality of life of families is improved as well as the environmental care.

In conclusion, with the development of "green microfinance", both sectors, the microfinance one and the responsible environmental technologies, move forward within the country. MFIs gain by diversifying their product portfolio and developing an innovative corporate image that cares for the quality of life for their customers. They also position themselves at the forefront of institutions responding to global trends for investors who seek MFIs with a comprehensive performance in financial, social and environmental sectors. Similarly, providers of these technologies are faced with an opportunity for growth and consolidation of their companies. By taking advantage of promotion and distribution channels, MFIs manage to reach a population previously unaware of such products and who are now aware of a new alternative for their needs.

#### THE CHALLENGE OF SUSTAINABILITY

Green microfinance represents an opportunity for both actors (MFI and suppliers of technologies), to develop a seamless interface between the technological supply and the microfinance sector, reaching spots that can transcend specific capabilities and responsibilities of both parties.

One of the biggest lessons learned is how fragile the chains that deliver this type of technology are. Although this new market has ample opportunities, often they do not yet have the logistical capacity to meet the demand and be efficient.

Moreover, developing a "green" financial product and having the tools necessary for promotion, sales and monitoring takes time. Therefore, the institutions ADA, EnDev-GIZ, and the Consortium of Private Organizations to Promote the Development of Small and Micro Businesses (COPEME), saw the necessity to develop a "green unit" (administered by COPEME), to provide specific services to both sectors to increase the impact of these kind of projects.

Thus, its goal is to coordinate and streamline the relationship between the microfinance sector and suppliers, optimizing demand for green technologies. The idea is to first strengthen MFIs with tools and specific knowledge for integrating energy access into a green portfolio, and secondly, empowering supply chains which is necessary for the provision of technological initiatives of green microfinance.

Its goal is to coordinate and streamline the relationship between the microfinance sector and suppliers, optimizing demand for green technologies.



Improved ovens are another one of the technologies promoted through green credits.



Thanks to the acquisition of a solar water heater, a villager of Chivay, in Arequipa, can offer hot showers to guests at her hotel and thus increase the price of lodging.

#### COPEME

The Consortium of Private Organizations to Promote the Development of Small and Micro Businesses (COPEME) is a network that has been at work since 1990 providing business development services to strengthen microfinance institutions in Peru and other Latin American countries. Its main focus areas are: financial inclusion, technological and innovation services to rural areas, green finance, risk management, and corporate governance.

[www.copeme.org.pe](http://www.copeme.org.pe)

#### ADA

Support for Autonomous Development or "Appui au Développement Autonome" (ADA) is a 20 year old Luxembourg NGO which works in the development of financial inclusion of vulnerable populations neglected by traditional financial system. Its focus areas are: innovation in inclusive finance, strengthening capacities, investment advice, and research and knowledge management.

[www.ada-microfinance.org](http://www.ada-microfinance.org)

#### ENDEV PERU

The Energising Development Project (EnDev Peru) aims to facilitate sustainable access to basic energy services, especially in rural populations.

The project is part of the international initiative Energising Development and has been working in Peru since 2007, being executed by the German Cooperation, implemented by GIZ, having four lines of action: energy for cooking, energy for lighting, energy for productive uses, and energy services by microfinance.

[www.endevperu.org](http://www.endevperu.org)

# Save a million tones of CO<sub>2</sub> per year

This goal has been achieved by promoting the use of appropriate technologies for energy access. In June 2014 the program EnDev has installed 2,1 million clean cook stoves and 125,000 photovoltaic systems in different countries, helping to reduce the greenhouse effect.

By **Gunnar Wegner**, Regional Manager for Latin America and Manager for Monitoring of the Energising Development Project (EnDev).

A mulanje family, in the Republic of Malawi, has access to clean energy for cooking thanks to a stove model promoted by EnDev.



In Benin, a woman has light for her business thanks to a photovoltaic system.

There are sources of power generation, known for their high emission of greenhouse gases (such as power plants). However, there are other less known sources that also produce a significant harmful impact on the atmosphere. One of these "sources" is the lack of access to energy or so called "energy poverty".

In that sense, this article shows how the Energising Development (EnDev) program has reduced over one million tones of CO<sub>2</sub> a year, working specifically with the poorest and most vulnerable populations.

To achieve this impact, EnDev promotes various technologies for adequate access to energy, of which two will be presented in this article: improved cook stoves and photovoltaic systems.

### IMPROVED COOK STOVES

Many families prepare their food with traditional cook stoves. These stoves are well adapted to local customs yet inefficient. They can be uncomfortable to use, unsafe and harmful to people's health.

To meet this challenge, EnDev promoted "improved cook stoves". These are stoves that consume 30% less wood or charcoal in relation to traditional cook stoves. Thus, the efficiency of these clean cook stoves has several advantages: the main one is the reduced fuel consumption, reducing CO<sub>2</sub> emissions to the environment. Moreover, in most cases, reduced wood consumption also means either to spend less time for collection, or a cost savings if the fuel is purchased.

The impact of improved cook stoves to reduce the generation of greenhouse gases can be

calculated according to the methodologies of the "Clean Development Mechanism". In short, this tool shows the efficiency of different models of improved cook stoves, promoted in countries around the world as well as the number of implemented stoves. So, up to June 2014, the number of cook stoves implemented by EnDev amounts to 2.1 million.

An improved stove saves, on average, 0,55 tons of CO<sub>2</sub> per year, so the number of improved cook stoves represents a reduction of more than a million of CO<sub>2</sub> per year. It is worth mentioning that there are other factors that influence this calculation, such as the correct use of technology, maintenance, and replacement, among others. EnDev works to take into account all these factors by monitoring the project to understand its true impact.

### PHOTOVOLTAIC SYSTEMS FOR RURAL ELECTIFICATION

EnDev works in the field of rural electrification through various technologies. Among them are solar photovoltaic (PV) systems, which have spread rapidly in recent years. For one thing, prices of solar panels fell. Additionally, there has been significant progress in developing batteries for phones and laptops. Similar batteries have also been used in the field of photovoltaic systems, making them more efficient and reducing costs. Finally, a third factor has been the recent availability of high-efficiency LED lamps, which have also become part of PV systems.

These systems promoted by EnDev provide access to lighting as the main benefit for users. However, some systems also allow for recharging a cell, providing energy for nocturnal activities such as basic telecommunications.

This article shows how the program has reduced over one million tones of CO<sub>2</sub> a year, working specifically with the poorest and most vulnerable populations.

Traditionally, many people in developing countries use diesel or kerosene lamps for light at night. It is estimated that total spent on these fuels is between 20,000 and 30,000 million Euros per year (25,000 to 37,000 million dollars).

Seeking to know the impact generated in the atmosphere and environment, EnDev conducted a study to compare kerosene lamps with PV systems. From the results, it is estimated that a PV system can replace two kerosene lamps, which corresponds to a reduction of 0,15 tons of CO<sub>2</sub> per year.

In June 2014, the number of PV systems implemented by EnDev, amounted to about 125,000 systems. This corresponds to a reduction of almost 20,000 tons of CO<sub>2</sub> a year. Furthermore, the production of soot or “black carbon”, a substance that produces a harmful effect for the people and the environment has been greatly reduced.

It is important to mention that the methodology for calculating the impact on the environment is more complex and elaborated than has been mentioned in this article, as there are other factors which are also important, such as the reduction of deforestation and of the fuel used to transport the kerosene.

#### CONCLUSION

Worldwide, 2,600 million people currently lack access to modern cook stoves and 1,300 million people are without electricity. Address this problem by promoting adequate access to energy for these people, has had an impact on the environment, as we have shown in this article.

It should also be noted that the impact on the population is even greater, since access to energy is a key to raising the quality of life and promoting human development of populations worldwide.

It should also be noted that the impact on the population is even greater, since access to energy is a key to raising the quality of life.

# The program BipBop for access to energy

Combining philanthropy and business, the company Schneider in 2009 launched its initiative to bring clean and sustainable energy to rural areas in different countries. Since then, it has electrified more than one hundred villages, facilitated the training of 50 000 people, and provided financial support to a dozen small and medium enterprises.

By Gilles Vermont Desroches, Senior Vice-president of Sustainability of Schneider Electric; and Thomas André, PhD of the Economics Department of the Ecole Polytechnique of France.



A rural house in Mozambique has a solar home system.



People that live in areas that lack electricity can charge their cell phones by using photovoltaic power.

#### ENERGISING DEVELOPMENT

Energizing Development (EnDev) is a global program for energy access. The program began working in 2005, implemented primarily by GIZ. The funders of this program are from the Netherlands, Germany, the UK, Australia, Switzerland and Norway.

EnDev has benefited more than 12 million people in 24 countries worldwide and more than 45,000 centers for social infrastructure and businesses that promote sustainable access to energy. It receives funding based on results and ensures the sustainability of their work by the development of markets for energy services and technologies.

In Peru, the program is developed by EnDev Peru, executed since 2007 by the German Cooperation, implemented by GIZ.

[www.endev.info](http://www.endev.info)

[www.endevperu.org](http://www.endevperu.org)



SCHNEIDER ELECTRIC

When it comes to access to energy, the world is paradoxical and unfair: 1,300 million people still lack reliable access to electricity. They are in the "Base of the Pyramid" or BoP. For them, energy sources such as kerosene, firewood and flashlights are expensive contaminants which further endanger health.

Access to modern energy not only improves the quality of life for low-income populations, but also facilitates access to healthcare, education and development through entrepreneurship. The issue is now internationally recognized as a basic need and a means for the development of populations worldwide. For this, the Secretary General of the United Nations, Ban Ki-moon declared 2012 the "International Year of Sustainable Energy for All" and a target of universal access to energy is set to be reached by 2030.

In this international context, multinational companies have an important role to play. The concept of the Base of the Pyramid (BoP) according to Professor C.K. Prahalad and the concept of "Social Business" of Muhammad Yunus, gave rise to many initiatives across all sectors in different countries. To be considered successful, BoP strategies have to meet three criteria. First, the activities must achieve social and environmental objectives, thus being relevant in terms of development. Second, the models must be sustainable and grow over time. Third, programs must affect many people as possible through scalability.

In 2009 Schneider Electric launched the "Business, Innovation and People at the Base of the Pyramid" (BipBop) program to promote access to clean energy for people most in need around the world. Business, Innovation and People, respectively, refers to the proportion of investment, creating markets, and supporting training efforts.

A balance of global and local actions allowed BipBop replicate projects in many countries: providing financial support for almost ten small and medium enterprises in the field of energy access; the distribution of nearly two million renewable energy products; the electrification of more than 100 homes; and creating training projects in energy management which trained over 50,000 people. Social and environmental outcomes of BipBop are measured and communicated through the Planet and Society Barometer, which shows their level of impact or sustainability "scorecard".

In early 2009, the BipBop program was launched to provide clean energy for low-income populations through the development of a combined approach of philanthropy and business. By investing in communities and interest groups in the Base of the Pyramid, the program addresses three key challenges in promoting access to energy.

1. **The pillar of business** provides financial, technical and management support to small and micro entrepreneurs in the field of energy access through a investing fund to stimulate the local economy.

In communities of the Amazon in Brazil, the program has been able to promote the access to technologies that permit the refrigeration of food and medicine.

2. **The pillar of innovation** develops a profitable portfolio of products and solutions that provide access to energy for low-income populations and creates plans tailored to local socio-economic contexts in order to address the lack of adequate equipment and respond to local needs.
3. **The Pillar of people** facilitates training in energy management for disadvantaged youth to promote local capacity building at long term.

While these fronts began autonomously, the synergies between them have already begun, which increases the impact of the activities.

The progressive integration of the BipBop program in the Group's strategy is the main factor of success. Positioned as a solutions provider, it addresses the energy needs of low-income communities. The program incorporates a business approach, gradually mobilizing different business functions

including management and maintenance. These global and local actions allow for a consistent BoP strategy. However, a multinational corporation does not have all the required capabilities. Therefore, activities rely heavily on a combination of internal and external capabilities. This allows BipBop to become part of the global strategies to address the issue of energy access faced by low-income populations, such as having modern energy.

Evaluated at the corporate level, the BipBop program is clearly in line with the overall strategy of the Group. Emphasis on the need for collaboration through external partnerships is also being made. The BipBop program exemplifies the progressive evolution of the responsibility of the Group, first starting with philanthropy, then building a framework of corporate social responsibility, and finally, moving towards greater integrated business. In this sense, the BipBop program exemplifies the concept of "creating shared value" emphasized by Porter and Kramer.



SCHNEIDER ELECTRIC

In this international context, multinational companies have an important role to play.

In-home communications are another one of the benefits brought by the program.

**SCHNEIDER ELECTRIC**

As a global specialist in energy management with operations in more than 100 countries, Schneider Electric offers integrated solutions across market segments, including leadership in energy and infrastructure, industrial processes, building automation, data centers and network solutions, as well as a broad presence in residential applications.

Through its commitment to help individuals and organizations maximize the use of energy that is safe, reliable, efficient, productive and green, more than 140,000 employees of the company achieved sales of 24,000 million Euros in 2013.

In line with sustainable development and the fight against climate change, Schneider Electric is committed to have its customers "do more with energy".

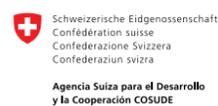
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