SMART VILLAGES
New thinking for off-grid communities worldwide

Smart Villages in South America: Lima Workshop Report

Workshop Report 16

LIMA, PERU

January 2016

Key words:
Energy access, Rural energy, Improved Cookstoves, Mini-grids, Solar home systems, Renewable energy

Smart Villages

We aim to provide policymakers, donors, and development agencies concerned with rural energy access with new insights on the real barriers to energy access in villages in developing countries—technological, financial and political—and how they can be overcome. We have chosen to focus on remote off-grid villages, where local solutions (home- or institution-based systems and mini-grids) are both more realistic and cheaper than national grid extension. Our concern is to ensure that energy access results in development and the creation of "smart villages" in which many of the benefits of life in modern societies are available to rural communities.

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Publishing

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The Smart Villages Initiative is being funded by the Cambridge Malaysian Education and Development Trust (CMEDT) and the Malaysian Commonwealth Studies Centre (MCSC) and through a grant from the Templeton World Charity Foundation (TWCF). The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the Cambridge Malaysian Education and Development Trust or the Templeton World Charity Foundation.

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MALAYSIAN COMMONWEALTH STUDIES CENTRE

CAMBRIDGE MALAYSIAN EDUCATION AND DEVELOPMENT TRUST

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Summary

While South American countries have made significant progress in energy access, tens of millions of people (more than 30 million, according to conservative estimates) do not have access, particularly in remote areas. From 24-26 January 2016, experts from across the region gathered to discuss the challenges and opportunities for energy access. The forum "Sustainable energy sources for rural electrification in off-grid communities in South America: Challenges and prospects" was co-hosted by Soluciones Prácticas (Practical Action) and the Smart Villages Initiative in Lima, Peru. It marked the beginning of the Smart Villages Initiative's engagement in South America. Representatives from the public sector, private sector, academia, and civil society attended, spanning numerous countries: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, and Peru from South America as well as Canada, the Dominican Republic, Germany, the United Kingdom, and the United States.

The forum aimed to facilitate analysis and exchange between the public and private sectors, academia, and civil society based on first-hand experiences in the field of energy in rural off-grid communities. Topics for discussion included rural electrification; energy generation and distribution; the inclusion of renewable energy sources (RES) in the energy matrix; productive use of energy in rural communities; clean cooking technologies; efficient heating; and rural energy entrepreneurship. The discussions helped to outline new prospects for reducing rural poverty in South American countries through access to, and use of, sustainable energy sources.

In discussions at the workshop, several important themes emerged in terms of challenges and barriers. Energy access, particularly electricity, is limited by geography and the by the dispersed nature of the communities, often made up of indigenous minority groups that are dispersed throughout the countryside. It was noted that remote communities often need tailor-made approaches given the wide variety of reasons for remoteness and the unique challenges of reaching these communities (e.g., in mountains,

Workshop participants in discussion during a breakout session

forests, etc.). Moreover, there are high transaction costs and problems with poor quality and counterfeit products. Financing was a hot topic among participants and featured in the presentations as well as the group discussion at the end of Day 2.

In comparison to some other regions where the Smart Villages Initiative has held workshops, there are fewer small- and medium-enterprises (SMEs) focusing on energy access in South America, though we were fortunate to welcome some SMEs that are working in the region on solar home systems, for example. It was clear, however, that NGOs have a strong presence in many of the countries represented at the forum. Some governments have taken responsibility for, and a lead in delivery of, energy access and the protection of indigenous people's rights, though this was variable within the region. Over the past few years, several countries in South America have changed status in the eyes of major donors (such as Brazil, Argentina, and Chile) and are no longer considered officially "developing" by the European Union and the World Bank, for example. This change in status for some countries means that financing for development of the "fringes", the most remote and poorest communities, is particularly affected.

It was also noted that government involvement in energy access can lead to red tape and discourage, or even prevent, private sector participation; the right type of involvement will be necessary going forward. Several speakers also critiqued some governments' approaches to tendering processes for delivery of energy access initiatives, noting that the selection of the private sector partner should be more rigorous and involve evaluations from experts with experience in the country. The need for better planning and coordination between government ministries—not only those focusing on energy—also featured in the discussions.

Throughout the workshop, speakers called for energy access not to be an end in itself but rather as a means of social inclusion. Examples were given of the ways that energy access can bring people together, such as a small restaurant in the mountains that not only cooked food but provided a warm space for people to gather. Energy access for productive uses was also a central theme: refrigeration had also brought together a fishing community, which was able to store fish and bring them to market regularly instead of in one go.

Many remote communities still need basic levels of energy for lighting and clean cookstoves. Several speakers described the ways in which they had brought light and clean cookstoves to remote communities. Distribution was a challenge given the dispersed nature of these communities. In addition, technical assistance and local know-how (via training, infographics, etc.) were crucial aspects of continued satisfaction with household lighting systems. Several speakers noted that clean cookstoves have been, and will continue to be, crucial for reducing reliance on biomass and solid fuels.

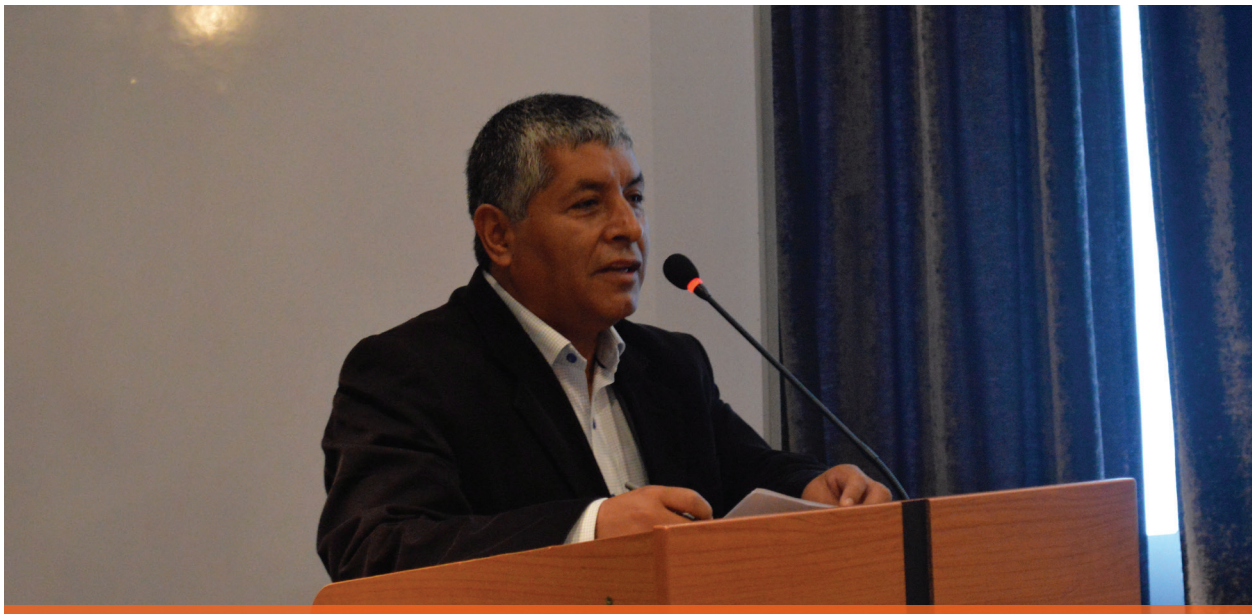
Introduction

The Smart Villages Initiative began its engagement in South America with a regional workshop held in Lima, Peru on 24-26 January 2016. The workshop focused on the many challenges for energy access in South America as well as examples of successful and ongoing initiatives. It was co-organised with Soluciones Prácticas (Practical Action).

This report summarises key points arising from the presentations and discussions. Copies of the presentations are available in Spanish and English on the Smart Villages website (www.e4sv.org). The workshop agenda and the list of participants along with their organisational affiliations are provided in Annexes 1 and 2 of this report respectively.

The workshop brought together more than 70 relevant stakeholders from across the region involved in energy access in South America. Representatives from the public sector, private sector, academia, and civil society attended, spanning numerous countries: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, and Peru as well as Canada, the Dominican Republic, Germany, the United Kingdom, and the United States. It provided a forum for animated and fruitful discussions with important learning points for the Smart Villages Initiative and the participants, including a final breakout session that dove deeper into questions of financing, management models, planning, etc.

The workshop began with a field trip north on the Pan-American Highway to visit rural energy projects, especially those based on wind and solar energy. Approximately 30 people were able to join the field trip. These projects included a visit with Soluciones Prácticas (Practical Action) to one of their pilot projects: a wind-powered generator for productive uses in a workshop that repairs tyres (funded by CONCYTEC—ITDG, a Peruvian research institution). The generator was installed in 2007 and produced 500 W; however, in 2010 there were some technical issues. At the present time, little has changed due to maintenance issues. The approximate loads that the equipment could support include 10 energy efficient lamps, a TV, and a blender.



Rafael Escobar, Soluciones Prácticas (Practical Action)

The group then visited wind-powered generators of 1 kW for lighting and television for agricultural and livestock workers at the Avícola Rio Azul. The station Llanos 2 is the most recent (2015) and has an installed solar hybrid system, wind system has a power of 1000W to 9 m / s (maximum power 1500W to 12 m / s). The photovoltaic modules are 4 x 85 Wp each and are maintained twice per year to ensure proper operation. The energy obtained gives lighting, entertainment (television), and communications (mobile phones). Rio Azul is also looking at the possibility of installing a cooling system for preserving food. Waira, the company that installed the wind power, also installed it at tations 1 and 3 in 2010 and 2012, respectively.

The visit concluded with a trip to Asociación Tarpuy, where wind energy generation provides lighting for a residential school and crop irrigation. In the beginning Tarpuy had no electricity and children were limited to performing the tasks only during the day, plus they did not have greater access to information via the internet. The water supply was also costly.

Today, thanks to the support of institutions such as Soluciones Prácticas (Practical Action), with the support of other financial institutions and private companies like Waira, Tarpuy could install two wind systems, one that produces 500 W and a Waira wind system of 3kW, which feed power to the residential school. The Waira system is also supported by a system of photovoltaic panels. Currently, Tarpuy has electricity for lighting three areas where the children live and study, an electric washing machine, computers for education and administration, wireless internet (Wifi), plus the system pumping water which is currently undergoing technical analysis.

Inauguration of forum

Welcome

Rafael Escobar, Soluciones Prácticas

Rafael Escobar welcomed workshop participants on behalf of Soluciones Prácticas (Practical Action). He noted the importance of bringing together actors from across South America to discuss the important issue of energy access, adding that he hoped the participants would have an informative and useful workshop.

General information and forum objective

John Holmes, Smart Villages Initiative

John Holmes welcomed workshop participants on behalf of the Smart Villages Initiative. He explained that the aim of the workshop was to explore the issues associated with off-grid energy for development in South America, identifying the barriers and how they can be overcome, and the messages that need to be taken back to policy makers and development organisations. An excellent cross section of key players from across South America had been assembled for the workshop, so he looked forward to fruitful and informative discussions over the next two days.

The Smart Villages Initiative

Claudia Canales, Smart Villages Initiative

The first Smart Villages Initiative workshop in Latin America was inaugurated by Claudia Canales, who explained the global picture of energy access and the current challenges facing rural, off-grid communities. While smart cities have received ample attention, their corollary, smart villages, have not been a primary policy focus. For villages to become “smart”, they will need access to education, healthcare, clean water and sanitation, and ICT (information and communications technologies) connectivity, particularly for participating in governance

processes. Perhaps most critically, entrepreneurship will need to be fostered to ensure the economic viability of remote, rural communities. Energy access is a prerequisite for all these aspects of smart villages.

The Smart Villages Initiative itself focuses on sustainable local energy solutions for rural communities, providing advice to policymakers so that future policies and interventions can be more effective. Each workshop brings together the key players: scientists, entrepreneurs, villagers, NGOs, financers, regulators and policymakers, etc. It seeks to identify framework conditions to foster entrepreneurial activities in delivering and using energy services and to maximise leverage of public sector funding.

An important part of the underlying premise of the Smart Villages Initiative is that to maximise social benefit and development impact, energy access must be integrated with other development initiatives and take a community-level approach. The initiative seeks to catalyse rapid progression through the various levels of energy access.

The findings of the Smart Villages Initiative to date were also highlighted, including the importance of investing in energy infrastructure and research and technology. Investment in energy infrastructure requires better access to finance, leveraging public sector funding, creating supportive regulatory and policy frameworks, integration with other development initiatives, and public-private-community partnerships.

Research and technology remains crucial for rural communities, not least to lower costs and improve durability. Quality assurance has emerged as an important issue, which is crucial for consumer acceptance of new technologies. The appropriate scale of energy systems—solar homes systems, DC (direct current) nano-grids, and village level AC (alternating current) mini-grids—has yet to emerge from a rapidly evolving marketplace.

In closing, Sustainable Development Goal 17 was emphasised. Better collaboration, capacity building, and information-sharing may make the difference between whether SDG 7 is successful or not.

Claudia Canales, Smart Villages Initiative

Session 1: Renewable energy and its role in rural development

Outlook on renewable energy in Latin America and the Caribbean

Fernando Ferreira, OLADE

Fernando Ferreira offered an overview of the types of energy utilised in Latin America and the Caribbean versus the rest of the world. In Latin America, a great deal of oil is used for transport on the mainland and for electricity generation in the Caribbean. Biomass is frequently used for cooking, which is a serious challenge to both human health and the environment. The substantial use of firewood and biomass needs to be replaced by more sustainable forms of energy. Large-scale hydroelectric plants are no longer possible due to environmental legislation. Small and micro-energy plants are the way forward for Latin America.

Approximately 30 million people in Latin America do not have access to energy. 16,000 MW will be required to serve them, but it is difficult to reach many people due to their remoteness. If energy efficiency is implemented, 30% less energy would be needed, so efficiency needs to be a priority and needs to be pursued in parallel to energy access. Moreover, per capita consumption of energy is low—on average, people use only 50% of the world average. The Latin American Energy Organization (OLADE) is currently working with the International Renewable Energy Agency (IRENA) on two scenarios for energy in 2030—one that follows the "business as usual" model and another, "REmap", that follows a model that integrates a more rapid introduction of renewable energy.

OLADE seeks to address energy vulnerability and energy-gender relationships and has published a manual on this. They are involved in a number of rural electrification projects in Bolivia, Guatemala, Guyana, and Paraguay, for example. They plan to implement a solar laboratory in Quito, Ecuador where people from member states can come to test and evaluate new solar equipment. Over 7000 professionals have been trained online, and they have 20 courses on renewables.

Energy is a complex issue, not a simple one—an integrated approach to energy access and sustainability is needed to drive development outcomes. It is important to explain the complexity as well as explain how to use energy and apply the solutions. Social inclusion, access to information, and improving lifestyles are important considerations.

Fernando Ferreira proposed that the example of Brazil should be followed, where the large rural electrification project "Light for all" ("Luz para todos") reached remote towns and villages. Energy helped make those communities economically active. But this must happen within a broader social inclusion project that does not solely focus on energy access and includes training to expand skills to encourage the productive use of energy.

Experiences and projects of the American Bioenergy Network

Jose Maria Rincón, IANAS

In December 2010 and June 2011 joint meetings were held between the Inter-American Network of Academies of Science (IANAS) and the Colombian Academy of Exact, Physical, and Natural Sciences (ACCEFYN) within the framework of the IANAS Energy Program. Six priority areas involving energy for the Americas were identified:

1. Satisfying the basic needs of the poorest
2. Increasing the contribution of renewable energies

3 Implementing bioenergy plans involving the use of advanced technologies

4 Improving energy efficiency from generation to use

5 Creating the necessary human, educational and institutional capital

6 Generating greater awareness of the need to take prompt measures to ensure a sustainable future.

The Bioenergy Network was founded in 2011 and membership includes organisations in several Latin American and Caribbean countries and Spain. It aims to serve as a channel for the exchange of ideas, as well as a relevant axis for the elaboration of studies and projects about the use of biomass waste for the production of sustainable energy. The network has run several seminars and published a book in 2015, *Bioenergy: Sources, conversion and sustainability*. Activities include waste to energy (including in urban areas) and densification of biomass fuel (pellets, charcoal, torrefaction). Co-firing with coal and other fuels up to 10% is possible, which increases national energy supply and energy security. Intelligent goals for the future are to combine modern sustainable biomass with solar, wind, and biogas in hybrid systems.

Bioenergy has advantages (stored solar energy, low emissions, and a natural replacement for fossil fuels) and disadvantages (low energy density, high hygroscopic capacity and moisture content, and susceptible to microbial attack). But new bioenergy technologies can act as a bridge between more traditional carbon energy sources (coal and oil) and the modern more sustainable use of biomass.

National Institute of Energy Efficiency and Renewable Energy, Ecuador

Dario Rodriguez, INER

The National Institute of Energy Efficiency and Renewable Energy (INER) is a government institution focusing on both energy efficiency—for transport, public lighting, buildings, and industry—and renewable energy for rural areas—wind, solar, biomass, and geothermal. It is active in capacity building and training, including developing new technology such as apps to guide users and decision makers. Ongoing issues for the government include knowledge sharing, climate change mitigation, energy efficiency and energy access.

INER has worked extensively in the Galapagos Islands, including developing mini-grids and solar catamarans. Working in the Galapagos Islands is even more complex than usual. There are the typical island issues of long supply chains and the high cost of infrastructure. In addition, there are difficulties in finding the best sites for installations or choosing the appropriate types of energy use since it is a unique world heritage site (e.g., they cannot easily develop infrastructures in the sea or use additional land area).

Each Galapagos island requires a separate mini-grid as joining them up would be too costly and lead to unacceptable environmental impacts. Furthermore, the appropriate energy source needs to be chosen carefully. Diesel gensets currently use the least land and are being run on biodiesel. But Ecuador's entire national production of biodiesel is insufficient to run the gensets for the main island. Due to intermittency of sustainable energy sources (e.g., wind, sun) and supply chain problems for diesel, they need redundancy in system design and capacity, and additional storage. But again, the cost and environment/land use issues limit their options. Hybrid systems involving diesel engine generation with solar PV (on Isabela Island) and with solar PV and wind (on Santa

Cruz Island) are in use and help maintain system stability. Research continues on energy storage and on smart control systems for the mini-grids.

INER has also worked in the area of sustainable energy for mobility. For example, they have developed a solar catamaran to sail between islands that utilises a photovoltaic and battery system. The catamaran's batteries can be recharged from the island grids when necessary and used to feed electricity into the grids in emergencies.

Off-grid rural electrification projects in Chile

Rosa Argomedo, Global Changes

Rosa Argomedo gave an overview of renewable energy in Chile as well as the advances in electrification since 1992. 238,000 households did not have power in 1992, which decreased to 77,000 by 2002 and 20,000 by 2013. However, this census data is likely overly optimistic. The government has played an important role by providing a stable regulatory environment as well as standards for companies. While national ministries establish the policy framework for energy access, regional governments and municipalities decide which projects to pursue.

An affordable consumer tariff is achieved through government subsidies, though the subsidy levels have changed over time. Subsidies can be substantial: for example, in the Coquimbo region 3000 125W solar home systems were installed in which the monthly cost of supply to a household was US$17.90, but the families only paid US$4.

In addition to solar home systems, hybrid minigrids for schools and rural healthcare centres have been built to help achieve equality of rights and opportunities for rural off-grid populations. It is government policy that all schools and health centres should have electricity. Small island systems have also been provided for very sparsely populated communities (ten families per island in some cases) using wind and diesel hybrids.

Chile has experimented with micro-hydro systems with community ownership and management models. For example, the Llanada Grande micro-hydro scheme in Los Lagos region is rated at 145 kW and supplies 117

Rosa Argomedo, Global Changes

houses. It operates without subsidy, charging a fixed monthly fee of US$3.60 and a unit rate of US$0.21/kWh. The government and NGOs seek to drive community productivity as well through productive uses like off-grid solar water pumping to increase agricultural productivity and generate increased income to get out of poverty. In cases like this, an exit strategy is developed in which the system can be handed over to the community to manage and maintain. Such projects need to be driven from the grassroots from the start.

Positive aspects of the approach in Chile have been a clear national policy on energy access, effective assessment methodologies for rural electrification projects, and efficient investment and operational subsidies. Bidding mechanisms for investment and operation have ensured the sustainability of supply in isolated areas.

Problems have included limited participation of private sector companies with experience of renewable energy systems. They have been reluctant to get involved; often foreign companies and organisations are more enthusiastic. Incentives for investment are lacking. Difficulties have been experienced in the execution and operation of energy schemes, and it is complicated to create a management model for each system.

The need for subsidies is ongoing, and exit strategies that leave communities independent are also important. There is a complex equation of subsidies for off-grid electricity tariffs and national diesel subsidies. The government is trying to reduce these subsidies.

But the overall government philosophy is that all people have the right to modern services, infrastructure, and equality. This drives the rural electrification strategy. New solutions for the most isolated and expensive cases will be needed, while legislation for very small systems is missing.

Access to energy services in Peru

Victor Murillo, Social Inclusion Energy Fund

Victor Murillo's presentation gave an overview of access to energy services in Peru, including both lighting and cooking. One of the main challenges in Peru, as in other countries, is the extreme remoteness of the rural off-grid population, and their inability to pay for energy services: often, the cost of provision of energy services is inversely related to the ability of families to pay. Solar pico solutions are still needed for light in many remote areas.

For cooking, one relatively simple solution has been to encourage the use of liquefied petroleum gas (LPG) cookstoves through the distribution of vouchers as a subsidy for the purchase of gas to households. Use of LPG instead of wood is growing, especially in the vicinity of road infrastructure, which determines LPG distribution network capacity. This has meant lower costs for LPG and increased availability and spread of distribution infrastructure.

But clean cookstoves remain the preferred solution for those communities without easy access to the distribution infrastructure or for whom LPG is simply unaffordable. These communities are characterised by high levels of poverty. To date, 325,000 clean cookstoves have been installed. Other types of cleaner and more efficient cookstoves need to be developed to replace wood fuel.

Census information and particular data gathering tools are used to map out the location of these last mile populations. They also map those that are situated so that they can benefit from the LPG distribution infrastructure to allow a more strategic planning of projects and initiatives. These maps show that the relative contributions of LPG and solid fuels for cooking vary widely between regions.

Articulation of international and national visions: the case of Colombia

José Eddy Torres, International Energy Consultant

Multilateral organisations and development agencies have been supporting energy access activities since 1981 in Latin America. In Colombia, there were also projects and initiatives for rural energy, but it was only in the 1990s that policies and laws around rural energy were developed. Initiatives become more coordinated and focussed, and new programmes were created. Between the 1990s and today, a good synergy has been established between rural energy access and clean energy provision, and with the 2012-2017 USAID Colombia Clean Energy Program, rural energy and clean energy solutions have moved up as priorities. The USAID program supports the formulation of policies and strategies, the structuring and implementation of concrete rural energy projects, and the structuring of financial mechanisms. It requires that all rural electrification initiatives be technically, economically, environmentally, and socially sustainable and directly contribute to the overall economic development of the communities involved.

The National Energy Plan created in 1994, together with an associated legal framework, seeks to support rural electrification by providing a fixed amount per generated kWh. This provision was renewed in 2014 for a further seven years. In 1999 the Institute for Planning and Promoting Energy Solutions for Non-Interconnected Areas was established. It is implementing a planning and participatory process in 21 "micro regions" that comprises six stages: identification and characterisation of social and institutional players (who to work with), preliminary definition of geographic area, development of a micro-region diagnostic, concept development of energy solutions and projects, project organisation and implementation, and operation and monitoring of installed solutions.

The micro-regional diagnostic examines the dynamics of the regional micro-economic base and undertakes a technical, energetic, and

José Eddy Torres, International Energy Consultant

environmental assessment of local production methods. It surveys available energy resources, analyses current energy consumption patterns and requirements for energy, and evaluates organisational forms and local co-management experience. Technological options for energy provision are consequently identified and analysed. The selection and feasibility evaluation of energy projects is undertaken in collaboration with socio-institutional players leading to the formulation of bankable projects. The programme works with government, communities, and companies.

Energising rural areas is much more than rural electrification. Since January 2012, Colombia has sought to increase access to renewable energy. It is crucial to see how national policy can use energy for the development of rural areas and to increase productivity and investment. The sustainability of energy initiatives in marginalised rural areas involves the development of economic uses of the generated energy. Projects must provide for investment recovery, raise productivity, and generate local added value, while also ensuring the continuity and development of the operational and maintenance framework.

Government policies have established sustainable rural energisation plans, starting with the Nariño pilot in 2013 and leading to the creation of a national strategy in 2015. A law passed in 2014 requires decreased dependency on diesel generation in off-grid areas through the increased use of solar and hybrid systems. A government decree in 2015 requires the expansion of electricity access (4% of Colombia's population still does not have access to electricity), with a 2018 target of providing electricity access to 173,000 new users of which 60,000 will be individual solar home systems for households.

In brief, several projects have already used energy for productive uses, and many of these projects are now run independently by the communities, such as solar cooling used by a cooperative of 313 fishermen, solar pumping for human and animal consumption and drip irrigation, and a micro-hydro scheme to support the threshing of rice and corn.

Q&A session

There has been plenty of private sector involvement in large electrical generation in South America (on the MW scale), but this has not trickled down to the rural level. There are still issues about how to transmit this power to more remote populations (if at all possible) and how to include social insights and productive use examples.

Contributors all commented on national approaches and tools used to carry out planning and mapping of underserved populations, possibilities for technical solutions, and how to develop appropriate capacity building plans.

Subsidies remain important because the real cost of power from mini-grid systems remains higher than rural populations are able to afford. Social sustainability is important and needs to include a longer term social trajectory in planning and implementing new systems and projects while ensuring that already existing projects can also incorporate these goals.

A disconnect between laws and actual coordination and implementation exists in some cases. Many projects therefore overlap. Mechanisms are needed for monitoring and follow up.

It was also noted that Colombia has legislation to protect indigenous rights, an element that is important when considering community participation and ownership of projects. In any project, the community needs to be consulted regarding what they need and want in terms of development, not just energy.

Session 2: Renewable energy and rural electrification

Institute for the Development of Alternative Energies and Self Sustainability and Network of Civil Society Organisations for Renewable Energies

Fábio Rosa, IDEAAS / RENOVE

The Institute for the Development of Alternative Energies and Self Sustainability (IDEAAS) and the Network of Civil Society Organizations for Renewable Energies (RENOVE) have been focused on energy access for over 15 years; they were pioneers in this area in Brazil. Their areas of expertise are: the development of initiatives on distributed generation, renewable energy, and rural electrification with innovative management styles for sustainability; the development of technical and business models for access to electricity in low-income rural communities with distributed microgeneration; the application of energy to income generation, rural development, agriculture, and livestock production; and education and training in the area of renewable energy and rural and urban sustainability.

There are three levels of energy access: mitigating exclusion from electricity (e.g., solutions for lighting, radio, phone charging, etc.) with 60–120 W per day, costing US$50–350; pre-electrification which offers around 350 W per day (adding radio and television, and water pumps) costing US$1000–1,200; and electrification, which is permanent and firm, providing up to 5 kW / day and costing US$700–3,500.

Fabio Rosa discussed the case of Brazil, where isolated states are the size of France. National policy and priority to mitigate exclusion from access to electricity were implemented via small off-grid solutions. Projects often involved international collaboration. Appropriate government regulation and implementation, combined with a "finance culture" and a democratisation model has led to success. Today, government figures indicate that only 2% of the population has no access to electricity (though in reality the number may be higher). The question remains: how to reach the most isolated communities in the Brazilian Amazon? Commercial business models are often unable to cover costs for such communities.

But past success at mitigating exclusion is not enough. He called for ministries to change their approach and to implement state programmes rather than government programmes. A permanently sustainable electricity service is needed. The poorest of the poor are remote and isolated and have no voice, while governments and electric companies do not have cultures capable of delivering low-cost, clean, and sustainable energy services in the near-term. International and multilateral financing models work primarily with governments and connected projects. Technological developments have provided viable off-grid solutions, but ministries of energy do not know how to handle them. Initiatives must be taken across government ministries, and should include key players such as civil society organisations, community-based associations, and rural electrification cooperatives. A new mindset is needed in ministries in which energy access is about social inclusion and economic development.

There remain two distinct objectives: access to energy and productive use of energy. Productive use requires distributed generation as well as innovative management and use of that energy. A careful analysis is needed, as are innovative business models for access in low-income communities and households. Possible productive uses are limited not only by the available power but also by fact that off-grid standalone systems and mini-grids are almost exclusively single phase.

Project IDTR II: Decentralised infrastructure for rural transformation

Wendy Guerra, World Bank Bolivia

Wendy Guerra presented the project IDTR II, a World Bank project that has been seeking to expand access to electricity in unserved areas of Bolivia via a decentralised model. By 2025, the goal is to eradicate extreme poverty by making basic services available to everyone, thus allowing electrical access to achieve full coverage by 2025. IDTR II has allocated US$50 million in total to the project, comprising US$43 million to electricity services in neglected areas, US$2 million to support access strategies and clean energy, and US$5 million for project management.

With US$43 million, the project is helping to provide electricity services to households and schools in rural areas and villages. Both grid extensions and the installation of photovoltaic systems in households and for community facilities are being used. Criteria have been established to decide on the most appropriate systems: if a community is within 1 km of the grid then grid connection is preferred, otherwise a local photovoltaic (PV) system is the chosen approach. The project is aligned with the agenda of the Bolivian government.

With US$7 million, the design, installation and evaluation of pilot energy access systems is being carried out in neglected areas using pico-solar systems. In addition, training and capacity building activities for local governments, service providers, and households are being undertaken.

Through their evaluation, they chose two main departments based on need: Chuquisaca and Potosí, both located in the South of the country. The focus is on eight municipalities in Chuquisaca and 10 in Potosí. In Chuquisaca, for example, 31% of homes (over 45,000) do not have access to electricity. Likewise, in Potosí, over 70,000 homes (30%) do not have electricity access. They then looked at these departments and identified where grid extension or off-grid solar would make sense. Operation and maintenance contracts have been awarded to distributors which collect fees from the users and which are responsible for the sustainability of the projects. Ownership of the equipment will be transferred to the municipalities.

By early summer 2016, the World Bank will share its results regarding the pilot projects and the overall success of IDTR II since its launch in 2014.

Wendy Guerra, World Bank Bolivia

Barriers to private sector involvement in the off-grid electricity market

Christoph Schultz, Light up the World

Light up the World is a Canada-based NGO founded in 1997 that has implemented and supported off-grid solar projects with more than 220 organisations in 54 countries. It is currently in transition from an NGO focusing on lighting to a social business. They have long believed that solar systems must be accompanied by educational programmes and literacy as well as local knowledge of system maintenance.

Christoph Schultz noted that there are active markets for off-grid products and services, for example, people who sell batteries and candles, but substantial barriers remain to private sector involvement in off-grid markets. These barriers include:

- Business model and service delivery: difficulties in reaching the last mile, high operating cost structures, and difficulties in making reliable sale projections
- Financial: availability of end-user finance, risk of default on loans and payments, difficulties in obtaining appropriate capital
- Technology: problems of reliability and high cost, and being mismatched to demand.
- Market information: uncertainty about the electrification plans and customer prospects/needs, and difficulties in evaluating willingness and ability of households to pay
- Finding the right business model is crucial for reaching off-grid communities. Key challenges and questions to be addressed in establishing viable business models include: how can the company establish a cost structure that is based around transactions?; can other distribution networks be leveraged to lower the cost of service delivery?; and how can follow-up services and maintenance be provided over time? Companies must address their assumptions about the market by gathering information on where their potential customers are, what products they want and what they are willing to pay, and how other off-grid solar actors in a region may affect their plans.

Christoph Schulz viewed pay-as-you-go systems as an interesting avenue in South America but noted that other companies, particularly in East Africa, have more experience with this model. The off-grid market is still in its infancy, and technology cost reductions will continue to encourage private sector entrance into it. We may expect to see a continued merging of ideas and adoption of proven approaches and business models. Companies that have succeeded in markets with fewer barriers will find ways to expand into other markets.

IANAS on basic energy needs

John Millhone, Energy Program, Inter-American Network of Academies of Science (IANAS)

The origin of the Inter-American Network of Academies of Science (IANAS) Energy Program was a report published in 2007 by the InterAcademy Council (the global network of national science academies) “Lighting the way toward a sustainable energy future”. This report concluded that “meeting the basic energy needs of the poorest people on this planet is a moral and social imperative that can and must be pursued in concert with sustainable objectives”.

John Millhone is the Co-Chair of the IANAS Energy Program, which was initiated to implement the InterAcademy Council’s recommendation in the Americas. 18 American science

academies are involved in the program, which is currently preparing a book, Guide toward a sustainable energy future for the Americas. The book examines energy for unserved populations along with women, water and energy, energy efficiency, renewable energy, bioenergy, and capacity building.

John Millhone concluded that it is important to continue to map the strengths and weaknesses of all energy resources throughout Latin America. Moreover, when exploring new technologies, it is necessary to look beyond solar and to consider micro-hydro, wind, and other emerging technologies.

Networking Experts' Knowledge Platform

Marcela Reinoso, Latin American Energy Organization (OLADE)

Marcelo Reinoso described the creation of a social networking platform for the energy sector in Latin America and the Caribbean established by OLADE. It is a platform that brings together policymakers, academics, businesses, multilateral agencies and consultants. It focuses on Latin America, and on themes such as best practices in the energy sector for rural electrification and access. It provides for numerous outreach activities, including news, webinars, reports, and discussion forums. It also seeks to inform energy policy and to ensure that affordable energy for rural areas and climate change remains a focal point.

Sustainable energy sources for off-grid rural electrification in South America: Challenges and perspectives

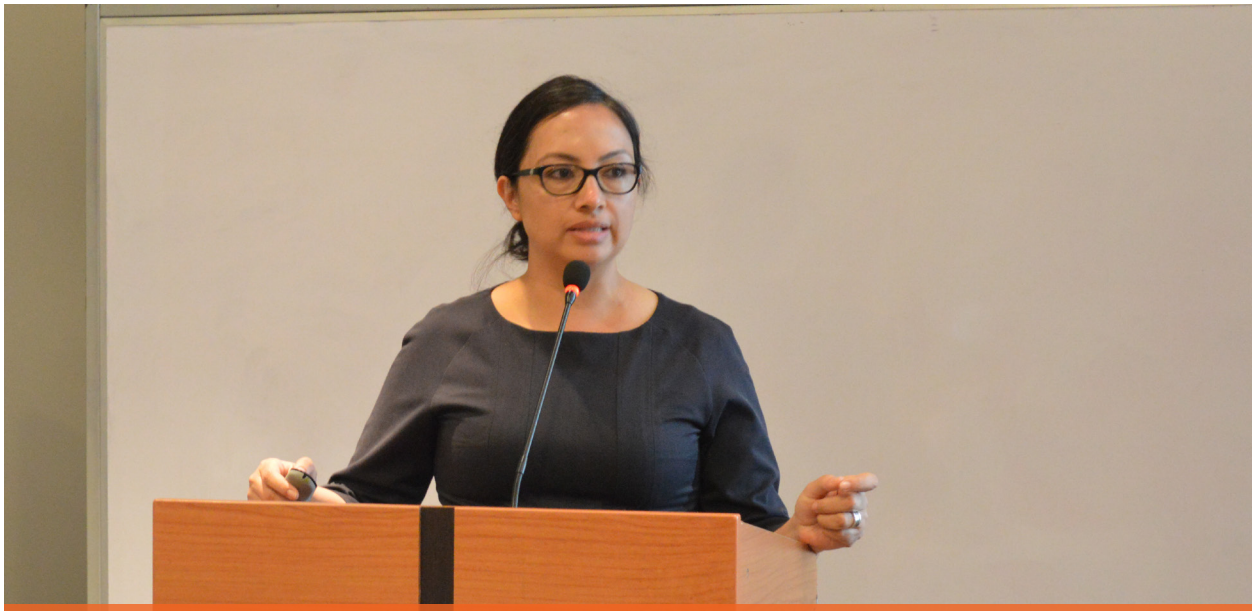
Marc Benhamou, Fundacíon Alimentaris

Fundacíon Alimentaris is a Swiss foundation that works in Latin America along with partners such as the World Bank. Marc Benhamou explained that in Argentina, for example, the context is complicated: some families are very poor: they are isolated and have no means of communication. 150,000 families, 5% of the population, do not have basic access to electricity. The logistics cost of providing electricity to them is very high, and there is a lack of technicians.

A project comprising pilots in each of three regions—Jujuy, Formosa and Santiago—has been undertaken to bring solar home systems to 72 households (24 in each region). Three brands of equipment have been used and the projects comprise baseline surveys, installation, mid-term survey and final survey. The work is funded by Fundacíon Alimentaris and the World Bank, with the active participation of the World Bank's Renewable Energy for Rural Markets Project (PERMER) and the National Institute of Industrial Technology (INTI), under the technical direction of the Bolivia Energy Foundation.

Marc Benhamou emphasised the importance of using third generation solar home systems, not least because of their portability for bringing solar panels to remote locations: they can be transported on motorcycles. The solar home systems are designed to be installed by the householders themselves after completing a two-hour workshop in which a demonstration set is opened and assembled. The equipment is then distributed to them along with detailed visual and written instructions, leaving the residents to install the equipment. In subsequent days, the project team visits the houses to check on and assess the installation which is recorded on a control form. The level of installation achieved has been good.

They also utilise infographics and photos to show householders the steps for maintaining the equipment. A team member visits regularly to make sure the equipment is working and to answer questions about maintenance. Overall, the preliminary results are positive and show that communities are maintaining the equipment well. 98.5% of the people found the light's intensity and quality to be satisfactory, and 100% agreed that the equipment was easy to use.



Marcela Reinoso, Latin American Energy Organization (OLADE)

Commentary

Ana Isabel Moreno, EnDev Peru, and Pedro Gamio, Global Village Energy Partnership

Ana Isabel Moreno emphasised that the discussion should not only focus on rural electrification but on rural energy. She called for public policies that will allow actors to develop new approaches; it is not enough to establish policies on paper. Moreover, they need financing. She also questioned the wisdom of putting one ministry in charge of rural energy; it is a cross-cutting topic. Ministries of agriculture, for example, should be involved because energy is utilised in agriculture. And we need input from the academic community.

She also called for an exchange of experiences between countries and stated that we must show pilot projects that have succeeded: people need to see new technologies working. Capacity building initiatives are needed, including to build effective local institutions and to support the introduction of technologies in the field.

Pedro Gamio commented that political will is necessary for change: this exists in Latin America. But he noted that at COP21, the 2015 Paris Climate Conference - United Nations Framework Convention on Climate Change, the voices of Latin American leaders were not heard. This was primarily because they did not speak with a single voice; they do not have a joint vision. Latin America needs to pay attention to its natural resources and better manage air and water pollution. For example, garbage is dumped and causes contamination rather than be re-used/recycled, and diesel engines are used for power generation burning high sulphur fuels.

He called for the creation of an agency for energy, not only light. Sometimes Andean regions are only using half the installed capacity, leaving room for productive uses of energy. There are many possibilities for improving education and health. The private sector must be involved as well; this is not a monopoly of the state. Companies can be set up to be managed by the communities themselves. Women and young people need to be involved and empowered, and women need to be trained to support the deployment and operation of energy systems as they tend to stay in the villages. Then, communities will become self-sustaining.

Session 3: Renewable energy: the view of academia and the private sector

PowerMundo

Michael Callahan and Paul Winkel, PowerMundo

PowerMundo is a company that focuses on lighting in Peru through selling pico-solar lights that are high-quality, long-life, plug-and-play products. One of the first challenges was the fact that people did not know about the products; marketing and distribution were very important. Key social impacts are saving money (US$830 for each light over its lifetime), improved education, health and productivity, more jobs, and environmental improvements.

They work in very isolated areas. Their products are used by households and also by small businesses; the light allows businesses to stay open later. Their salespeople go into the most remote areas of Peru, and they have created a way to reach people who are very isolated without sacrificing efficiency. PowerMundo sells products to distributors (there are 25 in Peru) who build sustainable businesses by selling lights to villagers. Shops allow people to see the products and become familiar with them: this helps sales.

Pre-payment systems with an app and post-sales service provided by the distributors help people to afford and maintain their systems. PowerMundo is able to collect information on the status of the equipment and how it is being used, and on payments by customers.

The private sector can contribute a lot to energy access, working without subsidy. However, private sector companies need better access to working capital and a supportive environment in which to work.

Healthy and sustainable lighting for the poor people of Peru

Manfred Horn, National University of Engineering, Peru

Manfred Horn's presentation was informed by the upcoming IANAS book on energy for unserved populations. People need energy for cooking, lighting, heating, and other needs, but cooking is perhaps the biggest need of poor people. He offered comparative data on access to electricity throughout Latin America as well as specific information on rural electrification in Peru. In Latin America, there is a good correlation between GDP per capita and electricity consumption per capita.

In Peru it took approximately 20 years to progress electrification from 7.7% in 1993 to 63% in 2012. Rural electrification is planned to reach 95.8% by 2022 according to the Ministry of Energy and Mines' "National Plan of Rural Electrification 2013-2022". Grid connections for rural households cost more than US$2,000, so in 2014, as a key step toward meeting the electrification target, the Peruvian Government initiated an international bidding process to install and operate 500,000 solar home systems which was eventually awarded to an Italian company. This tendering process has been criticised as poorly specified: experts were not consulted, the national experience over 35 years was ignored, and it used outdated standards. It provided for only one kind of solar home system, not admitting different sizes of solar home system or mini-grids according to local needs and possibilities. It also made no provision for technology transfer to national institutions or for training programmes of the users. It will almost certainly fall far short of targets.

Manfred Horn concluded by saying that there are still more than two million Peruvians living

in rural areas without electricity. A variety of technologies are available which can meet their electricity needs which cost less than the candles they use currently. In particular, pico-solar PV systems can meet basic needs for illumination and communication at a low cost (US$30-135) and can provide rapid social impacts without compromising future initiatives to provide more comprehensive electricity services. In order to deploy these technologies sustainably and at a sufficient scale, a number of actions are required:

- Disseminate information on the technologies through educational programmes which inform villagers of their advantages
- Establish a technical and commercial network to supply spare parts and services to introduce and maintain the technologies
- Promote the establishment of institutions that certificate and standardise the technologies
- Develop a system of micro-financing to overcome the upfront cost hurdle.

Energy supply for poverty reduction in rural areas of Ceara, Brazil—holistic view

Davi Francois, Institute for Technology Assessment and Systems Analysis, Karlsruhe Institute of Technology

Davi Francois spoke about the work of the Institute for Technology Assessment and Systems Analysis at the Karlsruhe Institute of Technology on the assessment of the impacts and influences that technologies may have on societies and vice versa. There is not a "straight road" between modern energy supply and poverty reduction. Rather, the road has many twists and turns: roadblocks come in the form of poor governance, lack of other infrastructure, land degradation, lack of capacity building, and corruption.

He illustrated the issues with the example of one Brazilian state, Ceara, and its experience of a programme of universal electricity access through the "Light for all" initiative. Out of a total population of around eight million, two million live in the countryside of which 40% are considered to be poor (living on less than US$2 per day). There are high levels of social inequalities and clusters of extreme poverty with people living on less than US$1 per day.

Davi Francois, Karlsruhe Institute of Technology

While basic needs for electricity are covered—including refrigerators, televisions, radios, light, and cell phone charging—people have not been lifted out of poverty. They lack water supply, basic sanitation, and waste treatment: access to energy should be accompanied by other basic services. Moreover, smallholder farmers resist participating in cooperatives or other collective organisations due to negative past experiences and a mistrust of government policies, programmes, and institutions. The questions that remain include: how to reach higher levels of energy so that businesses and other productive uses can be supported? How can they develop more trust for collective, political and social organisations?

In conclusion, Davi Francois indicated that on the whole rural electrification in Ceara has been an attempt to reduce poverty; however, it is clear that only providing basic energy needs will not lift people out of poverty. Lessons learned include that it is important to build trust in collective, political, and social organisations, and that initiatives on education and capacity building must reflect rural realities. Communities should be involved in the energy supply process, providing an understanding of local profiles and enabling local challenges and needs to be addressed.

Scenarios for energy planning and management

Melio Sáenz, IANAS

Melio Sáenz discussed scenarios for energy planning and management from a theoretical perspective. The aim of his presentation was to explain how scenarios theory can contribute to energy planning. He noted that some governments, businesses, or other organisations believe a plan is strategic because it looks 25-30 years into the future. But this long-range vision does not necessarily make it strategic. A mission must come first, then a code of ethics, then a vision. Strategic planning must be comprehensive and systemic. Strategy is a very clear concept: there are nodes of information, and strategy is a path between these nodes.

He closed with an argument for using general systems theory: the scenarios outlined under general systems theory, complexity and complex thinking, allow the problems of access to energy for isolated populations to be systematically addressed. They also allow reality to be described in a coherent and consistent manner. Computer models can then simulate the dynamics of the policies, strategies, tactics and tasks.

Application of tools for consultation, planning, and forward-planning in development projects

Fernando Prada Mendoza, FORO

Fernando Prada Mendoza focused on gathering information about rural areas. Information at the village level is needed not just about energy access and use but also on other issues such as mobile phone ownership, skill levels, food security, etc. It is important to consider the minimum information you need in order to take decisions on energy access initiatives.

He noted that ministries actually have a good data mining system, but the private sector does not always know how to use these complex databases. Why not use the information from these systems and share it with the private sector? The private sector can utilise the information if the public sector provides access to information in a straightforward manner, without requiring knowledge of complex databases.

Frequently, FORO works with journalists who carry out stakeholder mapping in rural areas. Farming communities have hierarchies, and certain decision-making processes—but one only learns this in the field. It is important to understand the people with whom you are working and to have baseline data. Only then can one go a step further to convince the population of the usefulness of a technology. New technologies or ideas

need to be explained in plain, neutral language. FORO has done this through storytelling and other innovative yet simple methods.

When talking about analysis, one wants to assess impact and create scenarios of what is being solved. It is difficult to forecast, but there are people who can help us within the community. In one evaluation, 80% of failures were a result of high turnover, poor expenditure, etc.—tools are needed to prevent this. It is also crucial to listen to the community and their needs, and to gain trust. Fernando Mendoza closed by noting that sometimes the state is absent, so other sorts of alliances need to be formed.

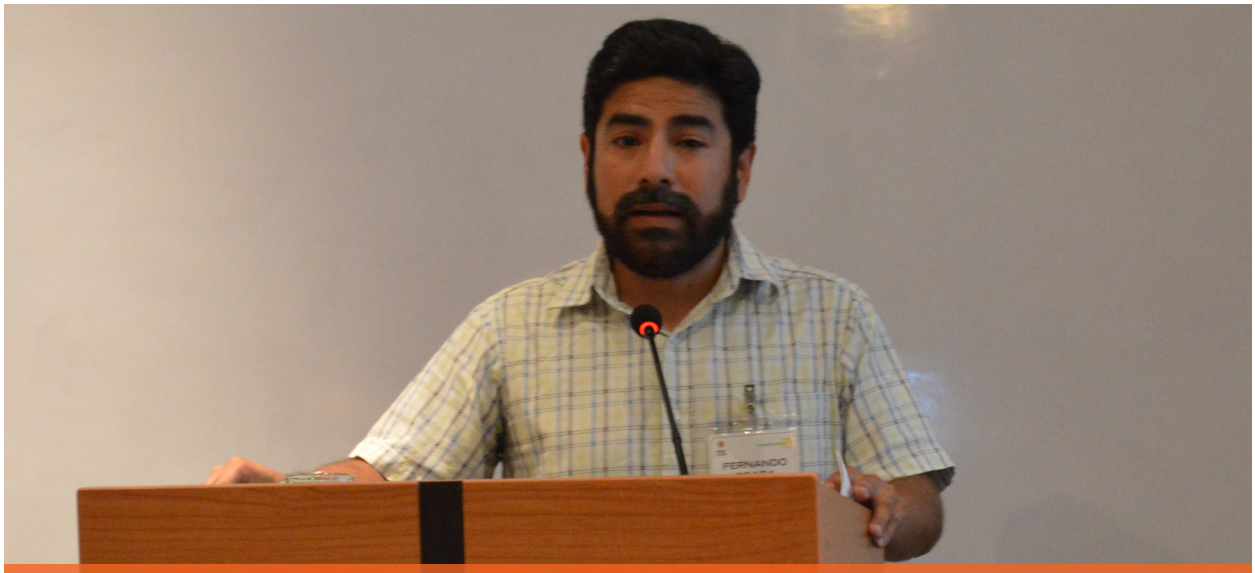
Commentary

Miguel Fernandez, Energética Bolivia, and Rafael Espinoza Paredes, Centre for Renewable Energy and Rational Use of Energy, Peru

Miguel Fernandez noted that the rural energy sector is not one of the most profitable due in part to low population density. This reality demands a lot more work and imagination than when providing electricity to densely populated areas. Academia can make a useful input based on systematic analysis and good theoretical understanding, sometimes providing evidence and insights that some stakeholders may not want to see.

If practitioners manage to make this issue of energy important, the solution for universal access will be found. But there are limitations—situations are completely different in the field. He called for information to be accessible and for actors in this field to connect with one another. To solve the problem of universal access, 31 million solutions will be necessary in South America. Data, technology, and human capacity will need to be committed to this, and there is a close synergy between energy access and provision of information and communication technologies. Light alone does not result in development: we need a comprehensive approach.

Rafael Espinoza Paredes commented that it is important to link academia with companies. Academia often focuses on knowledge, but there is also a side of it that focuses on applied research. This type of research can help to increase energy efficiency. He called for more laboratories in provinces. Referring to Peru's recent tender, he commented that 500,000 solar panels will need certification according to standards. He welcomed the role of the private sector in rural energy, especially for productive uses.



Fernando Prada Mendoza, FORO

Session 4: Experiences of rural electrification

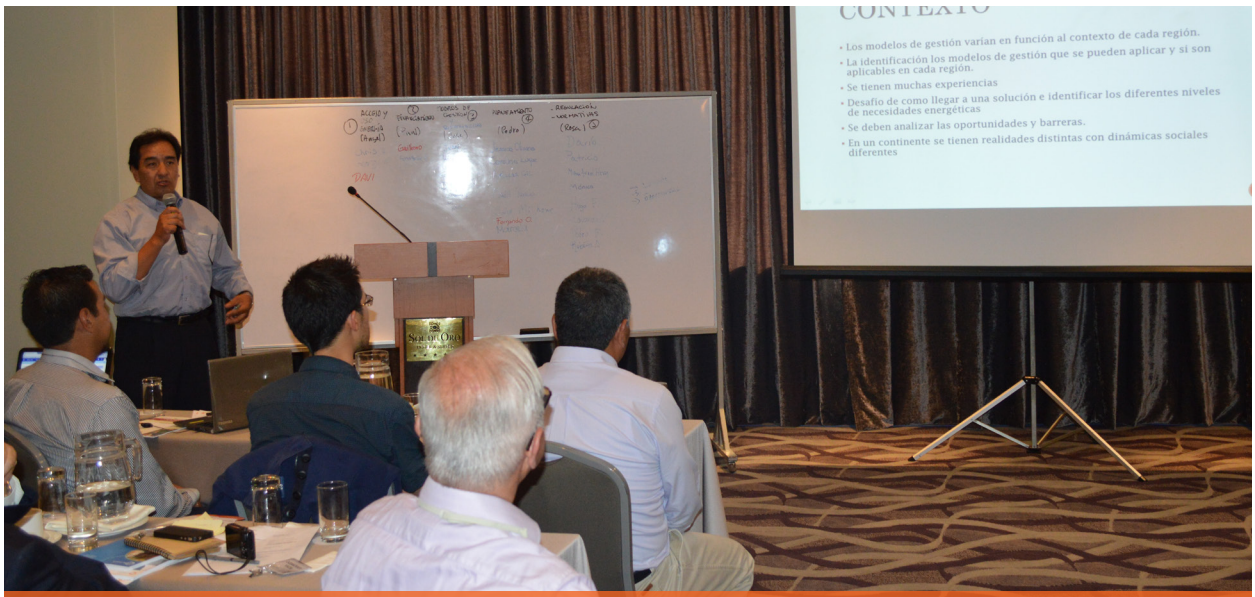
Perspectives in photovoltaic electrification

Miguel Fernandez, Energética Bolivia

In 2012, 500,000 families in Bolivia had no access to electricity. The Bolivian government has set a target of universal electricity access by 2025. It is anticipated that for 200,000 families, electricity access will be provided via photovoltaic systems. However, over the last six years, only 20,000 photovoltaic systems have been installed: the rate of deployment must therefore be substantially increased if the 2025 target is to be met. The lesson from other South American countries is that achieving universal access takes more time and resources than expected.

Miguel Fernandez indicated that substantial technological innovations over the last 10 years will help to promote the dissemination of photovoltaic systems. Lead acid batteries have been replaced by rechargeable lithium batteries, power requirements for lighting have been radically reduced by a move from tube lamps to LEDs, micro-electronic control systems have replaced electromechanical regulators, plug-and-play connectors are now available, and appliances such as cell phones, DVD players, etc. include rechargeable batteries. Taken together, these developments constitute third-generation photovoltaic systems.

Power requirements for a third-generation home system comprising two light points, a radio and TV, and a cell phone are around one third that of a traditional system which substantially reduces the cost (by 30 to 50%). Third-generation systems are quick and easy to install, lightweight (6 kg rather than 50 kg), portable, and modular enabling incremental additions. However, the technology is still developing and third-generation systems are not yet widely used in Bolivia. There are still big variations in the quality of components, and many manufacturers use unique specifications, making it impossible to get spare parts locally. Standardisation and certification criteria are needed to guide purchases and to ensure that systems can be repaired locally.



Miguel Fernandez, Energética Bolivia

The cost and performance improvements embodied in third-generation photovoltaic systems provide an opportunity for a new institutional model for their deployment. Historical concepts of access "delivering equipment" do not guarantee universality: the technology descends on the communities and there is little user identification with the projects and consequent user neglect, follow-up is non-existent and access to spare parts is not guaranteed. A paradigm shift is needed towards "regulated access" in which many end users participate in making technology sustainable. Alongside their participation, well-targeted partial subsidies of the initial investment should be made, and municipalities should decide on their priorities according to customer needs.

In conclusion, Miguel Fernandez indicated that universal access will not be possible without the participation of the state. New technologies, and in particular third-generation photovoltaic systems, can accelerate the goals of universal access in Bolivia and Latin America. A large majority of the 31 million people in Latin America currently without access to electricity will be supplied by photovoltaic systems.

Rural electrification in Bolivia

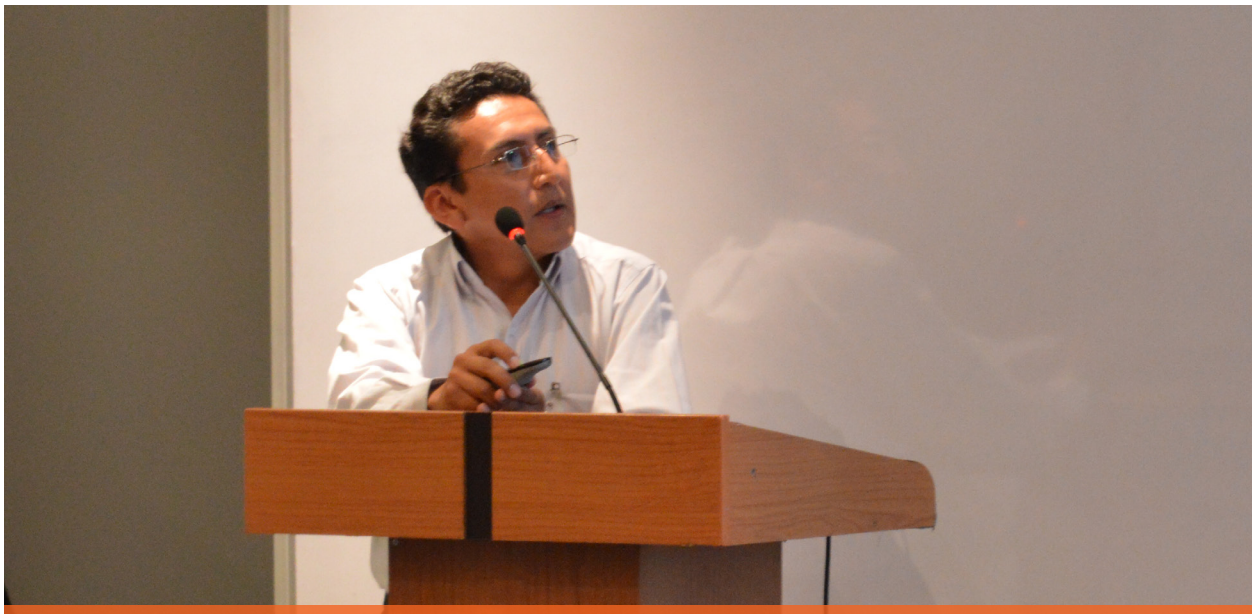
Carlos Reza, Soluciones Prácticas

Initiatives to address energy poverty in Bolivia face a number of challenges including:

- Local governments have limited capacity to promote energy development.
- There is an absence of local support for operation and maintenance.
- There is a gap between the different institutional levels in respect of information and decision making, and knowledge of electrification needs is inadequate.

Carlos Reza outlined the work of Soluciones Practicas (Practical Action) to address energy poverty in Bolivia by way of three example projects.

The first project, "MCH Amaguaya" concerned the construction of a micro-hydro scheme in a remote community that provides electricity to 90 families, an education unit for 110 students, and a health centre serving five communities. Villagers participated in the construction of the scheme



Carlos Reza, Soluciones Prácticas

and training has been undertaken of leaders, operators and families to ensure its effective operation. A community-based company has been organised to manage the operation of the scheme which charges for supply based on differentiated rates. Productive uses have been promoted, in particular the establishment of spinning and weaving businesses. People are now moving to the village and building new houses because the village has electricity.

A second project in the high plains of the Andes focused on the installation of a solar water heater and photovoltaic system on an eco-lodge for tourists. Local people were trained in the various aspects of the tourism industry, including gastronomy, the running of a hotel, and first aid.

The third project was concerned with building resilient and prosperous communities and involved the installation of a photovoltaic system to provide lighting and communication, replacing a gasoline engine, which was very expensive to run. There were initially some problems with the third-generation photovoltaic system, most notably the need to replace the batteries.

Energy, development, and life project—EnDev

Angel Verastegui, Cooking Thematic Group, EnDev

"Energising Development" (EnDev) is an energy access programme funded by the the Netherlands, Germany, Norway, Australia, United Kingdom, Switzerland, and Sweden. It is implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), which assists the German Government in achieving its objectives in the field of international cooperation in collaboration with the Dutch Cooperation Agency with the aim of providing sustainable access to energy to 14 million people across 21 countries in Latin America, Africa and Asia. The project objectives in Peru are to provide sustainable access to modern energy services through the construction of public private partnerships to support the development of markets and benefits. There are three components: energy for lighting (supplying 325,000 pico-solar saw and solar home systems), energy for cooking (clean stoves utilising wood and LPG that are 40% more efficient than an open fire for 881,500 people), and energy for productive uses (creating 9,160 entrepreneurs).

There are three million people in Peru without access to electricity. Important issues in establishing markets to meet their needs include per capita consumption and costs, operation and maintenance costs and default rates, profitable business models for the short- and medium-term, technologies and their ad hoc regulatory frameworks, and quality of service. A grid connection for a rural household in Peru typically costs US$2,000.

The EnDev approach is to establish pro-poor electricity markets through three action pillars:

- Supply: ensure production and sale of energy access technologies that are efficient and affordable, the availability of replacement parts, and after sales maintenance service
- Demand: access and adopt efficient and good-quality energy access technologies
- Environment: create a positive political and regulatory environment which facilitates sustainable energy access technologies, create the conditions to promote and maintain a market of energy access technologies, and develop multi-sectoral actions.

Interventions include actions to provide information and create awareness, capacity building including training local technicians and strengthening entrepreneurship, establishing effective

trading conditions to ensure materials supply, and building strategic partnerships with regional electric companies and other local organisations as promoters of the initiative.

700 electricians have been trained and 70,000 households have been provided with safe basic interior electrical installations. 10,000 households have been trained in the safe use of solar home systems, and a national PV training course established with SENSICO (the national body for construction industry training). 10 pico solar technologies have been validated or certified, and 15,000 pico solar systems have been sold. It has been difficult to explain to villagers why they should pay more for lithium-ion batteries.

Isolated rural electrification experiences in Ecuador

Patricio Canizares, Ministry of Electricity and Renewable Energy

Patricio Canizares explained that in Ecuador it is the responsibility of the state to provide electricity services: the aim is to achieve 100% access. Most of the poor people in Ecuador without energy access live in the Amazonia area in the east of the country. Energy access initiatives are being implemented through regional electricity distribution companies.

Problems have been encountered with solar home systems whose use has been abandoned as there has been no maintenance capacity. Also if you give technologies away people do not value them. You need to analyse people's capacity to pay.

The northern Amazonian region is an oil producing area and oil companies have offered communities electricity access based on fossil generation. Consequently, they have installed domestic appliances which cannot be supported by lower-powered solar home systems. In the southern Amazonian region 3,000 250 W solar home systems have been disseminated by the distribution company.

Key issues to consider in initiatives to provide energy access in remote communities are the geographic location, acceptance of the service, energy needs, and project sustainability. In respect of project sustainability, distribution companies need to be empowered to provide appropriate operation and maintenance systems, and analysis needs to be undertaken of beneficiary communities in respect of their payment capacity and willingness to pay.

Green Empowerment

Aaron Liss, Green Empowerment

The organisation, Green Empowerment, provides "village solutions for global change" and works in Latin America and Southeast Asia. Its mission is to provide rural farming communities in the developing world access to clean water, electricity through renewable energy, and sustainable solutions. It provides technical, financial, operational and organisational support to NGOs in target countries to implement projects. Local communities prioritise projects in consultation with the NGO partner who then requests assistance from Green Empowerment. Each community forms a committee to operate and maintain the system and collect a monthly maintenance tariff from each household. Previous experience is that in the absence of such tariffs systems will fall into disuse. Community members typically also participate in the construction and installation of systems: this helps build ownership.

Aaron Liss explained that there is a strong connection between water and energy services and the ecosystems that provide them. Technology choice is determined by energy needs, local resources (wind, water, sun etc.), local culture, and institutional factors. Costs per kWh for the technology options are typically: US$1.50-3.50 for solar PV, US$0.10-0.50 for micro hydro, US$0.30-0.80 for micro wind, and US$0.30-1.20 for diesel. An

important component of projects is to stimulate productive enterprises such as agro-processing and internet cafes which helps to pay for the system.

Key considerations in establishing a community management model include: who will fund project equipment, installation, training and maintenance?; what model is appropriate at different scales?; what model is equitable and financially sustainable?; what systems can increase with population growth?; and who will provide backup technical, administrative and financial support?

The following conclusions may be drawn from the experience to date of Green Empowerment in respect of the design and implementation of energy and water interventions:

- Energy should not be free, and the ability/willingness of households to pay is often underestimated.
- Electrons do not equal development: productive uses must be included to ensure sustainability and replicability.
- You need also to think globally and to have regard for national policies.
- You need to act locally and to diversify energy systems to fit local needs.
- Technology is usually the easy part of the project.
- All human-made things need maintenance: make sure there is a way to pay for it or else the project will not last.
- Community organisation, feasibility studies and pre-/post-assessments all help make the case for the project and establish long-term need and benefit.

More evidence is needed on the development benefits from energy access in order to make the case for investment in energy access interventions. Lessons from experiences across the world should be shared: the Smart Villages Initiative can play an important role in this respect.

Access to energy

Ivan Fernandez, EnDev Bolivia

The EnDev Bolivia "Access to energy" project is part of a global programme called "Energising Development" co-financed by the governments of Germany, the Netherlands, Norway, Australia, the UK, Sweden, and Switzerland. Projects compete for funding through their achievements: the average investment for a new beneficiary may not exceed €20 in the "Access to energy" project. The objective of EnDev's work in Bolivia is to increase the number of people in rural areas with sustainable access to modern energy sources to meet their basic energy needs. EnDev has been working in Bolivia since September 2005 on four work units: lighting, improved stoves, social infrastructure, and productive uses. It provides technical advice, capacity strengthening and co-financing (subsidies).

EnDev works with partners at national, departmental, municipal and local levels to stimulate the creation of demand for the technologies (through subsidies and dissemination) and to promote the development of a supply of different technologies (by creating entrepreneurs). A key aim is to establish access to energy systems that can last beyond the project by strengthening the capacity of a diverse set of actors and through facilitating access to microcredit. There are currently 584 sub-projects in Bolivia providing support to 319 municipalities.

Initiatives on energy for lighting include grid densification for homes and social

infrastructure, the provision of pico-solar lamps for low-income households that are not close to an electricity distribution grid, the establishment of decentralised systems typically micro-hydro plants or hybrid systems, training for men and women in the electricity sector, and information campaigns on the proper use of electric energy.

With regard to energy for cooking, the Malena stove has been developed using improved mud (a mixture of sand, straw, clay, donkey manure and, water), which saves 50% or more firewood and eliminates smoke. Models are available for households and for institutions, in particular schools. Portable metal stoves are also being designed and tested for use in the Amazonian region.

Schemes focusing on energy for productive uses address issues of primary production, in particular irrigation pumps and voltage transformers, and adding value to products, for example grain peelers, electric mills, ovens, toasters, quinoa blowers, and cooling tanks. Over the ten-year period since 2005, initiatives have helped over 25,000 local enterprises and 180,000 households. Future plans include developing new approaches, working more closely with market players, establishing public-private partnerships and micro-franchises, expanding the stove supply, and developing portable stoves for the lowland areas which are prone to recurrent flooding.

Commentary

Bernie Jones, Smart Village Initiative, and Cesar Rivasplata, Solarsur / National University Jorge Basadre Grohmann (UNJBG)

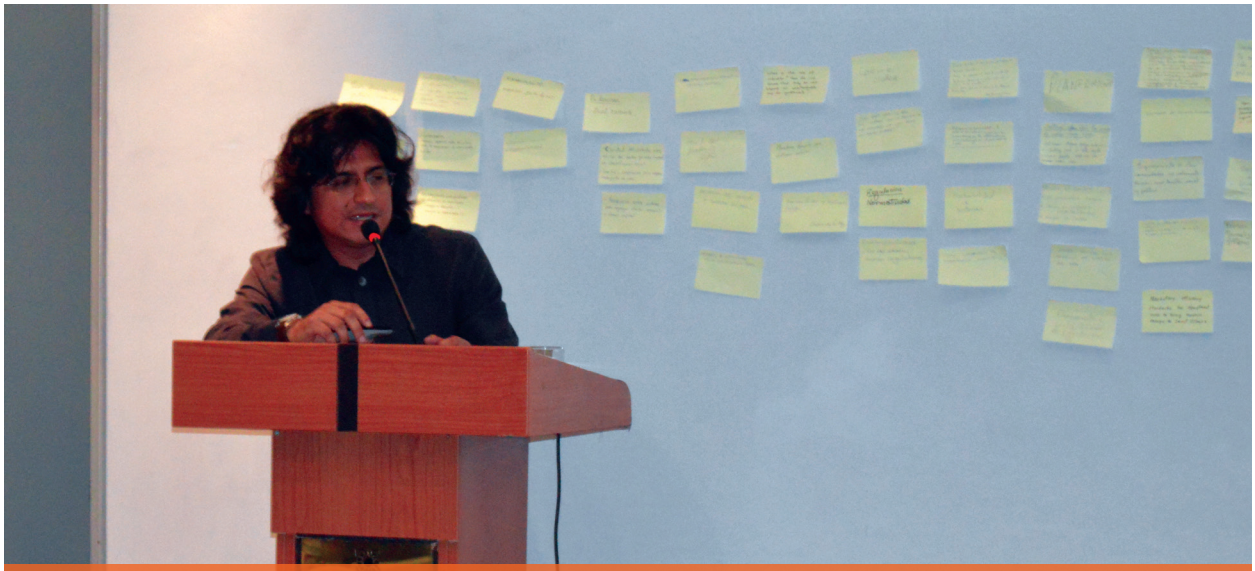
Reflecting on key points emerging from the six presentations, Bernie Jones pointed to the continuing challenges of last mile distribution, despite the good progress that has been made, and to the need to ensure product quality, particularly given the diversity of products now on the market. Working effectively with the community is a key to the long-term sustainability of projects, particularly so for very small systems in which utilities are not interested. The distinctive needs and capacities of communities need to be identified and addressed in an integrated way having regard to the wider environment within which the community is embedded.

Cesar Rivasplata spoke of the need to identify the aims of rural electrification, in particular to help overcome poverty within the concept of sustainable development. It is not electricity access alone that will solve the problem but a group of variables. We need to consider the balance between cities and the countryside: ongoing migration to the cities leads to a question of how many people will be left in rural communities.

In the south of Peru, mining companies have been established, and farming communities are typically no longer poor: the children study in cities, and there are few people left in the villages.

We need to work more with third-generation photovoltaic systems: academia needs to get involved, lending support to the evaluation and accreditation of technologies imported from abroad. Unreliable energy equipment is a backward step. Abandonment of equipment is an increasing issue and we need to quantify the environmental effects of developments.

Electricity access needs to contribute to education, which is fundamental to the long-term elimination of poverty. If equipment is given away it will not be appreciated: if households own the systems they will become more sustainable.



Gherson Linares, Energy and Environment Partnership Programme with the Andean Region (EEP) in the Inter-American Institute for Cooperation on Agriculture (IICA)

Productive uses of energy: Best practices in the Andean region

Gherson Linares, Energy and Environment Partnership Programme with the Andean Region (EEP) in the Inter-American Institute for Cooperation on Agriculture (IICA)

Gherson Linares indicated that the most valuable projects are those that can be reproduced, and a key consideration should be how energy access can lead to improvements in productivity. Energy is needed at every step in the agricultural value chain: in food production for land preparation, irrigation, fertilisation, crop protection and harvesting/threshing; in food processing and storage for drying, grinding, pressing, packaging and storage; and in distribution and sale for transport, sales and promoting demand. He gave a number of examples from the Andean region.

In a village in the mountains in the south of Peru, a solar pasteurisation system has been installed in a dairy. It provides 60 kWh/day and saves 3.5 tonnes of CO_2 per year, supporting annual sales of milk worth US$16,500 and milk products worth US$4,100. Pico- and micro-hydropower systems have been installed in mountain villages, providing substantial savings and supporting productive uses in wood and metal manufacturing, tourism, fishing, etc. The schemes have achieved good participation of women who had previously had little access to decision making in their household activities. In Colombia, residual biomass from sugarcane production is burnt in ovens to generate heat for brick making. In another scheme, waste from livestock management is used to generate gas for cooking.

The experience from the projects undertaken so far is that energy access makes pre-existing processes faster and that demand should be carefully analysed before initiating projects.

Is energy a sufficient condition for development?

Guillermo Verdesoto, Ecuadorian Foundation for Appropriate Technology (FEDETA)

Guillermo Verdesoto explained that FEDETA had been working in Ecuador for 30 years, with a particular focus on remote rural communities. Energy access alone is not a sufficient condition for development: other personal, social and environmental factors are also important. In projects in Ecuador that FEDETA has been involved in, communities have been closely

involved in the design, construction, and maintenance of energy systems. There has been a strong emphasis on training and women's participation.

A problem in Ecuador is that the government is responsible for electricity provision, so it is illegal for independent organisations to initiate schemes. Recent government focus has been on big hydroelectric schemes which generally do not help with energy access for remote communities, particularly in the Amazon region.

From FEDETA's experience to date a number of lessons have been learnt in respect of strategies for implementing energy projects:

- Projects should focus on people.
- Awareness of what people value and why is important.
- Communities need to be provided with the tools to carry out the technological choices.
- Project impacts should be assessed.
- Links to other actors should be facilitated
- A gendered approach should be undertaken in all actions.
- Energy does not in itself result in development. We need to understand people and the context in which they live.

La Fundación ACCIONA Microenergía

Jessica Olivares, La Fundación ACCIONA Microenergía, Peru

La Fundación ACCIONA Microenergía (AMP) facilitates access to basic electric services for human development, prioritising isolated rural communities and collaborating with other actors. It works closely with communities prior to, and after, installation of the solar home systems, which are loaned to families and for which they pay a monthly fee.

In the mountainous Cajamarca area in the north of Peru, its "Luz en casa" programme has provided a basic electricity service to 4000 families living in poverty through home-based photovoltaic systems (60-85 W) and a fee-for-service approach. Since 2013, operating income has exceeded operating costs. Families pay a subsidised 10 nuevos soles (US$3.5) per month, a saving on the 15 nuevos soles previously spent on batteries, candles, kerosene, charging cellphones, etc. The default rate is less than 1%. There are plans to provide electricity to 40 community centres in the area: so far, ten schools and five churches have been fitted with solar panels. 40 independent technicians have been trained to maintain the PV systems: repairs are carried out within four days.

Ten 'Luz en casa' centres have been established in the communities served by FUNDAME which provide efficient and affordable appliances together with advisory and technical services for the maintenance and repair of the solar home systems. Centres have been established on a micro-franchise model and are based at the homes of the technicians trained through the programme. FUNDAME tests and selects appliances, and provides the initial stock of the centres.

Jessica Olivares went on to describe the "Luz en casa" programme for isolated communities in the Peruvian Amazon, currently at the pilot stage. The Peruvian rainforest covers 60% of the national territory and is home to 400,000 people without access to electricity. The pilot will fit solar home systems to 50 homes and evaluate prepayment technology and remote payments.

The "Luz en casa" programme in the Oaxaca region of Mexico has shown that it is possible to electrify the smallest and most remote communities with third-generation photovoltaic systems sustainably, economically and affordably for the most marginalised. 3600 families have been provided with solar home systems in a public-private alliance for development. 25 W solar PV panels together with a lithium-ion battery support three LED light bulbs for four hours per day together with a cell phone charger and a radio or TV. The upfront cost of the solar home system benefits from a 50% subsidy. The user pays 10% down payment and the remaining 40% through 12 monthly payments.

The advantages of third-generation systems are their low-cost and easy repair, they do not contain polluting heavy metals, and their reduced size and weight means that users can transport and install them, and disassemble them and take them to user service centres for repairs. The user service centres are located in strategic municipalities serving the geographic area and are essential for the sustainability of the programme in the medium term. There are currently four operating centres in Oaxaca in which the staff members are trained to repair and replace faulty components and to inform and advise users.

Fund for Sustainable Access to Thermal Renewable Energies (FASERT)

Fernando Acosta Bedoya, FASERT

The Fund for Sustainable Access to Thermal Renewable Energies (FASERT) was established under an agreement between GIZ and the Inter-American Institute for Cooperation on Agriculture (IICA) as a mechanism to promote sustainable access to modern energy technologies and services through stimulating the market value chain of thermal renewable energy technologies. FASERT does not subsidise the technology but seeks to ensure a good match between products that are offered and the needs of users. It validates technologies and sets quality standards, and provides training to suppliers in how to set up and run a business. It also makes available appropriate financial products to suppliers and users. FASERT has supported the installation of over 10,000 improved stoves, 400 bio-digesters and 50 efficient brick kilns in Peru.

Stoves may be built in situ or be manufactured industrially. In situ stoves have the advantages of being flexible in design, adaptable to local needs, users participate in their construction and can provide local materials, and they promote local employment. Their disadvantages are that it is difficult to guarantee quality and performance, training installers and construction takes time, there may be a need for materials that cannot be found locally, and they are impossible to move. Cookstoves manufactured industrially have the advantages of standardised quality and performance, they are ready to use, local installers do not need to be trained, and they lend themselves to mass production and distribution. Their disadvantages are that local needs must be taken into account, price cannot be reduced through local participation, transportation costs must be considered, and taxes may be significant if imported.

National University San Augustin (UNSA) and electrification

Pedro Flores Larico, Centre for Renewable Energy Arequipa

Pedro Flores opened his presentation by outlining the academic activities of the Centre for Renewable Energy and Energy Efficiency at the National University San Augustin (UNSA). A Master's degree in renewable energy has been designed, and, after adaption to the new law, a call for admissions will be made.

He went on to summarise experience of casting Pelton runners by means of the lost wax method. He concluded his presentation by showing energy systems in Arequipa installed by Geonergia, which include a public lighting system at the Calquipa mine powered by a 145 W solar PV panel and a similar size panel at Jazminez de Cayma which powers a radio, TV, 20 W LED, blender, and four bulbs.

HUB Project—the Centre for Appropriate Technologies in Latin America (CETAL)

Giannina Solari, Soluciones Prácticas (Practical Action)

Soluciones Prácticas and the Institute of Development Studies (IDS) have collaborated to develop an open knowledge hub on appropriate technologies: the Centre for Appropriate Technologies in Latin America (CETAL). It aims to be an online space that facilitates the exchange of information on technologies automatically between the various partners and organisations that provide information. In its first stage, the hub will focus on the issue of renewable energy. A precursor study identified a great need to organise and disseminate information on renewable energy in Latin America.

The hub will not serve as a repository of documents but will be a database that provides bibliographic data and key information (such as title, summary, author, publisher, year of publication, themes, tags, URL to the material). Benefits of participation in the hub will include automatic exchange of specialised and reliable information, higher visibility of knowledge products through the hub, increased access and dissemination of publications through others windows, learning about new integration tools to share information in a more effective, creative and innovative way, better positioning of publications in search engines, and recognition as an organisation that is committed to the management, access, and exchange of open knowledge.

Commentary

Oliver Marcelo, IICA, and Oscar de la Maza, Universidad Nacional Pedro Henríquez Ureña (UNPHU)

Oliver Marcelo began his remarks by reflecting that energy access initiatives need to focus on the consequent uses and development benefits. Skills development should be stressed and knowledge made available in an orderly way. In past years we have only seen pilot projects: the market approach being developed over the last two years is welcome and should allow for interventions to be sustainable and to be scaled up.

Consideration of the ecosystem for renewable energy technologies has so far not considered financing sufficiently: financiers are needed at meetings like this. Technical people and bankers need to be able to speak the same language.

In Peru, there are very few startup companies focusing on the provision of rural energy. The state could play more of a role in encouraging the entrepreneurial approach.

Oscar de la Maza indicated that political will and vision are needed to promote rural energy: the state should be the engine that promotes rural energy access. Its participation should not just be through investment but also through providing appropriately targeted subsidies and incentives, taking care to ensure that they have a clear focus and avoid being permanent. However, state subsidies often do not reach remote communities. State involvement can also lead to red tape, which puts off private sector companies. Energy access initiatives should look beyond the provision of lighting to comprehensive solutions that contribute to social development.

Session 5: Renewable energy: Challenges, barriers, and perspectives for rural electrification in the current context

Workshop participants were asked to identify the issues that they wished to discuss in more detail during the breakout session on the final afternoon. Suggestions were grouped under five headings and five breakout groups were consequently convened to discuss. The plenary feedbacks from the breakout groups are summarised here.

Access to electricity

The key barriers to electricity access for rural communities were identified as geographical factors (for example developing supply chains for dispersed communities), high transaction costs, problems with poor quality and counterfeit products, and the lack of an energy vision in many countries. Also, higher levels of awareness need to be developed of financial savings of systems when compared to current practices, of social and environmental benefits, and of the technical aspects of new technologies. User confidence needs to be built in product quality and capability. Organisations sometimes push products without training.

Better understanding needs to be developed of what is valuable to a community's development (for example money, health, food, education, beers). Careful consideration should be given to other key factors that are important to development apart from just energy access: it is not just about energy for energy's sake. There should be community ownership at all stages of the process.

Energy products should be made available in non-specialist stores. Initiatives should enable villagers to capture more of the value chain (for example, to enable an Amazonian farmer to sell directly to a shop in London).

Financing

Financing schemes should be designed to meet the different needs and responsibilities of the various actors (e.g., NGOs, villagers/users, entrepreneurs, etc.), which need to be clearly identified. Financing arrangements need to be in place for the whole value chain, including end users. Governments should facilitate the establishment of an efficient environment for the

Workshop participants during a breakout session

value chain. Well-managed funds are needed for government programmes, and non-reimbursable and low-interest loans for the private sector.

The barriers to establishing effective financing arrangements vary according to the actors:

- Users often face high interest rates and have difficulty obtaining guarantees in order to access conventional credit. There may be confusion as to whether they should be given something or would have to buy it.

- Small businesses can solve the upfront cost barriers faced by users with pre-payment and financing schemes, but they lack access to working capital. Uncertainties around state intervention can damage the market. It can be difficult for small businesses to turn a profit.

- There may be state restrictions on large companies participating or investing. Low returns and high transaction costs associated with small schemes act as a disincentive.

- Governments often lack the required technical capacity and there is a shortage of investment in information required to inform decision-making. Government philosophies on where and how to provide funding may be incongruent with the needs of value chain actors.

- Multilateral organisations, banks, and investors can only enter through the state. There is an insufficient pipeline of projects in which they can invest. They are better suited for larger scale investments rather than for many simultaneous and smaller scale investments.

Governments can reduce the operating costs for actors in the value chain (for example, through simplified procedures, reduced taxes, etc.) and can provide incentives for financial institutions. They can act to facilitate the effective operation of the value chain (through providing information, establishing regulations, setting up training schemes, and promoting energy access). It is better that they cover the costs of introduction and operation rather than provide subsidies.

Multilaterals and financing entities, when working with governments, should support well-designed national programmes with defined roles and monitoring and tracking components. An important contribution is to establish non-reimbursable funds as seed money to prepare the ground in the sector. Also, low interest funds should be made available to the private sector, and guarantees/risk sharing arrangements can strengthen the system.

Management models

The realities and social dynamics will be distinctive within each region: the specific opportunities and barriers must therefore be analysed. The appropriate management model will vary according to the context of each region: there are many differing experiences.

Management models must consider three fundamental pillars: the participation of the community, the state (including funding and regulations), and the private sector/NGOs. Leaders, conflicts, and objectives to be achieved must be known for community electrification. The objective should be universal access to energy including appropriately equipped homes, the provision of community services, and the productive uses of energy. In several countries, access to energy is now considered a human right.

In order to ensure the sustainability of projects, training must be provided and there must be a proactive response from the end-users. Electricity access can support social inclusion and provides the opportunity to satisfy other needs. There may be a gap between the cost of electricity provision in rural areas and what people can afford: public-private partnerships help to address this problem.

Planning

There needs to be synergy between planning at the micro and macro level, and the approach to planning should recognise that specific needs will vary between different locations. Planning should address financing, subsidies and energy/food security, and should enable the identification of management models. There needs to be effective coordination between the various government departments.

Problems associated with planning include:

- Energy solutions are not discussed and agreed on with the target population, and the objectives of energy use are not established.
- There is no road map, reliable information, environmental impact assessment, regulations, or rates for hybrid systems, micro-grids, etc.
- The state is not ready to articulate the different services and there is a lack of infrastructure.

Public resources are likely to be wasted if there is a lack of planning. Planning at a micro scale can be replicated. Planning can provide new opportunities if it takes appropriate account of the potential role of women and ensures the provision of better education including training on specific subjects. It can also create an important role for the private sector through partnerships with other institutions, not just the state.

Regulation and standards

There should be a classification of consumption areas and differentiated charging. There is value in standardised equipment and systems. Governments should create incentives to promote renewable energy for rural communities which should establish viable and accessible financing mechanisms, generating investment (which should be regulated). Subsidies should be time limited and should be calculated in order to bring revenues up to a level that makes projects viable.

Regulations should be put in place for the handling of waste products and system components at the end of their operating life. Companies should establish systems that provide a mechanism for the treatment of redundant parts and should be required to set up recycling programmes. They should have environmental management plans for their products. Regulations should be mandatory, not just recommendations.

Session 6: Concluding Session

Summary and concluding comments

John Holmes, Smart Villages Initiative

In his concluding comments, John Holmes reflected on the substantial body of information that had been presented over the two days of the workshop through more than 30 presentations, and which had been generated through the many formal and informal discussions. There are substantial challenges in providing energy access to the 30 million people in South America who do not yet have electricity—they live in remote and difficult to access communities—but the impression from the inputs at the workshop is that there is the will and the means to overcome the challenges.

He explained that a workshop report and accompanying policy brief will be written by the Smart Villages team and distributed to workshop participants who would be encouraged to disseminate the reports to other stakeholders. He ended by thanking all the organisations and individuals who had made the workshop such a success, not least the workshop participants themselves who he hoped the Smart Villages Initiative would be able to continue to collaborate with in future.

Workshop participants

Annex 1: Workshop programme

Monday, 25 January 2016

0830 **Registration**

Inauguration of forum

0900 **Welcome**

Rafael Escobar, Soluciones Prácticas (Practical Action)

General Information and Forum Objectives

John Holmes, Oxford University and the Smart Villages Initiative

Smart Villages Initiative

Claudia Canales

Session 1: Renewable energies and their role in rural development

1000 **Plenary**

Fernando Ferreira, Latin American Energy Organization (OLADE)

1030 **Break**

1050 **Presentations**

Jose Maria Rincón, Inter-American Network of Academies of Science (IANAS) Energy Program, Colombia

Dario Rodriguez, National Institute of Energy Efficiency and Renewable Energy (INER)

Rosa Argomedo, Global Changes

Victor Murillo, Social Inclusion Energy Fund (FISE)

José Eddy Torres, International Energy Consultant

1230 **Q&A session**

1300 **Lunch**

Session 2: Renewable energy and rural electrification

1400 **Presentations**

Fabio Rosa, IDEAAS / RENOVE

Wendy Guerra, World Bank Bolivia

Christoph Schultz, Light up the World

John Millhone, Energy Program, Inter-American Network of Academies of Science (IANAS)

Marcela Reynoso, Latin American Energy Organization (OLADE)

Marc Benhamou, Fundacíon Alimentaris

1510 **Commentary**

Ana Isabel Moreno, EnDev Peru

Pedro Gamio, Global Village Energy Partnership

1530 **Break**

Session 3: Renewable energy: the view of academia and the private sector

1600 **Presentations**

Michael Callahan and Paul Winkel, PowerMundo

Manfred Horn, National University of Engineering, Peru

Davi Francois, Institute for Technology Assessment and Systems Analysis, Karlsruhe Institute of Technology

Melio Sáenz, InterAmerican Network of Academies of Science (IANAS), Ecuador

Fernando Prada Mendoza, FORO Nacional Internacional

1715 **Commentary**

Miguel Fernandez, Energética Bolivia

Rafael Espinoza Paredes, Centre for Renewable Energy and Rational Use of Energy, Peru

Tuesday, 26 January 2016

Session 4: Experiences of rural electrification

0900 **Presentations**

Miguel Fernandez, Energética Bolivia

Carlos Reza, Soluciones Practicas

Angel Verastegui, Cooking Thematic Group, EnDev

Patricio Canizares, Ministry of Electricity and Renewable Energy

Aaron Liss, Green Empowerment

Ivan Fernandez, EnDev Bolivia

1030 **Panelists**

Bernie Jones, Smart Village Initiative

Cesar Rivasplata, Solarsur / National University Jorge Basadre Grohmann (UNJBG)

1045 **Break**

1105 **Presentations**

Gherson Linares, Energy and Environment Partnership Programme with the Andean Region (EEP) in the Inter-American Institute for Cooperation on Agriculture (IICA)

Guillermo Verdesoto, Ecuadorian Foundation for Appropriate Technology (FEDETA)

Jessica Olivares, La Fundación ACCIONA Microenergía, Peru

Fernando Acosta Bedoya, FASERT

Pedro Flores Larico, Centre for Renewable Energy Arequipa

Giannina Solari, Soluciones Prácticas (Practical Action)

1245 **Commentary**

Oliver Marcelo, IICA

Oscar de la Maza, Universidad Nacional Pedro Henríquez Ureña (UNPHU)

1300 **Lunch**

Session 5: Renewable energy: challenges and barriers for rural electrification in the current context

1400 **Panel of specialists:**

Rosa Argomedo, Global Changes

Rafael Escobar, Soluciones Prácticas (Practical Action)

Pedro Gamio, Global Village Energy Partnership

Paul Winkel, PowerMundo

1530 **Plenary**

1545 **Break**

Session 6: Concluding Session

1600 **Summary and concluding comments**

John Holmes, Smart Villages Initiative

Annex 2: Workshop participants

Name	Organisation
Rafael Escobar	Soluciones Prácticas Peru
Ivo Salazar Taute	Soluciones Prácticas Peru
Ana Isabel Moreno Morales	EnDev Peru
Fernando Prada Mendoza	Foro Nacional Internacional
Víctor Murillo Huamán	OSINERGMIN / Social Inclusion Energy Fund (FISE)
Manfred Horn	National University of Engineering, Peru
Monica Gomez	Universidad Nacional de Ingeniería (UNI)
Carolina Luque Apaza	Centro de Energías Renovables y Uso Racional de la Energía
Rafael Espinoza Paredes	Centro de Energías Renovables y Uso Racional de la Energía
Maricarmen Larrauri	British Embassy
Paola Córdoba	British Embassy
David Carcausto Rossel	Fondo de Inversión Social Energetico – FISE
Pedro Gamio Aita	Global Village Energy Partnership
Gherson Linares	Energy and Environment Partnership Programme with the Andean Region (EEP) in the Inter-American Institute for Cooperation on Agriculture (IICA)
Fernando Acosta	IICA
Michael Callahan	PowerMundo
Paul Winkel	PowerMundo
Jessica Olivares	ACCIONA Microenergía Perú
Aaron Liss	Green Empowerment
Samuel Schlesinger	Green Empowerment
Raul Tolmos	World Bank
Christoph Schultz	Light up the World
Jonathan Cullen	Cambridge University
Wilfredo Herrera	Entelin Company Solar Systems
Paul Winkel	PowerMundo
Pedro Flores Larico	Centro de Energias Renovables Arequipa
Carlos Reza	Soluciones Practicas Bolivia
Miguel Fernández Fuentes	Energética Bolivia
Wendy Guerra	World Bank Bolivia (Project IDTR2)
John Millhone	IANAS
Jose Maria Rincon	Colombia
Melio Saenz Echeverria	Ecuador
Davi Francois	Karlsruhe Institute of Technology
José Eddy Torres	International Consultant
Edisson Guillermo Verdesoto Bolaños	FEDETA

Fernando César Ferreira	Organizacion Latinoamericana de Energia
Marcela Reinoso	Olade Expertos en Red
Oscar de la Maza	Director de Agronenergia
Rosa Argomedo	Directora Global Changes Energy, Chile
Fabio Rosa	Ideaas
Franco Canziani	Gerente de WAIRA Energía S.A.C.
Fernando Oscco	UNI
Marc Benhamou	Alimentaris
Diego Manzana Monzó	ECOTURRENOVA
Carolina Vidal	IICA
Angel Verastegui	GIZ
Roberto Arivilca	Geoenergia Peru eirl
Oliver Marcelo	IICA
Ivan Fernandez Guzman	EnDev Bolivia
Dario Rodriguez	MEER Ecuador
Patricio Canizares	MEER Ecuador
Nadit N. Paredes Choque	Consultant
Christopher Jensen	Light up the World
George Evans	Light up the World
Alejandra Bustamante	Energia Innovadora
Hugo Fernandez Otoya	Instituto de Estudios Peruano
Frédéric Bazzoli	PAC
Amilcar Gil	
Roxana Barrantes Cáceres	
Cesar Rivasplata	Solarsur / National University Jorge Basadre Grohmann (UNJBG)
Giannina Solari	Soluciones Practicas
Antonio Rico	FOSERA-NEMETSA
Doris Mejca	Soluciones Practicas
Andrea Ramos Bonilla	Grupo de analisis para el desarollo
Manuel Glave	GRADE
Eduardo Vargas	IEP
Roxana Barrantes	IEP
Diego Rafael Escobar Banda	Photographer
Bernie Jones	Smart Villages Initiative
John Holmes	Smart Villages Initiative and Oxford University
Claudia Canales	Smart Villages Initiative
Molly Hurley-Dépret	Smart Villages Initiative

SMART VILLAGES

New thinking for off-grid communities worldwide

The Smart Villages initiative is being funded by the Cambridge Malaysian Education and Development Trust (CMEDT) and the Malaysian Commonwealth Studies Centre (MCSC) and through a grant from the Templeton World Charity Foundation (TWCF). The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the Cambridge Malaysian Education and Development Trust or the Templeton World Charity Foundation.

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