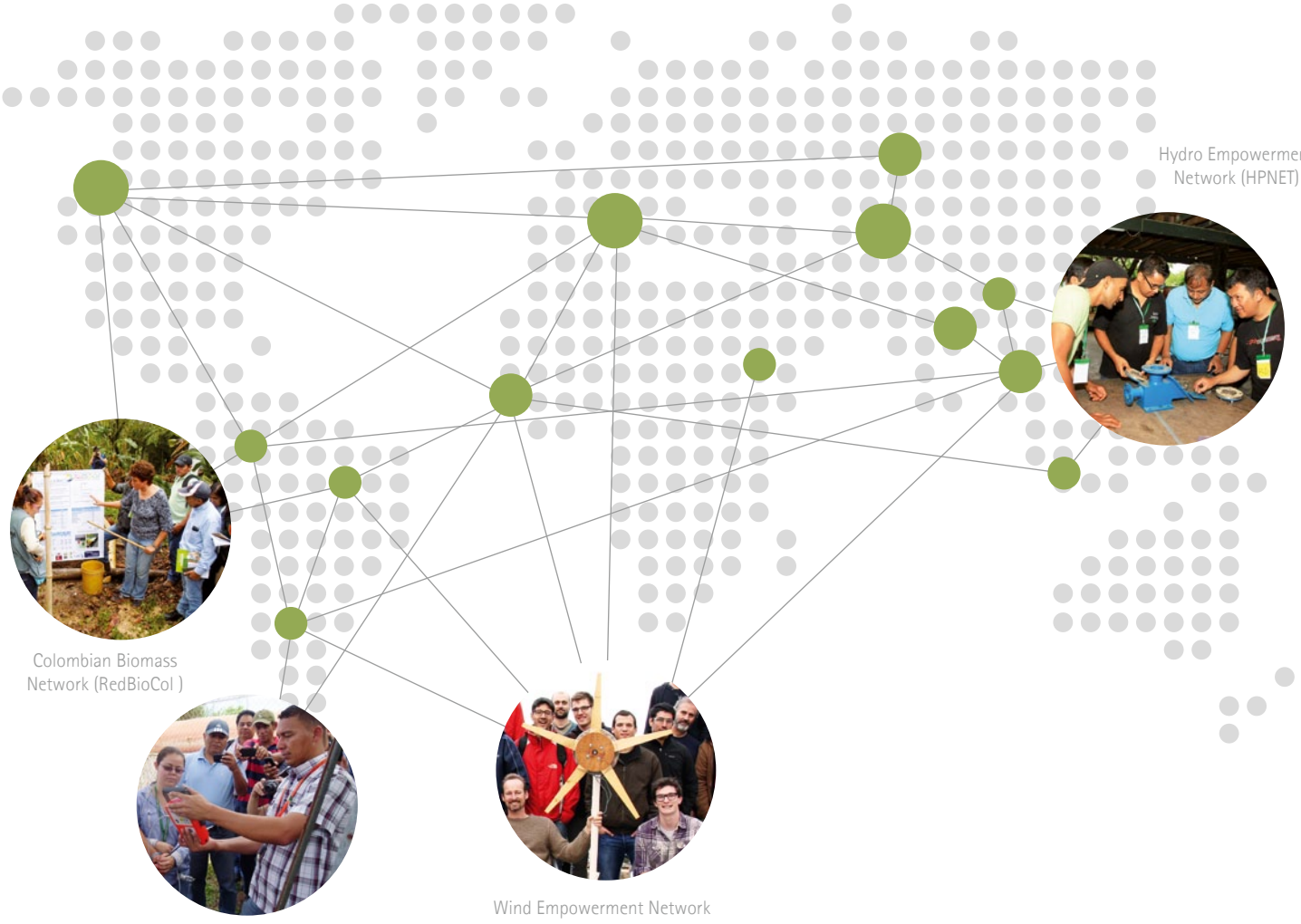


ENERGY PRACTITIONER NETWORKS

Linking knowledge and skills for sustainable energy solutions

www.wisions.net

WISIONS of sustainability

CONTENTS

WISIONS INITIATIVE

WISIONS of sustainability was launched in 2004 to promote practical and sustainable energy solutions. Its long-term objective is to make clean energy a default solution for basic energy needs in developing regions. The initiative's approach is to empower local practitioners to identify and scale successful models and techniques in their regional contexts. The recognition that energy access is not an end in itself, but a means of meeting human developmental needs and of improving livelihoods, is one of the guiding principles of WISIONS.

"WISIONS of Sustainability" is a Wuppertal Institute initiative supported by the Swiss-based foundation ProEvolution.

NETWORK SUPPORT

WISIONS fosters regional partnerships and practitioner networks to facilitate knowledge development and sharing between practitioners and stakeholders and to induce the broader dissemination of decentralised renewable energy solutions. Four international networks have been consolidated and they each focus on a specific technical solution for a region.

These networks actively involve more than 120 organisations and individuals who have long been committed to people-centred sustainable energy solutions. Their key elements, objectives and activities are described in this publication.

- RedBioLAC: the Latin American biogas network
- RedBioCol : the Colombian network for energy from biomass
- HydroEmpowerment Network (HPNET): for micro-hydropower in South and South East Asia
- Wind Empowerment: the global network for small wind turbines

SEPS PROJECT SUPPORT

Through the supporting scheme SEPS - Sustainable Energy Project Support - WISIONS nurtures innovative energy projects and fosters knowledge exchanges between practitioners. WISIONS applies a set of criteria to ensure the sustainable character of the projects and conformity with other development goals. Since its foundation, SEPS has provided total financial support of approximately 5 million EUR to over 100 projects and exchange activities in around 40 countries around the world.

Case studies, supported under SEPS, illustrate the lessons learned in the field. Some examples linked to the practitioner networks are described in this publication and also feature on our website: http://www.wisions.net/projects. We combine the practical development work of the WISIONS initiative with academic knowledge gained from research undertaken by the Wuppertal Institute in the field of energy development.

ENERGY PRACTITIONER NETWORKS

ENERGY PRACTITIONERS – THE PEOPLE BEHIND EVERY SUCCESSFUL ENERGY PROJECT

The key actors on the frontline of the on-going efforts to provide energy services to unelectrified and under-served areas in developing and emerging countries are considered to be "practitioners". These practitioners work for non-governmental organisations, as energy entrepreneurs, in energy agencies, for small and medium-sized enterprises or as independent experts. Together with associated organisations, they are based and operate in the target areas and offer a direct link to communities and end-users of the energy services.

Consequently, they are often more than simply providers of technology; ideally they should be good organisers, financial managers, problem solvers, trainers and mediators as well as good technical installers.

Their work in the field and within communities provides the practitioners with in-depth knowledge, daily lessons and hands-on training – and is riddled with challenges. At the same time, these practitioners have only limited opportunities to share their experiences with other practitioners or stakeholders such as policymakers or decision-makers.

We consider Energy Practitioner Networks to be an important means for facilitating effective knowledge exchange and mutual learning, giving practitioners a voice. As such, these networks play an important role in the transformation towards (decentralised) sustainable energy systems in off-grid regions.

NETWORKS – KEY ELEMENTS

Social networks – relationships between a set of actors such as individuals or organisations – are widespread and recognised for facilitating successful international cooperation and exchanging research knowledge [2].

Energy practitioner networks in the global south, which in this publication are defined as social networks that involve and interlink practitioners active in the field of decentralised energy solutions, are still scarce.

Network is a generic term and in different social networks the type of members, topics, organisational structure and means of communication differ enormously; however basic preconditions apply to every social (knowledge) network. These include the purpose of the network, its structure and its processes [3, 4].

SDG7 – Access to Electricity

Energy access plays a crucial role in achieving sustainable development. Recognising this importance, "access to affordable, reliable, sustainable and modern energy for all" is one of the 17 Sustainable Development Goals (SDGs) for 2030, adopted by the member states of the United Nations in September of 2015 and the driving force behind the United Nations Sustainable Energy for All (SE4All) initiative.

Micro and off-grid energy solutions are acknowledged to play an important role in meeting this goal and addressing the energy needs of the 2.7 billion people globally who lack access to modern energy services [1]

Purpose

- Shared target and vision – a basic understanding among the members that only by working jointly can the mutual targets be achieved and the mutual problems solved.
- Group composition/landscape of members – the network's members must be sufficiently heterogenic to allow for mutual learning, but not too different to hinder exchange.

Structure

- Member's mutuality – all members recognise that every member is an expert who can contribute, but who can also gain from the cooperation within a sound ratio of give and take. This spirit is facilitated through mutual trust and a flat network hierarchy.
- Network structure and formalising relationships – a basic structure is crucial and should include a clear organisational plan, clear decision-making processes and clearly allocated

Excursion during the national meeting organised by RedBioCol in Medellin, Colombia

Excursion during the annual conference organised by RedBioLAC in Honduras

responsibilities. Ideally the network structure should be planned when the network is initially created.

- Promoter – it is helpful to have an internal (or external) promoter or to develop a culture of cooperation and support the development of competencies, external relationships and advocacy.

Processes

- Communication – the relationships between the actors need to be maintained by means of (targeted) communication.
- Active exchange & common activities – a core element is the actual interaction between the members, which must take place regularly in order for the network to be effective and become sustainable.
- Monitoring impact – last but not least, measuring the impact and value of the network, as well as the functionality and efficiency of its work, are elements that need to be considered.

Specifically, knowledge networks provide an opportunity to foster the dissemination of decentralised sustainable energy solutions beyond the timeframe and scope of individual projects by emphasising joint value creation, by strengthening the capacity of all members and by providing more options to transform knowledge into policy and practice as well as to influence decision-making processes.

Considered literature: [2–8]

Energy Access Practitioner Network

On a global scale, the Energy Access Practitioner Network was formed as part of Sustainable Energy for All (SE4All), initiated by the UN foundation in 2011. The Network's particular focus is on the removal of market barriers to the effective delivery of energy services by promoting the adoption of new technologies and innovative financial and business models, as well as the identification and dissemination of best practices and advocacy for universal energy access. http://www.se4all.org/about-us_practitioner-network [9]

WISIONS SUPPORTED PRACTITIONER NETWORKS

Regional practitioner networks are an increasingly important element of the WISIONS initiative. A central finding from project support provided by WISIONS is that local capacity-building is crucial for ensuring the success and sustainability of clean energy projects.

Therefore, the WISIONS approach relies on fostering and maintaining cooperation with and between capable and committed individuals and organisations by promoting the foundation of energy practitioner networks and supporting existing networks. The aim is to facilitate knowledge sharing between local practitioners and other relevant stakeholders in order to develop local expertise in specific focus technologies, contributing ultimately to the broader dissemination of decentralised renewable energy technologies.

The first network supported by WISIONS was the Latin American Biogas Network RedBioLAC (see pages 5–11), in 2009. WISIONS now supports four networks (see map page 15–16). Three focus on specific regions and emerged from activities supported by WISIONS, while the fourth, Wind Empowerment, (see pages 17–21) is active on a global level and emerged from activities outside WISIONS supporting schemes.

The Hydro Empowerment Network, HPNET (see pages 22–28) is the newest but largest network, active in South and South East Asia to advance and advocate for sustainable micro-hydropower. The only national network is RedBioCol , the Colombian Network for energy from biomass (see pages 11–14).

The four networks involve more than 120 organisations and individual members committed to people-centred sustainable energy solutions and the direct support provided by WISIONS offers basic co-funding for management and coordination, as well as facilitating face-to-face gatherings and other network events. WISIONS also provides financial support to a number of workshops, selected projects and other exchange activities via open calls for its supporting scheme SEPS – Sustainable Energy Project Support (see Case Studies). To promote mutual learning between the networks, a format for regular exchanges between the network coordinators has been initiated.

The WISIONS team offers advice to the network coordinating bodies and steering groups on challenges faced and strategies for further development. However, all the networks are fully self-reliant in their decision-making processes and aim to become sustainable in the long-term by consolidating their funding and support from advisory bodies.

STRUCTURE AND KEY ACTIVITIES

The four networks all have their individual characters but share a similar centralised structure, with a strong core and close connections to their members [8]. The structure comprises an Executive Board (also called a steering group or Board of Directors), a coordinator, thematic working groups with leaders and the individual members and member organisations (see Figure 1).

Most important for day-to-day operations is the network management, a function carried out by the coordinator. The coordinator is responsible for internal and external communications, documentation and organisational tasks as well as – at least partly – for advocacy and fundraising. The coordinator is supported and supervised by a board or steering group, which meets regularly, develops the network strategy and makes key decisions. A handful of member experts are involved in thematic working groups to discuss problems, develop concepts or formulate studies, activities or further capacity-building.

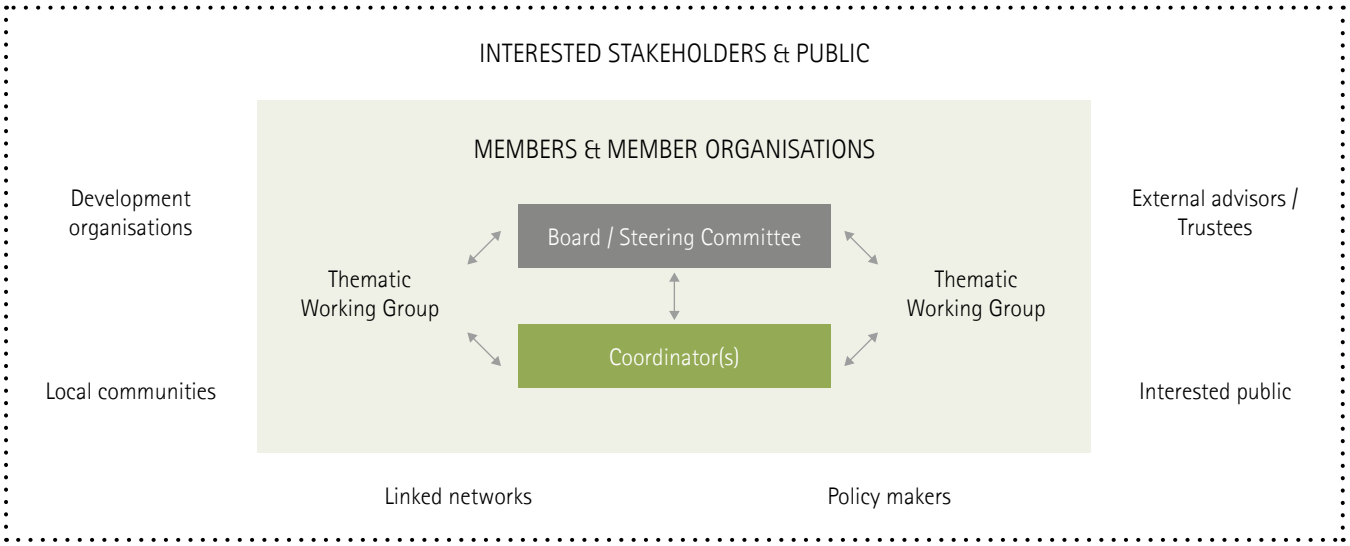


Figure 1. Simplified structure of the practitioner networks supported by the WISIONS initiative

REDBIOLAC

LATIN AMERICAN BIOGAS NETWORK

Website: http://redbiolac.org/ (Spanish)
Contact: redbiolac@gmail.com
Coordinator: Mariela Pino

Founded in 2009 in Peru, RedBioLAC – Red de Biodigestores Para Latino América y el Caribe – is a multinational network connecting actors in the biogas field across Latin America and the Caribbean. It brings together organisations, private enterprises and individuals from 14 countries (Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Colombia, Ecuador, Bolivia, Paraguay, Chile, Cuba, Argentina, Peru and Spain).

Its aim is to achieve the universal use of biodigester technology as a tool for contributing to a better quality of life and empowering the region's population.

From its establishment in 2009, RedBioLAC focused on hosting annual international conferences and by 2016 the network had coordinated 8 events in a number of its member countries. These events were open to the public and attracted around 100 participants annually, helping to grow the interest in biogas and off-grid energy technologies in the host countries and beyond.

Participants at the annual RedBioLAC conference in Colombia

BACKGROUND AND DEVELOPMENT

In May 2009, a workshop took place in Cajamarca, Peru, under the framework of a former SEPS project, which focused on sharing experiences on the use of domestic biodigesters in Latin America. The lively discussions demonstrated huge potential for mutual learning. Although there is a long history of initiatives which have adapted, tested and further developed small and medium-sized biogas technologies (ranging from 4m3 to 300m3), forums for exchanging experiences were almost non-existent, especially for practitioners active in the field.

During a second meeting in 2010 in Costa Rica, the network was formalised and the first strategic plan for RedBioLAC was developed. The focus of the founding members was on low-cost and locally-produced biodigesters that could easily be maintained, such as tubular (plug flow) systems.

In its early years the exchange concentrated on technical challenges and the development of domestic biogas systems based on livestock waste, but over time RedBioLAC's range of topics and member organisations diversified.

STRUCTURE OF THE REDBIOLAC NETWORK

During 2016, the network started a process of consolidation, aiming to strengthen its advocacy and outreach activities. The revised structure comprises a board of directors (in charge of strategic decisions), an honorary council with extensive experience in the biogas field (which provides advice but does not have decision-making powers), a coordination team (to ensure that planned activities are implemented) and numerous individuals who participate in the online forum. Moreover, topic specific working groups, with participants drawn from all layers of the network, provide increased capacity and improved agency, linking RedBioLAC and its members more strongly to both internal and external actors with shared goals.

In order to realise all the projected activities, continuous fundraising efforts are crucial for ensuring the smooth running of the network. Green Empowerment was a founding member and has occupied the role of network secretariat since the outset, responsible for the administration of the funds and for overall supervision, while WISIONS is one of the supporting organisations, contributing mainly through its funding schemes, advocacy and general advice.

OBJECTIVES

RedBioLAC's vision is to become the leading organisation providing research, development, implementation and advocacy for the use of biodigesters to stimulate the sustainable management of natural resources and promote the socioeconomic wellbeing of people in Latin American and Caribbean.

As part of the above-mentioned consolidation process, the following strategic priorities were set:

- Stimulate and facilitate knowledge exchange among biogas experts and with other relevant actors
- Promote the integration of biogas-related topics at different educational levels

Biogas

Biogas is the gaseous product of breaking down organic matter in the absence of oxygen. It can be used to meet different energy needs, ranging from electricity, cooking or food processing to heating and cooling.

Using the biogas in an appliance, be it an engine, a biogas stove or a cooling device, is relatively easy, but is only the final component in a relatively complex system, where biomass is converted into biogas. Several variables can affect the anaerobic digestion process and considerably reduce the production of methane (which is the main energy carrier in the biogas). Particularly important is the regular feeding of the biodigester with appropriate organic material, which is a laborious activity requiring daily input from the user (e.g. collecting substrate, mixing it with water, charging the biodigester, treating or disposing of the digestate etc.).

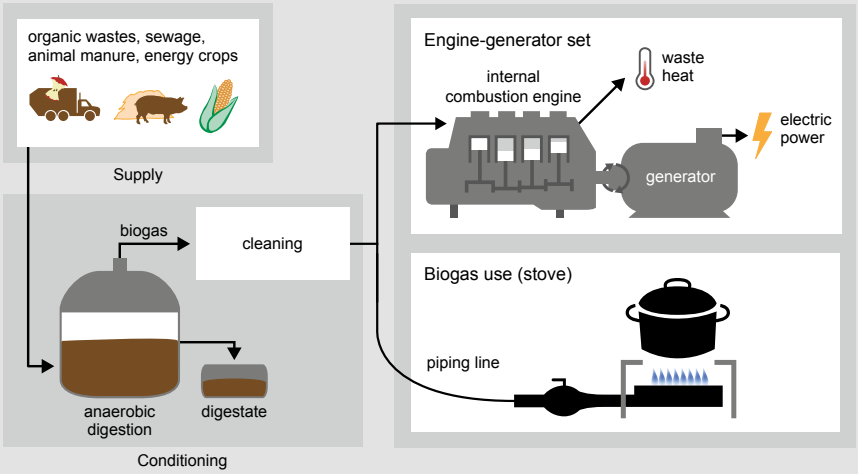


Fig. 2: Schematic view of a biogas system where biogas is used for cooking and electricity and heat generation

Biogas for cooking

The direct use of biogas, e.g. for cooking or for producing heat, is already widespread and this is the most effective way to use it. Biogas stoves are similar to conventional appliances that run on commercial fuels. However, modifications are required (particularly in the design of the burners) to ensure proper combustion and the efficient use of energy.

Biogas for lighting

Biogas lamps are widespread in Asia, but not in Latin America and the Caribbean. Biogas lamps are easy to use; however, they transform much of the energy into heat and require spare parts which are not always locally available.

Biogas for electricity

Electricity generation based on biogas is already a commercial reality in industrialized and emerging countries, but yet uncommon in developing regions. The main obstacles seem to be economic and institutional, as well as lack of experience and skills in project design and lack of financial support and (tailor-made) commercial credit lines [10].

Additionally, the size of the system can be also a restrictive factor. Generation sets that are able to run on biogas are already commercially available. However, for capacities below 5 kW commercial options are rather scarce. For biogas to become a real alternative for generating electricity in developing countries, particular effort is required in evaluating national/regional potential, undertaking feasibility studies of promising sites and supporting schemes for demonstration projects (see Case Study 2).

Linked development goals

Stoves using biogas have the potential to improve the wellbeing of marginalised populations, diminish energy poverty and offer an excellent opportunity to put an end to indoor pollution and related health risks. Biogas solutions for cooking generally depend on the user producing the fuel (biogas) by using available organic waste, often animal manure. This can have a positive impact on the vicious cycle of poverty by freeing up time, reducing energy costs for cooking and avoiding pollution from organic waste.

However, biogas solutions for cooking depend on the technical feasibility of users producing their own fuel (biogas). This means that the broad diffusion of the technology requires a thorough assessment of the potential and requirements of the target population, as well as the awareness and training of users.

Social Issues

Assuring the long-term adoption of the technology has proved difficult in many cases as the stability of the complex biochemical process depends on a variety of parameters, and changes to users' daily routines may be required (e.g. cooking and husbandry practices). Therefore, fostering and transferring knowledge to users about appropriate monitoring and operating strategies, as well as motivating users to see biodigesters as investments (instead of donations from development aid programmes) are crucial for the sustainable use of the technology. Key issues affecting the adoption of biogas technologies are:

- Awareness of user input and limitations to the technology: The operation of a biogas system necessitates regular user input and possible change their traditional practices. E.g. it may be easier for milk producers with a fixed cattle shed to start a manure collecting system than for breeders whose cattle graze freely. The availability of water and appropriate substrates may also limit the application of the technology.
- Ensuring user motivation to invest: In many cases, where the technology is provided as a donation from government or an NGO, the users are not enthusiastic about the technology, which may lead to underuse, failure or even the user abandoning the technology [11, 12].
- Supervising the start and training the users: Starting the anaerobic digestion process can take from two weeks up to two (or more) months. Providing appropriate assistance to the users during this phase is crucial in order to build up their confidence in the technology. Moreover, after-sales service for monitoring and follow up is crucial to ensure adequate and long-term use.

Economic Issues

The major cost is the biodigester, but one also has to invest in distribution pipes, (eventually) storage, biogas stove or engine. Total investment depends mainly on the kind of biodigester and its size. Another important cost factor is the distance between the biodigester and the final use. The cost of a small biogas system (biodigester capacity from 4 to 6 cubic meters) ranges from US$200 to US$1150 [13, 14].

These figures generally only include the cost of materials for the biogas system, not labour and other materials required for site preparation. Additionally, programmes supporting biogas solutions commonly absorb the more "intangible" costs such as technical advice, monitoring services, operational training and the cost of marketing, awareness campaigns and research and development of the technology.

Details see http://www.wisions.net/technologyradar

- Identify relevant research gaps and promote research and development activities
- Advance advocacy for the emerging biogas sector(s) at different policy and decision-making levels
- Initiate actions aimed at monitoring and evaluating biogas digester programmes and projects in the region

REDBIOLAC ACTIVITIES

The network has become a lively platform for knowledge exchange and dissemination. This is mainly achieved via two channels: the annual conference and the online forum. Additionally, two areas of activity fostering knowledge creation and dissemination are envisaged as part of the consolidation process: working groups and an internship programme.

The annual conference provides a dynamic opportunity for interaction between experts, relevant stakeholders and interested audiences in general. The conference format entails not only presentations and discussions about the latest developments, but also training courses on basic biogas technologies and field visits. The latest annual conferences encouraged rich discussions and feedback from all participants through participative sessions from which conclusions were drawn, leading to the first book published by the network. The book is available online and downloadable in a printer-friendly version.

Installation of a tubular biodigester during the annual RedBioLAC conference in Mexico

Of the online tools, the discussion forum is the liveliest area for interaction, with more than 600 participating subscribers. Almost 500 topics are available on the forum, providing a rich source of knowledge on anaerobic digestion as applied in the region, together with information about the practitioners involved.

Topic-specific working groups aim to involve network members in the development of cooperative projects in order to address specific knowledge gaps (e.g. technical issues, management, monitoring and impact assessment) or to strengthen cooperation at sub-regional level (e.g. the 'southern cone', the 'Andean countries', the Caribbean states and Central America).

Field visit during the knowledge exchange between Bolivian and Ecuadorian biogas experts

The student internship programme aims to facilitate and support applied research on topics relevant to network members by involving students at the advanced stage of their studies. This serves to address knowledge gaps, while simultaneously contributing to international knowledge-sharing and capacity-building of the next generation of experts and decision-makers.

SPECIFIC CHARACTER OF REDBIOLAC AND OUTLOOK

The network is the longest-running of the four in this brochure and, since 2009, has gained broad recognition as a platform in the region. It has, therefore, made a significant contribution to raising awareness of biogas technologies and has also helped to shed light on innovative approaches for its application in the diverse contexts. Although it receives only very basic funding and at certain times faced scarce active participation, the network survived lean periods and was reinvigorated in 2016 with its new structure.

RedBioLAC has an extensive geographic distribution in the region and, despite their diversity, the participants share a strong mutual vision. Although there are huge differences between the levels of development and expertise in the various countries, they all benefit from sharing their experiences in their native language, Spanish. Topics on the agenda include new technical solutions, such as slaughterhouse waste water treatment, the production of heat and electricity, the diversification of substrates and the use of effluents, as well as effective business and delivery models.

The renewed structure, as well as the new activities (working groups, internships and improved communication and dissemination tools), are expected to strengthen the network's ability to contribute to the consolidation of the biogas sector at national and regional levels.

CASE STUDY 1 KNOWLEDGE EXCHANGE

RedBioLAC

EXCHANGE OF BIODIGESTER EXPERIENCES BETWEEN GUATEMALA AND COSTA RICA

The status of biogas development in Latin America varies between regions and countries, but users and installers have accumulated a significant volume of knowledge which is valuable to share. Given the varying levels of experience of network members, RedBioLAC organised south-to-south exchanges of individual experts to provide emergent biodigester programmes with more extensive hands-on training, technology transfer and business model development.

This particular exchange provided the opportunity for an experienced Costa-Rican engineer, Joaquín Víquez of Viogaz, to assist the Alterna-Guatemala team in improving its biogas programme with the aim of creating a social business model. The exchange took place in February 2014 and was given financial support from Green Empowerment and WISIONS.

ACTIVITIES

The exchange included field visits and meetings with users and partners, as well as specific training modules.

During the first few days, several field visits to biogas system projects were organised. These included visits to biodigestion units installed on farms in different communities in the department of Sololá and the town of Salcajá, Quetzaltenango. Furthermore, the slaughterhouse at Santa Lucía de Utatlán (Sololá) was visited to analyse the feasibility of installing a biodigester to treat the waste and waste water which is discharged into the nearest naturally-running water source.

In addition to the field visits, the first biodigester users' meeting in Guatemala was organised on 10 February 2014 by Alterna. The main objectives of this meeting were to learn about user experiences, share advances in bioslurry use for different crops and discuss the beneficial impacts on potential future market value, provide information to users on how to maximise the production of biogas and gather information and ideas to help improve the systems and maximise output.

Furthermore, the activities included a training session for Alterna's team in the chemical and biological character of bioslurry from organic and animal waste for use in annual crops and intercropping. The training focused on the interpretation of results from laboratory analysis on the nutritional content of bioslurry and criteria for selecting appropriate digester size. In addition to the training, it provided a general review of the implementation methodology promoted by Alterna. Advice was also provided about mechanisms to use in the design of monitoring systems for quality control and assurance of long-term biodigester projects and operations.

Field visit during the knowledge exchange between Alterna and Viogaz

RESULTS & IMPACTS

The field visits provided the farmers with an insight into how to increase biogas production and the quality of the bioslurry by using pig manure in addition to cow manure. It was also discovered that female users find it physically difficult to feed the digesters. In order to overcome this issue, it was recommended that users ignore the filtering process, which involves the manual separation of fibrous material from the mixture of manure and water. The fibrous material can be removed from the biodigester as part of the general maintenance programme, which should take place every year or two. Avoiding the manual separation of the fibrous material resulted in a reduction in the daily time necessary for feeding the biodigester from 30 minutes to about 10 minutes.

The visit to the slaughterhouse resulted in a proposal for the installation of two biodigesters to which the board of the municipality agreed. The two digesters will produce biogas and bioslurry, helping to mitigate the environmental problems that currently stem from the slaughterhouse. This initiative also expects to generate more interest in biodigestion technology amongst other municipalities in the region.

The visit to the organic farm allowed Alterna to gain a better understanding of the issues and criteria necessary for the installation of larger capacity biodigesters. Until then, all the systems installed by Alterna had a capacity of eight cubic metres (8m3).

The biodigester users' meeting provided the opportunity for 18 pioneer users to share their positive and negative experiences of biodigester operation and use of bioslurry. This helped users to understand that, in order to increase biogas generation, higher temperatures are needed. Furthermore, the users were given advice about feeding the system and emptying the sludge.

The training helped Alterna's team to expand their knowledge of the parameters necessary to determine appropriate biodigester size and to better address maintenance issues. They also learned how to interpret results from laboratory analysis on the nutritional content of bioslurry in order to create an implementation programme.

CASE STUDY 2

SEPS PROJECT

RedBioLAC

REMOVING BARRIERS TO GREENHOUSE GAS MITIGATION ACTIVITIES IN MEXICAN LIVESTOCK FARMS

PROJECT'S AIM: **To demonstrate the use of converted gasoline motors for generating mechanical and electrical energy from biogas in order to improve the productivity of medium-scale livestock farms**

This project aimed to improve the productive use of biogas from livestock waste in small and medium farms in central Mexico by demonstrating various applications of biogas and adapting off-the-shelf electric motors to run on biogas. It was implemented by IRRI Mexico (Instituto Internacional de Recursos Renovables AC), with support from technicians from IRRI's spinoff organisation, Sistema Biobolsa. The Biobolsa (Biobag, in Spanish) is a modular biodigester system designed to be affordable, durable and easy to install and operate.

The industrial-scale and domestic biogas sectors are currently growing in Mexico; however, the use of biogas by small farmers in the agricultural sector is still limited. One key barrier to the use of biogas for productive activities is the lack of suitable small biogas motors on the Latin American market. To address this, the Sistema Biobolsa team developed and tested a range of small-scale gasoline motors capable of running on biogas, which this project demonstrated in the field.

Location:
States of Puebla, Tlaxcala, Estado de Mexico and Morelos. Mexico

Technology:
Biogas
Biomass electric power

Costs:
Total: € 65,500
WISIONS financial support: € 45,000

Partners Involved:
IRRI Mexico
(www.irrimexico.org)

Duration:
May 2014 to November 2015

TECHNOLOGY, OPERATIONS & MAINTENANCE

The project comprised two main phases. In the first phase, four Biobolsa biodigesters, waste treatment systems and biogas use systems were installed at four medium-scale livestock farms (two pig farms and two dairy farms). During the design phase, baseline data was collected on the volumes of livestock and waste production at each farm, as well as on energy use and and opportunities for reusing nutrients as fertiliser. The biogas now being produced on these farms is used for space heating for pig maternity areas, for heating water for cleaning purposes, and as gas for cooking.

In the second phase, the project adapted 20 small (5–10 kW) commercial gasoline motors available on the Mexican market so the small and medium farmers could produce mechanical and/or electric power from biogas. Of these motors, 16 were installed in existing small biogas plants and 4 in new medium-sized demonstration plants, totalling 152 kW of new capacity. In this phase, there were five significant areas of R&D: biogas filtration, matching energy production and use, motor sizing and design, grid interconnection, and training and maintenance.

The motors are used for powering milking parlour pumps, pumping water and fertiliser, powering small grain and animal feed mills and for meeting other electricity needs on the farm premises. One of the participating farms received approval from the grid authority to connect its 13.5 kW biogas motor to the grid. This allows for the maximisation of the production of biogas-generated electricity as the farm is not limited to using the motor to power the farm's loads.

One of the farmers using a gasoline motor modified to run on biogas

The installed motors are currently being monitored for a period of 12 months following the end of the project implementation, with the aim of collecting data for further technical improvements to the components; for example, increasing the methane concentration in the biodigesters through improved filters. Moreover, the monitoring regime aims to build clear projections for the costs and benefits of the system under a range of different conditions and uses.

DELIVERY MODEL & FINANCIAL MANAGEMENT

WISONS funding provided an economic incentive to the farmers at demonstration sites, while co-funding came from the crowd-sourcing KIVA loan platform. The farmers must pay back the loans provided via the KIVA platform.

Operating data from the systems installed as part of the project show a high level of energy recovery and technical viability. It is estimated that the return on investment period for the four installed systems is less than three years, based on the value of the energy and fertiliser produced per year. Preliminary analysis showed that the farmers are motivated by the financial savings made from biogas use in differ-

ent ways, depending on what the biogas replaces. Those with access to grid electricity prefer to use their biogas for thermal uses. Farmers who run gasoline powered motors for their productive uses see a higher value in replacing the gasoline with biogas.

ENVIRONMENTAL ISSUES

The main benefit of the project arose from replacing fossil fuel based energy supply (LPG, grid electricity and gasoline motors) by energy from biogas. However, there was also an emphasis on the pollution mitigation aspects of the technology. The four systems installed included secondary treatment stages for demonstrating the options available for treating the effluents from the biodigesters. A three-part model was tested, with a sedimentation phase, subsurface wetland phase and a surface lagoon with aquatic plants. Tests showed that this system enabled farms to meet national water quality discharge standards.

SOCIAL ISSUES

During the project it was observed that although the farm managers appreciate the economic benefits arising from the fuel savings, the staff in charge of operating the motors do not always perceive this benefit. Comprehensive training and the implementation of procedures are required to better integrate the use of the motors into the daily farm routines.

In addition to demonstrating the technology to farmers, this project sought to develop technical capacity with local motor distributors to convert, install, service and maintain these small biogas motors. The project used a variety of motor brands, including those that guaranteed the best quality and service in Mexico.

RESULTS & IMPACT

The project led to significant advances in the application of biogas for small-scale electric power generation (between 5 and 10 kW) and has opened the door to the further development of the technology. In particular, developing a low-cost, simple filter for the biogas proved to be a central challenge. In order to produce electricity from biogas, proper filtration of the gas before it enters the motor is critical. Based on previous research by Biobolsa, the design of the filter was optimised in a number of ways, including the biogas flow through the filter, pressure losses, operational life and increased energy density of the biogas. The research also considered the economics and practicalities of different filter materials in the disposal, recycling and regeneration phases. In addition to investigating currently available filter materials, the study investigated an innovative iron oxide-based product with promising characteristics as a potential alternative.

A further key innovation was the development of low-cost adaptors for receiving low-pressure gas from Sistema Biobolsa digesters and drawing the gas into the motor at the required rate.

REPLICABILITY

This project is part of a wider effort by IRRI to increase biogas use in rural communities and in small and medium-scale farms in Mexico. Awareness-raising activities and practical demonstrations run by IRRI are coordinated in order to maximise the impact, and IRRI participates in knowledge exchange networks in the region and abroad. This particular business model, where access to credit is available and economic benefits are achieved in a relatively short time frame, has a high potential for replication in the region.

LESSONS LEARNED

A number of barriers to the adoption of the adapted motors were observed. For example, some farmers saw the biogas generator as a back up option for times without grid electricity. In some cases, it was found that farmers who were already using biodigesters prior to the installation of the biogas electric motors were accustomed to having access to the thermal energy and did not always administer the gas properly in order to have some excess for producing electricity. Matching energy production and energy demand was a further challenge. Improved load profiles for the farms are needed in order to identify the peak periods when power is required for milking, pumping and other uses.

Source: Final Report submitted to WISIONS by IRRI in March 2016

Examples of biodigesters installed by IRRI for the treatment of livestock waste in Mexico

REDBIOCOL

COLOMBIAN NETWORK FOR ENERGY FROM BIOMASS

Website: http://redbiocol.org (Spanish)
Contact: lylianr@utafoundation.org
Coordinator: Lylian Rodriguez

RedBioCol is a network of individuals and organisations committed to contributing to the sustainable development of Colombian society by promoting the use of organic residues for energy generation.

The national network was inspired by the Latin American network RedBioLAC (see pages 5–10), but has a broader objective as it includes biomass energy in all its forms, instead of focusing solely on biodigesters. Since RedBioCol's foundation in 2012 in Guapotá, its membership has grown to more than 35 and includes farmers' associations, NGOs, small and medium-sized enterprises with social purpose, social movements, universities and educational institutes in both rural and urban locations.

The network links practitioners within a single country and, as a result, it can help to facilitate more regular face-to-face meetings to intensify the synergies that exist between its members, as well as focusing on specific national political, economic and social conditions. The aim is to promote the use of biomass in Colombia to generate energy in order to realise potential benefits, particularly in the agricultural sector but also in other sectors with significant flows of organic residues.

BACKGROUND

Biomass residues are produced in several sectors of the economy and society. In Colombia (as in most Latin American and Caribbean countries), there is plenty of organic matter which is disposed of as waste without proper treatment and/or additional use, such as harvest residues, the organic fraction of municipal waste, the organic load of municipal sewage and manure from animal husbandry practices. Biomass energy technologies (such as biodigesters and gasifiers) offer options for producing energy from these biomass residues. Moreover, the remaining substrate is also valuable as fertiliser (the effluent from biodigesters) or for soil improvement (the charcoal from gasifiers) (see also page 7). By 2012, Colombia had a large number of organisations who had been working in the field of biodigester technology for two or more decades, so forming a national network was a natural step forward.

OBJECTIVES

- Promoting the use of biomass energy technologies as a tool for improving farming systems and the livelihood of farmers
- Facilitating the exchange of experiences and knowledge among organisations and individuals
- Promoting the formulation and realisation of research and development projects that are relevant to the needs and conditions of the network's individual members and associated organisations

DEVELOPMENT AND STRUCTURE

The network emerged from a seminar for sharing experiences in the use of biomass for energy generation in Colombia, which took place in Guapotá, Colombia in October 2012. The productive discussions and recognition of common interests motivated the participants attending this first event to find ways to facilitate interaction on a more regular basis. To date, the network has focused mainly on the application of biomass

Excursion during the national meeting organised by RedBioCol in Medellin

energy technologies in small and medium-sized agricultural systems. In this context, the technologies are used as tools for improving the circulation of energy and matter within farms, while simultaneously improving the livelihoods of farmers. However, building knowledge for peri-urban and urban applications is also being considered.

In terms of structure, the network comprises two main bodies for administration and operation: a team of coordinators, which takes care of maintaining continuous communication and implementing individual activities, and a group of committees, where network members work jointly to create knowledge and build capacity on specific topics such as communication, solidarity economy, research and local leaders/promoters. The main body for strategic decisions is the General Assembly, where all members are represented.

Green Empowerment is also involved in RedBioCol and provides advice, but does not act as secretariat for the network. Since the network's inception, WISIONS has provided financial support as well as active advice and research knowledge through a master and PhD thesis linked to the network's topics.

Demonstration of a small gasification stove during the national meeting organised by RedBioCol in Medellin

ACTIVITIES

Since its establishment, the network has put particular emphasis on field workshops in order to foster links and knowledge sharing between organisations (such as farmers' associations, NGOs and enterprises) which have advanced specific technical and/or social innovations with the general aim of improving the use of organic residues. Field workshops take place at the sites where the host organisations are in the process of implementing relevant innovations. In this way, representatives from the visiting organisations have the opportunity to learn at first-hand about concepts that might be relevant in their own context.

The network organises a bi-annual national meeting with the aim of bringing together experiences from all over the country and presenting research and development on the subject of biomass energy. The national meetings are a platform for promoting the creation/strengthening the links between players who are involved or interested in the field. They are also a platform for disseminating information about the technologies, as well as about the national experience, to a broader audience.

The newly-established committees involve network members advancing specific areas that have been identified as strategic priorities for the further development of the network: communication, research, solidarity economy and local leaders/promoters.

SPECIFIC CHARACTER OF REDBIOCOL AND OUTLOOK

The network is relatively young, but has already gained significant momentum since it was first formed in 2012. Several farmers' organisations, NGOs and individuals have joined as members or have participated in different activities organised by the network, contributing their own knowledge, experience and skills. The committees aim to contribute to the further consolidation of the network by finding effective ways of pursuing collaborative work, providing specific resources (such as promotional materials, research results, guidelines, training modules etc.) and organising activities (e.g. training sessions, workshops and research projects). In this way the combined skills and knowledge of the network's members are expected to provide decisive motivation for promoting the use of organic residues in Colombia for energy generation.

The network's policy and advocacy work, as well as its promotional material, directly targets domestic decision-makers. This differs significantly from the approach of the other networks presented in this brochure and is a specific benefit of RedBioCol's particular structure and focus.

There is a close connection with the Latin American network (RedBioLAC), which ensures the exchange of knowledge not only on technical aspects but also on network coordination and advocacy work. In addition, there is the potential for national sub-networks in other countries to learn from the experiences in Colombia.

CASE STUDY 3 KNOWLEDGE EXCHANGE

RedBioCol

FIELD WORKSHOPS FOR NETWORKING, KNOWLEDGE EXCHANGE AND CAPACITY-BUILDING

NEED AND OBJECTIVE(S)

One of the central findings from the seminar that triggered the inception of RedBioCol was the realisation that numerous initiatives using biomass energy technologies were already being implemented in Colombia. While all these initiatives were applying different technical and social innovations, they shared the same aim to use organic residues as a way of improving farmers' livelihoods.

However, there was very little mutual knowledge about the various projects and also a lack of established relationships. Therefore, the primary aim of the 'field workshops' during the first two years of the network's operation was to strengthen links between these committed organisations and individuals.

The field workshops also aimed to support knowledge exchange and capacity-building by enabling close interaction between individuals and by offering first-hand experience and practical training at sites where biomass energy technologies were implemented.

Site preparation for the installation of a tubular biodigester during the field workshop in Guadalupe, Santander

ACTIVITIES

The first four RedBioCol field workshops took place between April and August 2014 in four different regions of the country and were organised jointly by the experienced host organisations and the network coordinators.

The first one was hosted by the Association of Indigenous and Peasant Producers of Riosucio, Caldas (ASPROINCA). The 29 participants from 11 organisations were introduced to applied integrated farming systems. The workshop took place at one of the association's most advanced farms, where participants had the opportunity to learn at first-hand how such integrated systems work. During the training, emphasis was put on the role of the biodigester as a tool for re-shaping energy and biomass matter flows within farms in order to improve productivity, protect the environment and reduce families' expenses (in terms of energy and fertiliser).

The farmers' association 'El Común' hosted the second workshop in Guadalupe, Santander. A central element was a training module on the design and construction of small tubular biodigesters. The 46 participants from 13 organisations were introduced to the principles of anaerobic digestion and the basic rules of design. As a practical component of the training they worked together to install one small tubular biodigester.

The Women's Coffee Association of Córdoba, Quindío hosted the third event, at which 40 people from 10 organisations gathered for a full day to discuss and learn how to integrate biodigesters into 'coffee farms'. In this context the biodigester offers an option for the treatment of wastewater from coffee processing, while also providing energy for the families' domestic and productive needs and organic fertiliser for the farm.

The fourth field workshop took place in the experimental campus of the Colombian Agrarian University Uniagraria and introduced 38 students to the main principles of renewable energies. The emphasis of the training was on the options and challenges faced when integrating renewables into agricultural systems and the associated impact on farmers' livelihoods. The students also had the opportunity to participate in the installation of a small tubular biodigester at their own campus.

RESULTS & IMPACT

These initial field workshops enabled more than 150 participants from 25 organisations to gain first-hand knowledge about biogas technology and its application in agricultural production systems. The workshops also provided space for mutual learning and for establishing links between organisations with similar missions but which, in many cases, had not previously been aware of each other.

Field workshops, as well as other types of practical exchanges in the field and promotional activities, have become one of the main tools for the consolidation of RedBioCol . While the idea of facilitating exchanges between organisations in the field is not new, these field workshops have provided fresh motivation for other organisations to take the initiative and arrange similar activities. Each new exchange activity helps to strengthen existing relationships and often builds new links to other organisations.

CASE STUDY 4 SEPS KNOWLEDGE EXCHANGE

RedBioCol

COMMUNITY EXCHANGE AND CAPACITY-BUILDING IN COLOMBIAN HOUSEHOLDS

EXCHANGE ACTIVITY'S AIM: **Joint capacity-building, networking and hands-on training of six organisations in Colombia working on energy alternatives for local food production**

EXCHANGE NEED AND OBJECTIVE(S)

Food processing in Colombian rural communities is typically fuelled by firewood in inefficient stoves, or by expensive diesel generators. Firewood combustion drives deforestation and causes health problems, as well as requiring significant time and resources. One key barrier to improving the situation is the lack of technical capacity and empowerment in rural communities. There is a need to complement capacity-building with knowledge sharing and networking and to position energy as an essential component of sustainable livelihoods.

The exchange was supported by the WISIONS supporting scheme SEPS, but was not facilitated by RedBioCol.

PARTICIPANTS & TARGET GROUP(S)

This project involved the creation of a social alliance and collective learning process between NGOs and rural communities from three regions of Colombia (Santander, Córdoba and Antioquia). Three recognised non-governmental organisations in the field of sustainability and community education in Colombia led the process: CENSAT Agua Viva, Fundaexpresión and Otros Mundos.

The exchange engaged six community-based organisations, all with knowledge and experience in agroecology, local markets, food processing and the community conservation of ecosystems. Around 40 representatives from these organisations participated in both exchange visits. The ultimate target groups were the members of the participating associations, i.e. peasant farmers, fisher-folk, women and youth groups.

ACTIVITIES

The activities consisted of two four-day exchange visits to the region of Bajo Sinú (Córdoba) and the region of Soto Province (Santander), where two of the organisations manage sustainable energy projects. During the visits, the participants were able to appreciate at first-hand different community initiatives and the application of alternative energy technologies (solar, biogas and efficient stoves) for food production and water sanitation schemes in isolated rural areas.

Design of improved biomass stove installed during the exchange activities

The following objectives were pursued: a) the development of a holistic energy analysis of existing community-based alternative energy initiatives related to food processing; b) capacity-building on the design and installation of energy systems and evaluation of impacts for families and microenterprises; and c) the organisation and empowerment of local communities based on the concepts of food and energy sovereignty.

RESULTS & IMPACT

The exchange enabled the participants to share the experiences, achievements and challenges they faced in promoting alternative technologies. The results included increased practical knowledge, stronger networks and the development of a series of action plans to promote the adoption of these technologies within community-based organisations.

The exchange itself provided the opportunity to install a plastic tubular biodigester and gave insights into various existing systems, including energy efficient wood stoves, solar dehydration units and PV-powered water pumps, which were used for practical demonstrations and assessments of energy balances.

The host organisations created a short video documentary, with interviews and testimonials from the local communities, which is available online and will allow the organisations to continue promoting sustainable alternatives in different community and institutional settings.

LESSONS LEARNED

Linking concepts and experiences in energy and food sovereignty within a diversity of cultural and territorial contexts allowed local practitioners to gain a broader view on options to improve livelihoods.

The particular approach – based on dialogue, local innovation and the empowerment of communities in the improvement of local livelihoods – shows potential for driving systematic change towards sustainable energy solutions.

Source: Final Report submitted to WISIONS by CENSAT in February 2015

RedBioCol – Colombian Network for Energy from Biomass

The Colombian Biomass Network aims to improve the perception of biomass technology, including biodigesters and gasifiers, through the dissemination of the various benefits of the technology in different areas of Colombia where the network has members.

RedBioLAC – Latin American Biogas Network

RedBioLAC is a network of institutions involved in the applied research and advocacy of biodigesters for the treatment and management of organic waste, as a strategy for improving the wellbeing of the Latin American and Caribbean people.

HPNET

HPNET – Hydro Empowerment Network in South and Southeast Asia

HPNET supports micro-hydro practitioners in the advancement and advocacy of resilient micro-hydropower, working towards the equitable and sustainable development of rural communities in South and Southeast Asia.

Wind EMPOWERMENT

Wind Empowerment Network

Wind Empowerment is a global association for the development of locally-built small wind turbines for sustainable rural electrification which has been supported by the WISIONS initiative since the middle of 2014.

WIND EMPOWERMENT

Website: http://windempowerment.org

Contact: windempowerment.group@gmail.com

Coordinator: Jon Sumanik-Leary

Wind Empowerment is a global association for the development of locally-manufactured small wind turbines (SWTs) for sustainable rural electrification. It aims to strengthen the capacity of its members through collaboration and knowledge exchange to promote and support small wind technology as a viable solution for rural electrification.

Small-scale wind turbines, in contrast to large-scale wind turbines, can be considered a niche technology. SWTs can offer viable off-grid power solutions where strong wind resources (4–7m/s and higher) are available and evenly distributed throughout the year, or in regions where the combination of small wind technology and solar PV can provide a reliable power supply. Moreover, the option to manufacture SWTs locally can offer a number of additional benefits, such as capacity-building for operations and maintenance, a shorter supply chain for spare parts and the creation of local employment.

DEVELOPMENT AND CURRENT STRUCTURE

A group of organisations active in the field of locally-manufactured small wind systems met for the first time in Dakar, Senegal in 2011 and formed the Wind Empowerment association. The aim was to bridge the geographical gap between its members by providing a global platform for knowledge sharing and collaboration. While the online platform helped to facilitate knowledge sharing, establishing continuous collaborative activities among the members proved more challenging. During a second conference in 2014 in Athens, Greece, there was renewed motivation for the strategic development of the association, which led to changes in the association's structure.

In parallel to the global network, WISIONS (in close cooperation with Green Empowerment) laid the foundation for a regional Latin American network on small wind – WindWorks – by facilitating two network meetings in Lima/Peru in 2011 and 2013. This regional partnership WindWorks merged with Wind Empowerment in 2014 and, since then, Wind Empowerment has been supported by WISIONS.

Wind Empowerment is now a Charitable Incorporated Organisation (CIO) registered with the Charities Commission in the UK, with formal structures for decision-making and operation. The association is administered by an Executive Board on behalf of its members. A Board of Trustees is responsible for ensuring the charity achieves its stated aims.

OBJECTIVES

Wind Empowerment supports the development of locally-built wind turbines for sustainable rural electrification by strengthening the capacity of its members globally through:

- Building and sharing financial and human resource connections
- Performing joint technical research, sharing technical information and collaborating on key vendor relationships

Participants at the conference organised by Wind Empowerment in Athens

Small Wind Turbines (SWTs)

Wind power systems transform wind energy into mechanical or electrical energy. Wind turbines are the main component of wind power plants. There is no globally agreed definition of 'small wind turbines' but, in general, wind turbines smaller than 100 kW are considered as small-scale [15]. The focus of the members of the Wind Empowerment network is on systems below 10 kW.

As well as the wind turbine, a small wind power system includes other components important for the system's functionality. The support structure commonly comprises a tall tower which is, in some cases, supported by guy rope cables. The 'Balance of System' (BoS) in the case of grid-connected systems comprises switches, cables, circuit breakers and electronic devices needed to properly connect the turbine to the grid. Off-grid systems include components such as an inverter, batteries and charging controls, as shown in Figure 3.

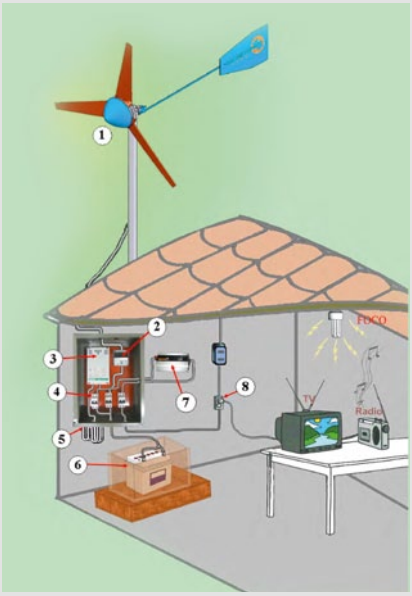


Fig. 3: Schematic view of a wind power system for off-grid applications

1. Wind power turbine
2. Safety diodes
3. Power generation control
4. Circuit breaker
5. Resistance
6. Battery
7. Inverter
8. Load

Assessing the available wind resource in a given location is extremely important. The actual electrical power output of a small wind plant is proportional to the cube of the wind speed passing through it. Wind speed, in turn, is a consequence of local climatic conditions, which fluctuate at any given moment and often have high seasonal variability. As a result, it is important to gather wind speed data over a certain time period in order to forecast the potential for electricity production and to design the small wind power systems appropriately.

Global potential

Small wind power systems already have different fields of application, such as providing power for remote off-grid facilities (e.g. communication masts), farms, single houses or clusters of houses, or as part of distributed power systems connected to regional or national electricity networks [16]. However, it is anticipated that the role of small wind plants – in contrast to large wind turbines – on a global scale will be fairly marginal. The most significant contribution of small wind will probably be as an alternative method of electrification for remote 'off-grid' areas and as a complementary power supply in grid connected areas. Its applicability is also restricted to sites with good wind resources (e.g. coastal regions and flat plains).

Environmental issues

Small wind power has no water needs and generates no CO2 emissions other than small amounts in the production and installation of the turbines. However, wind power has an environmental impact at local and regional level. This is mainly due to the visual impact, which includes shadows from the rotating turbine blades, changes to the landscape and noise from the turbines, as well as the risk of bird collisions and disruption to wildlife. These potential disadvantages may be alleviated by careful site selection, system design and community engagement.

Social issues

Experiences from small wind projects designed to improve access to energy for poor populations highlight that securing consistency of supply is often very challenging [17, 18]. Some relevant aspects are the thorough assessment of the available wind resource (see above); the development of technical skills among local actors as the operation and maintenance of small wind systems is quite complex and laborious; and the establishment of transparent communication channels to suppliers so they can provide a prompt response to major technical problems.

Development status and prospects

The World Wind Energy Association estimates that the global installed capacity of small wind reached 443.3 MW by the end of 2010 [16]. The global picture in 2016 is one of several regional/national markets predominantly served by national suppliers, with the major markets for small wind turbines found in the USA, China, UK, Germany and Canada.

One challenge faced by the sector is the need to move towards widely accepted and applied standardisation. Technical specifications are often given in different formats and the methods for testing are often not compatible (e.g. data on power curve or annual energy yield).

As well as implementing available commercial products, several initiatives – such as those undertaken by members of Wind Empowerment – have been promoting the local manufacture of small wind turbines as a central tool for providing electricity to remote (often off-grid) communities. Although there is the potential for this market to grow, the technology cannot be applied in all areas. Recent research has identified crucial factors that influenced the success (or failure) of previous initiatives [18]. Conclusions included a) that initiatives should consider the total system package, i.e. from the turbine itself to the appliances delivering energy to the end user and b) that effective feedback loops by end users should be established to ensure iterative improvements and adaptation to the local context.

Economic issues

The total investment cost for a small wind power system varies from market to market. In the United States, projects report a cost of between US$3,000 and US$6,000 per installed kilowatt; whereas in China the total cost of a system can range from US$1,500 to US$3,000 per kilowatt [15].

These cost ranges give a general indication of the necessary investment levels, but projects in remote off-grid areas must consider other factors that can cause costs to increase, such as import duties (particularly relevant for countries without their own suppliers) and transportation infrastructure.

Details see http://www.wisions.net/technologyradar

- Strengthening understanding of business and social models for the effective implementation of small wind technology
- Managing projects, offering consultancy services and developing/distributing products in line with the association's guiding principles

ACTIVITIES

Three main channels for exchange activities have emerged in the network:

Wind Empowerment's **webpage** is a rich source of information and serves as an exchange platform for the members, as well as for other people interested in the network and the technology. It covers not only recent news and event information, but also contains a library of documents and articles on wind technology, research background, broadcasts and the latest information on working groups. In addition, lively dialogue takes place in the discussion forums and the webinars offer background information on relevant current topics.

A school in a remote area of Argentina – a typical installation site for small wind turbines

Wind Empowerment **Working Groups** (WGs) have been set up to actively address the key barriers facing the development of small wind technology for rural development. The six WGs are: Maintenance, Technology and Measurement, Market Assessment, Delivery Models, and Education. In 2016 all six working groups started to develop so-called kick-starter projects to ensure a more intensive form of collaboration within clearly targeted projects or studies.

The Wind Empowerment **conferences,** which take place every 2 years, have been key in building and maintaining the relationships between individuals and organisations that form the basis of the network. Despite the staggering array of digital technologies available and used across the network, it has become clear that face-to-face follow up meetings are essential to allow members to discuss their experiences in person, share practical skills and build trust and partnerships.

SPECIFIC CHARACTER OF WIND EMPOWERMENT AND OUTLOOK

The Wind Empowerment network is the only globally-active network in this brochure and the only network with a legal status. In addition, the membership is dominated by "practical academics" with direct links to universities or research contexts, which is quite different to the other networks. This is due to the niche character of the technology and the fact it is still at a developmental stage.

As well as facilitating exchanges among its members, the association is involved in the development of specific projects, which include carrying out market assessments (on a national and global scale, see Case Study 5), providing consultancy services and actively participating in the implementation of energy projects involving small wind turbines.

The global market assessment takes into account the learning from country level studies (i.e. Ethiopia and Malawi) and applies this to international data sets in order to pinpoint exactly where the niche technology can make the greatest contribution to poverty alleviation. In this way the association can combine the different skills of its members in specific collaborative projects, while also generating revenue to improve its financial sustainability. As a result, the formalisation of the network is expected to increase its administrative and financial sustainability.

Through the collaborative projects of the working groups, the knowledge and skills of members across several continents can merge and showcase concrete outcomes. As a stable and sustainable organisation, Wind Empowerment will be in a position to transmit knowledge and build capacities in regions where small wind technology can make a significant contribution to sustainable development. Although the network is aware that small wind power is a niche technology, it may be the crucial missing piece in the technology puzzle for achieving global access to energy for all. What is more, the association will actively seek out potential new member organisations in regions with high potential and, where none exist, the skills and resources of the association will be mobilised to establish new organisations capable of exploiting these local hotspots of small wind potential, as has already occurred with pilot projects run by the association in the Somali region of Ethiopia.

CASE STUDY 5 EXAMPLE / MARKET ANALYSIS

Wind Empowerment

MARKET ANALYSIS OF SMALL-SCALE WIND POWER IN NICARAGUA

NEED AND OBJECTIVE(S)

During a symposium in Lima in 2011, a number of organisations implementing small-wind based electrification initiatives in Nicaragua had the opportunity to discuss their progress and the challenges they faced with several international small-wind experts. One key finding that emerged was the need to analyse the potential market for both private and community-based systems by considering the technical capacity to install and service small-wind based systems, the real-life technological performance and the long-term costs of operations and maintenance. In addition, such assessments could help to disseminate the lessons learned from the various unconnected initiatives across Nicaragua.

Consequently, Green Empowerment and WISIONS contracted this study in 2012 to assess the market potential of small-scale wind power (defined in this study as wind systems with rated power below 10 kW) for rural electrification initiatives, i.e. the off-grid context.

ACTIVITIES

In order to undertake the market assessment, a group of experts decided to collaborate and formed a team comprising different nationalities, expertise and experience. The first challenge was to develop a methodology to assess the market potential of small-wind on a country-wide level. To that aim the team built a model to provide cost estimations differentiated at the municipal level, taking into account the broad set of aspects that influence the economic performance of a small-wind based system during its whole life cycle (e.g. supply chain, installation, operations and maintenance).

To complement the cost estimations, the methodology includes descriptions and mapping of small-wind stakeholders in Nicaragua. This step is not only relevant for understanding the 'ecosystem' in which a local small-wind sector might establish itself, but also for collecting data that fits into the Nicaraguan context and for avoiding the use of global or generalised estimations of the different kinds of parameters needed (e.g. capacity factors, wind resource measures, prices, etc.). Additionally, two practical initiatives (case studies) were analysed in detail in order to categorise important lessons gathered in the field.

Installation of a small wind turbine in Nicaragua

RESULTS & IMPACT

The study was completed and published in March 2013 and is available online on WindEmpowerment website. Some of the main findings are:

- Most of the regions in Nicaragua that are suitable for wind power already have access to the national grid or have high solar and/or hydro potential.
- Small-scale wind power has greater requirements in terms of operations and maintenance than solar PV and the levelized cost of electricity is much more expensive than hydro, so it is important to identify locations where these two technologies cannot provide a comprehensive solution.
- There is limited potential for small-wind in the mountainous regions when used in a hybrid system with PV because both peak seasonally in the dry season.
- In poor communities, linking small-scale wind installations to productive uses of energy, such as irrigation or agricultural processing, is key to ensure sufficient funds can be raised to pay for the operation and maintenance of the systems.

Overall, the key result was that the distribution of the wind resources (highest in the mountains and on the Southern Pacific Coast) does not match well with the location of communities without access to electricity (mainly in the Northern regions and on the Atlantic Coast). Therefore, only a limited number of communities without electricity in the central highlands could potentially benefit from small-scale wind turbines.

Although from an average global perspective wind and solar resources tend to peak at different times within a short-term timescale (i.e. cloudy days are often windy days and vice versa), in Nicaragua both resources peak in the dry season – vastly reducing the value of solar-wind hybrid systems.

In addition to the specific findings on the potential of small-wind in Nicaragua, one important output of the study is the methodology that was developed. The methodology has been further refined through the collaborative work of Wind Empowerment members.

CASE STUDY 6 KNOWLEDGE EXCHANGE

Wind Empowerment

'DEVELOPMENT WEEK': DESIGNING AN OPEN-SOURCE DATA LOGGER FOR SMALL WIND APPLICATIONS

NEED AND OBJECTIVE(S)

Measuring the basic parameters of small wind turbine operation is crucial for several reasons: for monitoring operation, planning maintenance, improving design or for research purposes. Many of Wind Empowerment's members had been independently developing their own data loggers. The main aim of the 'Development Week' was to share knowledge and expertise in order to advance the development of data logging equipment that better matches the needs of locally-manufactured small wind turbines. In addition, the activity enabled participants of the Measurement Working Group (one of Wind Empowerment's six working groups) to familiarise themselves with each other's work to date.

ACTIVITIES

The 'Development Week' took place from 20th to 24th May 2015 in Lîlegal, near Toulouse, France. Ten wind experts and electronic engineers came together to work on a collaborative design for an open-space data logger. Through the online working group forum and a live Q&A session, Wind Empowerment members from Nepal, Palestine, Argentina, Greece and elsewhere also had the possibility to provide live input into the work taking place at Lîlegal. This provided valuable feedback for the participants and broadened the collective knowledge base.

The collaborative design approach was selected in order to build a common understanding about the specific functions and requirements for the data logger, to enable brainstorming of technical solutions for specific components, to test some of the options and to decide how to progress the design.

Local technical college lecturer speaking on source electronics development tools to the 'Development Week' participants

RESULTS & IMPACT

The main output of the 'Development Week' was the direct exchange, capacity-building and cooperation between European members, as well as remote participants from different continents, who had the opportunity to work live on a solution for a technical issue that affects small wind experts around the globe. In this "masterclass" the participants worked on the development of a prototype for measuring small wind turbine performance in an empowering workshop space.

Another major result was the creation of a new repository for this project on the open-source software development platform, GitHub. This acts as a central point where new developments on both the software and the hardware can be collated.

Some subsequent linked activities also resulted from the 'Development Week'. The host in Toulouse, Gilou Longeut, started a six-month training programme on electronics development. Moreover, Matt Little, founder and director of Renewable Energy Innovation and coordinator of Wind Empowerment's Measurement Working Group, is already manufacturing and selling early prototypes of his Arduino-based data logger for bespoke research and educational projects.

Another important initiative undertaken by the Measurement Working Group, together with the Technology Working Group, was the co-supervision of the development of an Arduino shield by a French student at AFPA, Toulouse. This knowledge was made available to the Wind Empowerment community via the Wind Empowerment website.

HPNET

HYDRO EMPOWERMENT NETWORK

Website: http://www.hpnet.org/
Contact: hydroempowerment@gmail.com
Coordinator: Dipti Vaghela

The Hydro Empowerment Network is a group of practitioners in South and Southeast Asia and a knowledge exchange platform that aims to advance and advocate for sustainable pico, micro and mini-hydropower for rural empowerment. Since its establishment in 2013, the network has evolved rapidly. By 2016, it had over 50 members from 14 countries and had successfully facilitated a number of exchange activities and annual gatherings.

Pico and micro-hydro power systems have huge potential, especially in the humid and hilly regions of South and Southeast Asia. Although micro-hydro is well established in several countries in the region, it faces a variety of challenges and has yet to reach its full potential (see page 19). The network addresses these challenges and its members have a wide range of expertise in policy, financing, technology development, watershed strengthening and community organising processes.

NETWORK'S OBJECTIVES

The network's key objectives can be summarised under two main aims:

To provide an effective knowledge exchange platform for:

- Technology development and innovation for robust implementation
- Policy for sustainable impact and scalability
- Cultivation of local experts, productive uses and vibrant watersheds

To transform knowledge exchange into action, by building capacity at community level for:

- Technology design and dissemination
- Policy ideas and outputs
- Bottom-up sustainability mechanisms

DEVELOPMENT & CURRENT STRUCTURE

The network was initiated during a workshop hosted by Janathakshan in Sri Lanka in 2012 at the request of several grassroots organisations involved in the micro-hydro sector. At the first official gathering in August 2013 in Borneo, 25 practitioners met to formally establish the network and identify the goals and needs to improve and scale sustainable micro-hydro projects in South and Southeast Asia.

The network evolved quickly and by 2016 had attracted 50 members (individuals and organisations) from 14 countries.

After an initial phase coordinated by Janathakshan/Sri Lanka, in 2015 MHP expert and HPNET's founding advisor Dipti Vaghela became the coordinator of HPNET.

To better achieve the network objectives and to ensure more focused knowledge exchanges, three working groups were established, focused on technological features, policy issues and socio-environmental aspects. The three working group leaders also form the steering committee, which meets regularly and gives advice to the coordinator. HPNET continues to evolve its

Excursion during the annual gathering of the Hydro Empowerment Network in Indonesia

Micro-hydroelectric Power

Micro-hydroelectric plants are appropriate for the provision of electricity where the demand for power is relatively low (e.g. below 100 kW)[1] and where a constant flow of running water is available. The plants are commonly designed in "run-of-river" schemes, i.e. configurations where only part of the water flow of a stream or river is deviated to drive the hydroelectric turbine, as shown in Figure 4.

The flow of water turns a water turbine, which drives an electric generator and transforms the rotary movement of the turbine into electricity. The total power delivered to the turbine is proportional to two factors: (1) the rate of water flow, and (2) the hydraulic head of the plant, i.e. the difference in elevation between the water level of the water source and the turbine outflow.

Environmental Issues

The operation of micro-hydro plants involves modifications to the natural water flow, although in the case of "run-of-river" schemes, only a section of the stream will be used (i.e. between the intake weir and the outflow of the turbine). In order to guarantee the minimum supply of water needed to conserve local ecosystems, water management strategies are important to be developed in situations where water flows are modified as they can have a critical impact on the habitats of local species (e.g. fish).

Social Issues and development aspects

A micro-hydro project is often affecting a whole community and can lead to positive or negative impacts beyond pure electricity supply. For example, it can be integrated into programmes addressing other local needs, such as irrigation, flood prevention or the fostering of tourism activities. On the other hand, the operation can also result in conflicts about the use of water flow or cause trouble within the community or the neighbourhood.

A well planned project strategy should include a sound management system and apply measures to avoid conflict and harness synergies, e.g. appropriate trainings and strengthening local human resources and involve community organisers right from the outset of the project.

Development Status in South & South East Asia

Focus of the HydroEmpowerment Network are pico- to micro-hydro schemes, ranging from a few tens of Watts for single households to about 5kW to 100 kW for communities, mini-grids or rural industries.

Most of the applied water turbines and generators as well as electric load controller used are commercially available. The technologies are already mature and no significant cost changes are expected. However, in some countries access to the technology can be improved by developing local hardware and software supply capacities. There are also self-built approaches applied for low-cost variants (e.g. of pico-turbines in Sri Lanka) and the network is aiming to develop a handbook/guideline for an open-source load controller.

The development of in-stream turbines is gaining increased interest. They are designed to better use the kinetic energy of water flow. The installation does not require complex civil works to divert the water, as the turbines are submerged in the river and commonly fixed to a floating platform. Some concepts in this field reached commercial maturity and are demonstrated in the region (e.g. India). An increasingly important topic is the grid-connection of individual MHPs to the national grid once it is established.

Economic issues

The capital cost of hydroelectric systems generally depends on several features of the site (e.g. accessibility, need for special civil works, available head etc.). The total capital cost of micro-hydro projects generally ranges between US$1,000 and US$3,000 per kilowatt [19], although projects outside this range are not uncommon.

Annual operation and maintenance costs are estimated to range between 1% and 4% of the total capital investment costs [20]. Consequently, even if the initial investment costs are covered by external funders, a local tariff and management system must be established to ensure the running costs are covered and the project is sustainable in the long term.

Details see http://www.wisions.net/technologyradar

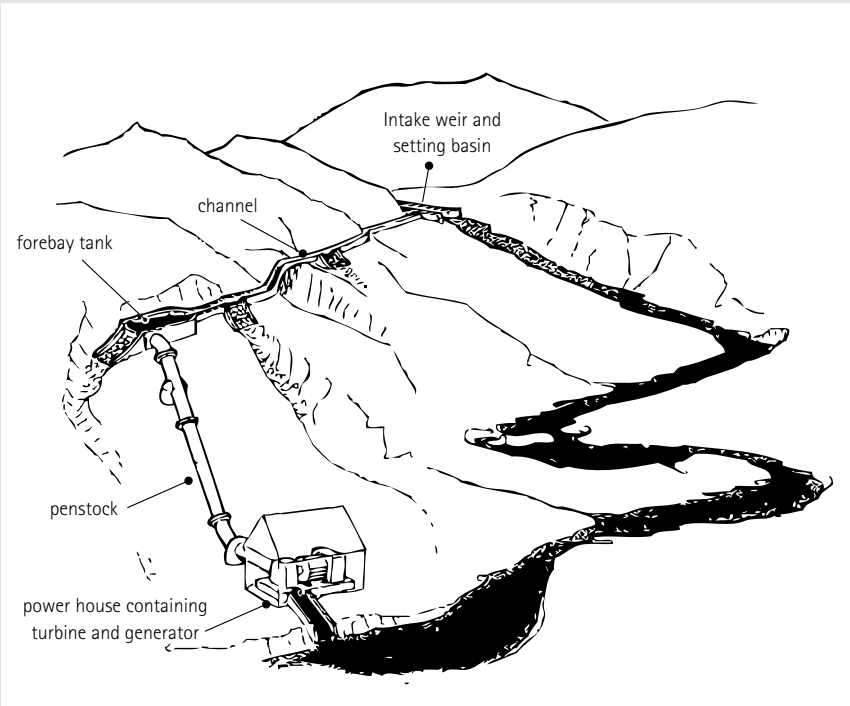


Fig. 4: Typical configuration of micro-hydro plant, Source: Practical Action, technical brief on micro-hydro power

[1] HPNET refers to less than 5kW as pico hydro, 5kW to 100kW as micro-hydro, and 100 kW to 1000kW as mini hydro.

Group work during the annual gathering of the Hydro Empowerment Network in Indonesia

structure and operations in order to increase its impact on the ground. The WISIONS initiative initially acted as co-founder and has since supported the network by providing financial support for the coordination, gatherings and exchange activities, as well as by acting as the supervising body.

HPNET'S ACTIVITIES

The network's activities include collaborative research among members (both regional and country-specific), advocacy and bi-lateral and multi-lateral in-person exchanges, such as technical capacity-building workshops, practice-to-policy exchanges and network gatherings.

Network gatherings: The meetings provide the opportunity for members to exchange knowledge and ideas in a face-to-face setting; to share experiences, gain new insights and build new partnerships, as well as to further develop and strengthen existing ones. The first two gatherings were held in Borneo/Malaysia, 2013 and in Bandung/Indonesia, in 2015, while the third was the first gathering in South Asia, held in Nepal in 2016.

Practice-to-Policy workshops: HPNET's practice-to-policy exchanges facilitate practitioners and other MHP multi-actors to understand common goals in order to advance the sector.

Practical workshop during the annual gathering of the Hydro Empowerment Network in Borneo

HPNET's policy exchanges focus on country-specific strategy (e.g. Myanmar, see Case Study 7) and policy mechanisms requested regionally (e.g. grid-interconnection of MHP).

Technical training sessions: HPNET members organise different forms of capacity-building sessions to strengthen the skills of local technicians and community organisers, who are often the first point of contact in local communities, e.g. training courses to build local capacity on concrete pico-hydro turbines, electronic load controllers (ELC) and advocacy through the development of multi-media skills.

Online exchange and web-based knowledge portal: The different levels of face-to-face exchange are complemented by a network website presenting profiles of the members, members' online forums and an online library of catalogued micro-hydro documents, multi-media products and a contacts database.

SPECIFIC CHARACTER OF HPNET AND OUTLOOK

Despite the huge distances between the countries (up to 5000 km linear distance), as well as the social, cultural and lingual differences, practitioners from the region are greatly interested in this form of exchange and share a mutual vision for collectively promoting and advancing pico, micro, and mini hydro in South and Southeast Asia. The network uses a 4-step approach to any exchange: collation of available data on the topic into an online library, ground truthing with baseline research from the field, designing the exchange using collated data and most recent field programmes, and post-event advocacy to better inform decision-makers and partners regarding changes on the ground.

A key component – and equally a key challenge – in achieving these objectives is the fostering of active online communication between members that does not burden the members' full-time role as practitioners. In addition, although the network is already internationally recognised, gaining more direct support from decision-makers in internationally active organisations and refining its structure and operations could further build on HPNET's existing benefits to the sector.

CASE STUDY 7

SEPS KNOWLEDGE EXCHANGE

Hydro Empowerment Network

MICRO-HYDRO FOR MYANMAR: PRACTICE-TO-POLICY DIALOGUE APPLYING LESSONS FROM INDONESIA, NEPAL AND SRI LANKA

EXCHANGE ACTIVITY'S AIM: **To facilitate dialogue between decision-makers in Myanmar and their counterparts in countries that have successfully implemented micro-hydro**

EXCHANGE NEED AND OBJECTIVE(S)

In Myanmar the per capita consumption of electricity is among the lowest in Asia at 100 kWh per year. The rural electrification rate is 26%, with vast regions of the country beyond the reach of the grid. With its mountainous terrain and abundant rain in many areas, Myanmar has excellent potential for developing community-scale hydropower but, historically, Myanmar's rural electrification efforts have not focused on micro-hydro or other types of decentralised energy as key components for providing energy services to rural areas. The focus has instead been on increasing access to electricity through the expansion of the central grid. Addressing the domestic power sector challenges in Myanmar will require a variety of measures, but community-scale micro-hydropower presents particular promise as an equitable, economical and sustainable solution that can be more rapidly deployed in some areas than conventional grid extension.

Dipti Vaghela, the coordinator of HPNET, with participants on a field trip in Shan State, Myanmar

Recognising these opportunities, this exchange, which was organised by the Renewable Energy Association of Myanmar (REAM) – a member of the National Energy Management Committee – comprised a practice-to-policy dialogue on the potential of micro-hydro power for Myanmar. The workshop provided decision-makers and key stakeholders in Myanmar with an opportunity to interact with key actors involved in successful micro-hydro programmes in Indonesia, Nepal and Sri Lanka, in order to formulate a strategy for advancing micro-hydro small power producers (SPP) in Myanmar.

The main objectives were to generate micro-hydro advocacy and create awareness of successful policy models and best practice in scaled micro-hydro programmes in South and Southeast Asia to support Myanmar practitioners and policymakers with lessons learned. Furthermore, the workshop aimed to learn from Myanmar stakeholders and visited Myanmar micro-hydro sites to understand micro-hydro challenges and opportunities in two regions of Myanmar.

PARTICIPANTS & TARGET GROUP(S)

The event brought together policymakers, small power producers, players in the field of rural development and civil society groups to take a closer look at successfully scaled micro/mini-hydro programmes in Indonesia, Nepal and Sri Lanka, in order to develop appropriate efforts to leverage micro/mini-hydro for rural Myanmar.

ACTIVITIES

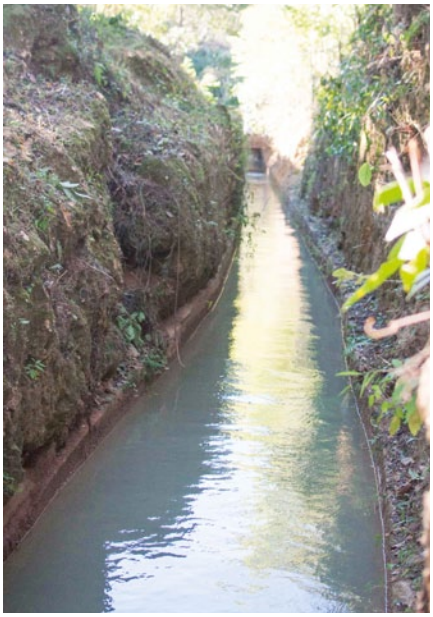
The programme included activities in Yangon and Shan State, Myanmar, from November 24–28, 2014. On the first day, following an introduction to the Myanmar energy scenario, experts from Indonesia, Nepal, Sri Lanka and the United States gave comprehensive presentations on key aspects of sustainable micro-hydro programmes, such as success factors, technology delivery, financing and policy mechanisms. External actors presented on innovations and possibilities for Myanmar. During day 2 local micro/mini-hydro practitioners from Myanmar's Shan State presented on their achievements and challenges, followed by interactive group discussions. The field visit on days 3 and 4 was to a village micro-hydro site in Shan State, its community and regional local manufacturing workshop facilities, with follow-up group dialogue. The last day focused on developing a vision and recommendations to leverage MHP for empowering rural Myanmar.

Participants during the open space discussion forum

RESULTS & IMPACT

The practice-to-policy exchange was very successful and resulted in a number of key findings and subsequent activities. To prepare for the event, REAM conducted a field assessment of the Shan State region,

Locally-manufactured MHP in Shan State, Myanmar



Field trip to locally manufactured MHP in Shan State, Myanmar, with Aung Myint, General Secretary of Renewable Energy Association Myanmar (REAM)

which revealed the existence of hundreds of functioning projects developed by local micro and mini-hydro practitioners. Experienced practitioners are also said to exist in the Chin, Mandalya and Kayin regions, but a formal assessment to identify them and assess their skills is needed.

The event itself contributed to minimising the gap between Myanmar micro-hydro practitioners, the government, policy actors, the private sector, international aid and investment groups, and micro-hydro advisors. It became clear that decentralised renewable energy is considered to be a viable component for the electrification of rural Myanmar by the majority of stakeholders. The event contributed practical and policy insights to Myanmar's extensive energy reform process.

Additionally, as result of the workshop, follow-up activities including next-step meetings and events comprising multiple interest parties were achieved:

- The United Nation's Sustainable Energy for All Initiative (SE4ALL) invited REAM and the Shan State practitioners to present at their key brainstorming meeting for off-grid and mini-grid efforts in January 2015.
- The World Wide Fund for Nature included micro-hydro in their DRE efforts for Myanmar.
- The Global Integrated Service Group of Companies engaged the Shan State micro-hydro practitioners in a proposal to demonstrate improved new and upgradeable projects.

LESSONS LEARNED & RECOMMENDATIONS

A number of lessons emerged from the dialogue between the delegates from Myanmar and the international attendees. The existing experience from decades of work in scaled and sustainable micro-hydro programmes in Indonesia, Nepal and Sri Lanka should be applied to the micro/mini-hydro sector in Myanmar. There is no need for Myanmar to follow the same learning curve if leap-frogging is possible.

Some communities with operational stand-alone MHPs have become wary of micro-hydro technology due to the need for constant maintenance and issues of low output in low quality projects. They consider the extension of the central grid as more progressive. However, in contrast, it is promising that increasing numbers of communities are approaching local practitioners to develop their own micro-hydro sites.

International experts consider that upgrading and promoting new micro/mini-hydro projects could be more efficient and effective than extending the central grid. To ensure better quality manufacturing, skills training is required on turbine fabrication, load controllers and grid connectivity. Consequently, the development of a technical assistance (TA) programme is recommended for providing training to Myanmar micro and mini-hydro practitioners, in parallel to providing financial assistance and developing policies in order to ensure sustainability and integration with mainstream rural electrification policies.

Source: Final Report submitted to WISIONS by REAM

CASE STUDY 8

SEPS PROJECT

Hydro Empowerment Network

PROMOTING THE LONG-TERM USE OF MICRO-HYDRO SYSTEMS BY PROVIDING ENERGY TO RURAL ENTERPRISES IN NEPAL AND INDIA

PROJECT'S AIM: **To ensure the sustained operation of existing micro-hydro plants through rehabilitation, optimisation, increased financial stability, capacity-building and management support**

Decentralised energy systems based on micro-hydro power can increase access to energy in remote off-grid locations. In the medium and long term, micro-hydro plants (MHPs) installed in rural settings may face maintenance problems and stop working at optimal levels. One of the main reasons for poor operation is under-utilisation: low plant load factors leading to weak cash-flow and, as a result, to insufficient maintenance. Simultaneously, opportunities for income-generating activities and for supporting rural enterprises often go unexploited.

Participatory Market System Development (PMSD) workshop

Practical Action aimed to promote the long-term use of certain existing MHPs using a holistic approach called Participatory Market System Development (PMSD). It emphasises stakeholder participation for creating sustainable rural enterprises and empowering marginalised market actors.

Five existing micro-hydro projects (three in Nepal and two in Odisha state, India) ranging from 14 to 100 kW capacity, saw their MHPs serviced and refurbished. Moreover, additional demand for power was created by establishing 21 new enterprises, ranging from mills for rice and wheat to construction businesses. The aim was to increase the load factors of the MHPs and, consequently, their financial viability.

Lastly, technical and business skills trainings were provided to the existing and new MHP users. The project also supported rural enterprises establishment and operation for optimum utilisation of the MHPs. All the activities are expected to contribute ultimately to the long-term sustainability of the MHPs. The project also worked towards influencing policymakers to remove policy barriers to micro-hydro and to support energy-based rural enterprises.

TECHNOLOGY, OPERATIONS & MAINTENANCE

The technical aspect of the project revolved around improving the reliability of the energy supply at the five targeted MHPs. The first step was to identify the rehabilitation, improvement and maintenance needs and to determine a baseline against which project outcomes could be measured. The improvements included replacing or refurbishing generators, fixing water leaks in the canals, de-silting tanks, repairing distribution lines and points, installing new meters, replacing one whole turbine and various parts of others, and refurbishing the power houses. The community and the MHP management committees actively participated in this work.

DELIVERY MODEL & FINANCIAL MANAGEMENT

Non-technical efforts were directed towards making MHP management committees aware of opportunities for increased revenue generation from the sale of a reliable electricity supply. In addition, the project provided incubation support to new enterprises and helped existing ones to upgrade by providing advice and capacity development on business planning and management. Capacity development activities also targeted policymakers and local partners, and aimed to explain the Participatory Market System Development (PMSD) approach.

Key stakeholders of the MHPs and selected enterprises participated in PMSD workshops at the five project sites. The process helped to identify potential enterprises in the MHP catchment areas. Market studies for the potential enterprises were then carried out and support was provided to the entrepreneurs to develop their business plans. Additionally, the project supported the entrepreneurs in the selection, procurement, installation and operation of machinery and equipment. The project also provided financial support to the entrepreneurs as an incentive to establish and run their businesses and facilitated links to micro-finance institutions.

At the start of the project, the Nepalese MHPs had functioning community funds to cover maintenance and operation costs.

Location:
Baglung District, Nepal
Odisha State, India

Technology:
Micro-hydro

Costs:
Total: € 71,150
WISIONS financial support: € 50,000

Partners Involved:
Practical Action South Asia
(www.practicalaction.org

Duration:
February 2014 – January 2016

In contrast, the funds for the two MHPs in Odisha state were inactive. The project supported the reactivation of the funds and established systems for their long-term management.

Finally, the capacity of the MHP management committees and operators was enhanced through targeted training, shadowing/exposure experiences and workshops.

Production of Lokta paper in Nepal

ENVIRONMENTAL ISSUES

In addition to enhancing access to electricity in remote rural locations, the project contributed to replacing the use of fossil fuels. As the project involved existing MHPs, no particular provisions were made to assess the environmental impact of the plants.

SOCIAL ISSUES

The project worked to improve governance and transparency in the management of MHPs. Efforts were made to promote gender equity and the inclusion of marginalised groups. Of the 21 new income-generating enterprises, two are owned and operated by women.

Regular interaction with the communities was key to their involvement in improved MHP management and to creating a sense of ownership. Throughout, Practical Action worked in partnership with local NGOs (Dhaulagiri Community Resource Development Centre (DCRDC) in Nepal and Koraput Farmers' Association (KFA) in Odisha, India).

RESULTS & IMPACT

Five MHPs were rehabilitated and maintained and these now provide a reliable electricity supply, delivering significant efficiency gains. An additional 110 households (total 1910) were electrified in comparison to the baseline of 1,800.

The productive use of micro-hydro generated electricity has expanded and this, in turn, has led to increased plant load factors by, on average, a factor of two. The monthly income generated by the MHPs has increased proportionately and this additional revenue will ensure adequate cash-flow for long-term operations, repairs and maintenance.

The PMSD approach for the promotion of energy-based rural enterprises was used to provide business counselling and orientation to around 80 individuals. This, in turn, led to 21 new enterprises being formed. A further 20 people were trained in the principles of the approach, with the aim of reaching out to entrepreneurs in other micro-hydro catchment areas.

However, the project results also show differences between the two project sites. While the conditions for developing business activities and increasing productive use in Nepal were favourable, Odisha's situation was not advantageous as access to electricity and practical support cannot instantly bridge the gaps that a community has faced for decades.

REPLICABILITY

Lack of access to electricity is a significant barrier to development in rural communities in Nepal and Odisha state, where around 40% and 70% (respectively) of households have no electricity. Past efforts to exploit the regions' potential for micro-hydro power have encountered varying degrees of success. The experience gained in this project might help to re-energise under-performing micro-hydro projects by focusing on growing the use of micro-hydro power for productive applications.

To increase the possibility of replication, the project results have been shared via workshops, reports and project visits with local/district governments and ministries in Nepal and Odisha, as well as with the Nepalese Alternative Energy Promotion Centre (AEPC).

LESSONS LEARNED

This experience demonstrates that promotion of end-uses of MHPs and strengthening the financial base of MHPs is instrumental in ensuring their optimal operation and maintenance which, in turn, affects their long-term sustainability. The PMSD approach is warranted where certain underlying conditions for market development exist. For regions and communities facing severe development shortfalls, the approach has limits and needs to be accompanied by other development measures.

Source: Final Report submitted to WISIONS by Practical Action South Asia Regional Office in March 2016

SUMMING UP...

The four energy practitioner networks emerged and developed differently according to particular conditions (technological, geographical and socio-political), but share key objectives: strengthening the capacity of members through collaboration and knowledge exchange and advocacy by fostering dialogue and sharing knowledge with relevant stakeholders.

They all have members with a strong shared vision, are coordinated effectively and have a dynamic approach. For most of the practitioners, the network events and activities are unique experiences. The networks often provide the practitioners with the opportunity to widen their focus from dealing with pressing local community aspects to considering issues from a regional or even global perspective. It is inspiring for the practitioners to realise there are similar people and organisations in neighbouring countries who share the same challenges but also the same aims.

However, the wide-ranging geographical distribution and associated long distances between member organisations make maintaining active communication within the networks an on-going challenge. Therefore, annual/bi-annual gatherings are particularly important for strengthening and revitalising mutual trust through direct personal contact and face-to-face communication.

Notwithstanding their relatively short existence, the networks supported by WISIONS have already become acknowledged as important exchange platforms for practitioners and other stakeholders working at the forefront of delivering sustainable energy services to households and communities in the developing world.

Although time alone will demonstrate the medium-term impacts, initial effects are already evident. These include internal outcomes, such as increased knowledge due to hands-on training, and new transnational connections between both individual practitioners and organisations. In particular, intercultural understanding has increased and self-awareness of the role that local experts and NGOs play in achieving the global target of sustainable energy access has grown.

Externally, the networks have successfully contributed to increasing the positive perception of small-scale decentralised energy technologies as viable alternatives to conventional energy sources and grid-connectivity. Representatives from local governments and national ministries, as well as the national media, have attended network events – raising awareness and attracting further interest in sustainable small-scale energy solutions.

GET INVOLVED...

- Are you interested in these networks and their work?
- Do you want to become a member or a supporter?
- Do you know of similar networks and see the potential to link efforts?

PLEASE VISIT THE NETWORK'S WEBPAGE AND CONTACT US DIRECT:

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Contact: info@wisions.net

http://www.hpnet.org/
Contact: hydroempowerment@gmail.com

http://redbiolac.org/ (Spanish)
Contact: redbiolac@gmail.com

http://redbiocol.org (Spanish)
Contact: lylianr@utafoundation.org

http://windempowerment.org
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Wuppertal Institute is a German research institute and think tank that explores and develops models, strategies and instruments to support sustainable development at local, national and international level.

Sustainability research at the Wuppertal Institute focuses on ecology and its relation to economy and society. Special emphasis is put on analysing and supporting technological and social innovations that decouple prosperity and economic growth from the use of natural resources (www.wupperinst.org).

Built on the Wuppertal Institute's 25 years of expertise and leadership in transition research towards sustainable development, the WISIONS initiative has been committed for over a decade to promoting sustainable solutions for clean energy access.

REFERENCES:

[1] OECD/IEA (2016). World Energy Outlook. Modern Energy for All. www.worldenergyoutlook.org/resources/energydevelopment/ (accessed 28/6/2016)

[2] Henry, A. D.& Vollan, B. (2014). Networks and the Challenge of Sustainable Development. Annu. Rev. Environ. Resour. 2014, 39, 583–610.

[3] Neugebauer, U. & Beywl, W. Methoden zur Netzwerkevaluation (2006). Z. Für Eval. 2006, 249–286.

[4] Gajo, M. et al (2013). Netzwerkevaluierung – Ein Leitfaden zur Bewertung von Kooperation in Netzwerken; GIZ: Eschborn, 2013.

[5] Creech, H. (2006). Measuring while you manage: Planning, monitoring and evaluating knowledge networks; International Institute for Sustainable Development: Winnipeg.

[6] Bellwald, S. et al (2013). Netzwerke und Kooperationen in der Regionalentwicklung – Praxisblatt; regiosuisse – Netzwerkstelle Regionalentwicklung. Brig.

[7] Borkenhagen, P. et al (2004). Netzwerkmanagement; Arbeitsgemeinschaft Betriebliche Weiterbildungsforschung e. V.: Berlin, 2004.

[8] GIZ (2015). Work the Net – A management guide for existing and emerging formal networks. Publications on international personnel development. Volume 5. Bonn, 2015.

[9] United Nations Foundation (2012). Energy Access Practitioner Network. Towards Achieving Universal Energy Access by 2030. Washington, D.C.

[10] Dimpl, E. (2011). Small-scale Electricity Generation from Biomass. Part II: Biogas. German Agency for International Cooperation (GIZ)

[11] Cheng S, et al (2014). Application of fault tree approach for technical assessment of small-sized biogas systems in Nepal. Appl Energy 2014: 1372–81.

[12] Huanyun D, et al (2013). Analysis on sustainable development countermeasures and barriers of rural household biogas in China. J Renew Sustain Energy 2013.

[13] Thu CTT et al. (2012). Manure management practices on biogas and non-biogas pig farms in developing countries – using livestock farms in Vietnam as an example. J Clean Prod 2012: 64–71

[14] Landi M, Sovacool BK, Eidsness J. (2013). Cooking with gas: Policy lessons from Rwanda's National Domestic Biogas Program (NDBP). Energy Sustain Dev 2013: 347–56.

[15] International Renewable Energy Agency (IRENA) (2012). Wind Power. Renewable Energy Technologies Cost Assessments, Volume 1, Issue 5.

[16] World Wind Energy Association (WWEA) (2012): Small Wind World Report

[17] Ferrer-Martí, L., et al (2012). Evaluating and comparing three community small-scale wind electrification projects. Renewable and Sustainable Energy Reviews, 16(7), 5379–5390.

[18] Leary, J., While, A., Howel, R. (2012). Locally manufactured wind power technology for sustainable rural electrification. Energy Policy, 43, 173–183

[19] IPCC (2011). IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation

[20] International Renewable Energy Agency IRENA (2015). Renewable Power Generation Costs in 2014, 30

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