

# 1 BIOGAS PROGRAMME IN VIET NAM

Heating, cooking and lighting

## PROJECT SUMMARY

The Biogas Programme for the Animal Husbandry Sector in Viet Nam was founded in 2003 with the objective of developing a commercially viable biogas market to increase sustainable lighting and heating services and to provide fuel for household cooking in rural areas. Since its inception, and combined with several spin-off projects, it has facilitated the construction of nearly 250 000 domestic biogas digesters, resulting in access to clean, renewable and reliable energy while addressing the waste management challenge of Viet Nam's growing livestock population and improving living conditions for over 1.2 million people.

## TECHNOLOGY

Biogas digesters produce both biogas and bio-slurry. The biogas can be used for cooking (for households and for livestock feedstock) and as a fuel for electricity production that then can provide lighting and power for other income-generating activities, such as egg hatching and the production of rice wine and tofu. The bio-slurry, as a fertiliser, can result in increased yields of better-quality crops that can be sold at higher prices. The most popular digester model is a brick-made fixed-dome system, since it requires relatively little maintenance and can be built with local materials and by local masons. The project also supports a supply chain of composite biodigesters that offer the advantages of a much faster installation time, reduced skilled labour needs, and the ability to deal with areas with high water levels.

## FINANCE AND DEPLOYMENT MODEL

The biogas programme was initiated by the Dutch government and the Vietnamese Ministry of Agricultural and Rural Development (MARD) in partnership with SNV Netherlands Development Organisation – which acted as the technical advisor – and was implemented by the Department of Livestock Production. This institutional framework

## PROJECT SNAPSHOT



**Location:** Viet Nam

**Starting year:** 2003

**Implementing agency:** EnDev/GIZ/SNV, Ministry of Agriculture and Rural Development, Nexus for Development

**Beneficiaries:** End-users and enterprises

**Relevant policy and regulatory support:** Active participation of the government and a formal decree on support to biodigester dissemination

**Key takeaway:** A sustainable market for domestic biogas can be developed, and socio-economic and environmental benefits can be maximised, through long-term commitment, tailored incentives and a focus on local capacity building.

helped ensure that the programme was nationally owned and managed. Between 2003 and 2014 the programme costs were funded by the Dutch government, the Vietnamese provincial governments and the lion's share by the farmers themselves.

Since 2013, Energising Development (EnDev), an energy access partnership of six countries, has been the key donor, and the programme now also receives funds from the sale of carbon certificates (managed in partnership with Nexus for Development). A flat-rate subsidy of approximately USD 50 (VND 1.2 million) per digester was offered, incentivising households by reducing the initial

investment required. On average this subsidy is 10% of total investment costs (VND 12 million/ USD 500), making households by far the largest investors.

Recently, the household subsidy is being phased out and replaced by EnDev with a results-based financing (RBF) incentive that goes to the suppliers. In preparing for a competitive free market, enterprises are taking additional risks and executing extra tasks and responsibilities that are otherwise undertaken by the programme. Between mid-2016 and mid-2017, 16 500 biodigesters had been constructed under this mechanism. After almost 15 years of operation, the biogas programme, currently in its final phase III that runs until 2020, has contributed to the development of a commercial domestic biogas sector.

## OBSERVED LIVELIHOOD BENEFITS

### Economic

**Reduced fuel spending and increased energy affordability:** Savings from the use of biogas and bio-slurry are realised by replacing fuel for cooking and by reduced need for chemical fertilisers (and in some cases pesticides). Annual savings per household is around USD 167.

**Income generation and poverty alleviation:** The programme has generated many sources of income, especially for the workers directly involved in the construction process, such as trained masons and untrained assistants, who earn around USD 2 000 and USD 1500 per year, respectively, assuming a full-time basis of 220 working days. A biogas digester results in annual time saving of 544 hours – mainly in time spent cooking and in collecting manure and wood and agricultural residue – equivalent to 30% of an average full-time job per family.

**Job creation:** Over its 15-year lifetime, the programme has resulted in around 16 800 full-time equivalent jobs. This is a conservative estimate as it does not account for biodigester construction outside of the programme, which is happening in significant numbers.

### Social

**Gender equality:** The use of bioenergy and bio-slurry has reduced the time required for meeting daily fuel needs, enabling women to carry out different activities and contributing to improved gender equality. Of the women surveyed, 35% spent the extra time on farm-related activities and only 3% had income-generating activities outside of the farm; 26% spent the extra time on domestic responsibilities such as cleaning the house, 16% on taking care of the children and 19% on leisure. Moreover, it has been observed that men take more interest in cooking since biogas has been introduced.

**Improved education and skills:** More than 1 000 government technicians have been trained in biogas technologies, and more than 1 700 masons have been trained in construction of the various designs of the brick, dome-shaped, domestic biogas digester. Furthermore, 355 teams have been supported in establishing their biogas digester businesses.

### Health

**Prevention of diseases and health hazards:** As a result of reduced indoor air pollution (measured as concentration of particulate matter PM 2.5), the programme averts approximately 27 700 DALYs (disability-adjusted life years) and 750 premature deaths.

### Environmental

**Reduced emission and impact on climate change:** Each digester reduces 6.7 tonnes of carbon dioxide-equivalent per year by displacing fossil fuels, such as liquefied petroleum gas and those used in the production of fertilisers, and from improved manure management which reduces considerable methane emissions.

**Waste management:** One of the most important benefits for farmers is managing the livestock manure by using it as feedstock and thus reducing water and air pollution, thereby avoiding the diffusion of water-related diseases caused by untreated manure.

## 2

# WONDER WOMEN PROGRAMME IN INDONESIA

Fostering social entrepreneurship

### PROJECT SUMMARY

The Wonder Women programme, an initiative of Kopernik, a non-governmental organisation in Indonesia, focuses on empowering women to expand last-mile energy access through off-grid renewable energy technologies.

One of the sites where the programme has been carried out is Lembata, an island in East Nusa Tenggara province. Since 2013, the programme has recruited more than 500 “wonder women”, who have sold more than 55 000 clean energy technologies reaching more than 250 000 people in some of Indonesia’s poorest and most remote areas, where the vast majority of the population lacks access to electricity, clean water and modern cooking methods.

### TECHNOLOGY

Kopernik works with the wonder women to make clean energy technologies available to remote communities, including solar lanterns, clean cookstoves and water filters.

### FINANCE AND DEPLOYMENT MODEL

The programme provides training to women social entrepreneurs to develop their capacity to build and sustain businesses. The training focuses on technology use and maintenance, sales and marketing, bookkeeping and financial management, and public speaking. The original deployment model focused on a consignment approach wherein Kopernik delivered the products and the entrepreneurs earned a margin on every sale. Over time, the model has changed such that the wonder women now collect the money from customers first, before the products are delivered.

The entrepreneurs sell from home, through their networks, at market stalls and small shops (warung-

## PROJECT SNAPSHOT



Photo credit: Kopernik

**Location:** Lembata Island, Indonesia

**Starting year:** 2013

**Implementing agency:** Kopernik

**Beneficiaries:** Social entrepreneurs and households

**Key takeaway:** Local social entrepreneurs can play a pivotal role in facilitating the deployment of off-grid renewable energy solutions. Empowering women to be champions of market development supports a more holistic approach to deployment, while bringing a range of other socio-economic benefits to the communities.

warung), or at community events. Often they are part of community groups, contributing a portion of their margin to support group activities such as savings and lending programmes. Over the long term, the programme provides business development coaching and mentoring to support the entrepreneurs. Key lessons learned from the programme include the importance of matching products with needs, the product should be ready-to-use and relatively inexpensive, and fostering women entrepreneurs ensures that the potential socio-economic benefits are better captured in decision making.

## OBSERVED LIVELIHOOD BENEFITS

### Economic

**Reduced fuel spending and increased energy affordability:** Households were observed to have been spending one-third of their monthly income on kerosene for lighting and cooking. With the introduction of solar lanterns, the monthly expenditures on energy dropped by more than half.

**Income generation and poverty alleviation:** From a survey among the wonder women group, carried out 12 months after the programme's inception, almost 90% of them affirmed earning additional income thanks to the solar lantern business. Depending on the technology and variant, margins from sales could range from USD 1.5 to USD 26. Another boost to the local economy resulted from the use of solar lanterns during sea cucumber harvesting; since these marine animals are attracted to light, the use of solar lanterns is known to increase fishery yields by up to four times, enabling an income of at least USD 90 per month from the sale.

**Job creation:** Over 500 women have received training and employment through the programme.

### Social

**Gender equality:** The survey among the wonder women group, shows that 26% of them fully learned

how to run a business and 21% became more empowered in the family, witnessing a greater role in household decision making. Almost one-half of the respondents perceived an improvement in their self-status, and 19% increased their empowerment within the community.

**Improved education and skills:** The capacity building sessions contributed to spreading knowledge on the technology sold, on sales and financial management, as well as on public speaking. Use of the solar lanterns at night has increased the hours and quality of after-school study time, thanks to the reliable, brighter light provided and preventing fatigue, eye strain and exposure to harmful emissions. In addition, the increased income strengthens the education level of the community: 39% of survey respondents affirmed investing the revenues to pursue their personal education and that of their children.

### Health

**Prevention of diseases and health hazards:** The use of renewable technologies reduced fatigue as well as pollution from traditional kerosene lamps.

### Environmental

**Reduced emissions and impact on climate change:** The programme has reduced carbon dioxide emissions by an estimated 20 000 tonnes, due to reduced use of kerosene and energy savings.



Photo credit: Kopernik

**3**

## SOLAR PV IN RESORTS IN THE PHILIPPINES AND INDONESIA

Advancing sustainable tourism

### PROJECT SUMMARY

The tourism sector contributes immensely to local economies in Indonesia and the Philippines. The Nikoi Island and Qi Palawan resorts are two examples of how off-grid renewable energy solutions can improve the sustainability of the tourism sector and reduce its carbon footprint, as well as attract more tourists through the provision of more reliable services.

Nikoi Island is a resort island in Indonesia that became operational in 2007. Since the island was unoccupied before the resort's construction, it was not served by the national grid and its only energy sources were diesel generators. In 2012 Nikoi Island upgraded its energy supply to a hybrid solar photovoltaic (PV)-diesel energy system.

Qi Palawan resort, located in remote north-eastern Palawan, is the first full-service resort in the Philippines powered almost entirely by solar. Together with the use of local materials and labour for the construction of the structure, this has allowed the resort to meet its objectives as laid out within the Responsible Tourism Policy.<sup>1</sup>

### TECHNOLOGY

**Nikoi Island Resort:** The earlier energy system comprised three diesel generators, running 24 hours a day, with capacities of 25 kilowatts (kW), 36 kW and 58 kW. Together these provided electricity for all of the island's appliances and electrical equipment. In 2012 a hybrid solar-diesel-battery system was commissioned, consisting of 24 kW solar PV panels and a 3 200 amp-hour/48-volt battery bank to utilise the excess power generated. This configuration generates approximately 32 000 kilowatt-hours (kWh) of solar energy per year, which represents 30% of Nikoi Island's power demand.

### PROJECT SNAPSHOT



Photo credit: Autarsys/Qi Palawan

**Location:** Nikoi Island Resort (Indonesia) and Qi Palawan Resort (the Philippines)

**Starting year:** 2012 (Indonesia) and 2017 (the Philippines)

**Implementing agency:** Nikoi Island Resort and Qi Palawan Resort

**Beneficiaries:** Local tourism and communities

**Relevant policy and regulatory support:** Deregulated

**Key takeaway:** Off-grid renewable energy solutions can boost the sustainability of the tourism sector and improve the reliability of energy services while achieving economic and environmental benefits.

In addition, the resort installed a 150-litre passive solar water heater in each guest villa and 21 individual solar water heaters for use in the villas' kitchens.

**Qi Palawan Resort:** In 2017 the resort installed 40 kW of solar panels, equipped with a battery capacity of 124 kWh. The plant allows the resort to procure much of its electricity needs from solar even during peak occupancy periods. The resort has a diesel generator for backup.

<sup>1</sup> Nikoi Island Responsible Tourism Policy 2017, [www.nikoi.com/wp-content/uploads/2017/05/Responsible-Tourism-Policy-2017.pdf](http://www.nikoi.com/wp-content/uploads/2017/05/Responsible-Tourism-Policy-2017.pdf).

## OBSERVED BENEFITS

### Economic

**Reduced fuel spending and increased energy affordability:** The hybrid systems enabled considerable reductions of diesel consumption in both the resorts. In Nikoi Island diesel consumption was reduced by half, with average daily saving of diesel in 2016 amounting to 119 litres per day, reaching a peak of 150 litres per day. Hybridisation of the power plant allows an estimated decrease in energy costs from USD 0.88 per kWh to USD 0.63 per kWh. In the Philippines, Qi Palawan Resort saved almost USD 15 000 on diesel spending in 2017 by going almost 100% solar.

**Income generation and poverty alleviation:** The deployment of off-grid renewable energy solutions enables the provision of clean, reliable and more affordable energy services, such as reliable power, internet and hot water, that can help attract more tourists to remote locations, boosting the local economy.

### Social

**Inclusive growth and community empowerment:** Nikoi Island set up The Island Foundation, which serves the community as an umbrella entity for various social activities including a learning centre for teacher training workshops and a venue for selling local arts and crafts.

### Environmental

**Reduced emissions and impact on climate change:** In Nikoi Island the displacement of diesel generators and a decrease in energy consumption through the implementation of energy efficiency measures limited the emission of harmful gases into the atmosphere. Specifically, the amount of carbon dioxide and carbon monoxide, particulate matters, unburned hydrocarbons, sulphur dioxide and nitrogen oxides dropped by approximately 42%. The Qi Palawan Resort, covering almost 100% of its annual energy needs through solar PV panels, saves nearly 34 tonnes of carbon dioxide per year.



## 4

## SUMBA ICONIC ISLAND INITIATIVE IN INDONESIA

A collaborative effort to support local development

### PROJECT SUMMARY

Sumba Island is one of the four largest islands in Nusa Tenggara Timur province in eastern Indonesia. A significant share of its 700 000 people are subsistence farmers, and poverty is widespread. A quarter of the island's population is served by two small diesel-based mini-grids. Transport of fuel to the island results in high energy production costs and unreliable supply.

Recognising the potential of renewables on the island, the Iconic Island initiative was launched by Hivos, a Dutch non-governmental organisation (NGO), to showcase the potential for local development facilitated by a supply of 100% renewable energy. The initiative is a collaborative effort with the district, provincial and national governments, the state electricity company, local NGOs, the corporate social responsibility units of several companies, and development donors such as the Netherlands Directorate-General for International Cooperation, Millennium Challenge Corporation and EnDev.

A renewable energy blueprint and roadmap was jointly drafted and developed by all stakeholders, focusing on all forms of renewable resources. In 2015 the Ministry of Energy designated Sumba as an alternative renewable energy icon through Ministerial Decree no. 3051K/30/MEM/2015.

### TECHNOLOGY

Several technologies have been deployed as part of the initiative:

**Micro-hydro:** A 37 kilowatt (kW) micro-hydropower plant is installed in collaboration with IBEKA, a national not-for-profit, in the village of Mbaku Hau in Kamanggih, in Eastern Sumba. In addition, a 15 kW system has been deployed in La Au East Sumba and a 27 kW system in Kalimbukihi Central Sumba.

**Solar:** Twenty-five schools and 30 village kiosks are equipped with off-grid solar PV systems to provide electricity to schools and to charge a total of 7 000 solar lanterns that are leased by community members for a fee. The solar PV panels range from 1 000 to 1 500 watts peak (WP), with a lantern-charging

## PROJECT SNAPSHOT



Photo credit: Hivos

**Location:** Sumba Island, Indonesia

**Starting year:** 2015

**Implementing agencies:** Hivos, IBEKA, Winrock International and Yayasan Rumah Energi

**Beneficiaries:** Households, communities, schools  
**Relevant policy and regulatory support:** Government Special Allocation Funds, Ministerial Decree no. 3051K/30/MEM/2015

**Key takeaway:** A holistic and tailored approach to off-grid renewable energy deployment can support local development objectives, alleviate poverty and improve living conditions.

system capacity of 600 WP, while the lantern-charging systems installed in the kiosks are sized at 200 WP.

**Biogas:** One thousand biogas digesters, which range in size from 4 to 12 cubic metres (m<sup>3</sup>), provide not only biogas for cooking but also high-quality organic fertiliser (bio-slurry). The digesters are constructed under the Indonesia Domestic Biogas Programme or Biogas Rumah (BIRU), which is an initiative of Hivos and SNV.

### FINANCE AND DEPLOYMENT MODEL

**Micro-hydro:** The micro-hydro facility is owned, operated and maintained by Kamanggih Community Cooperative, a local co-operative. The system supplied electricity to over 100 households, and also exports electricity to the nearby PLN grid. The community co-operative has grown its assets from nearly USD 300 000 to over USD 624 000 with a wide range of socio-economic benefits.

**Solar:** The 7 000 lanterns can be rented by community members, out of which 6 000 are distributed in the schools and 1 000 in the kiosks. The solar PV systems have been installed, operated and maintained by a renewable energy service company (RESCO). The end-users pay for each lantern charge; for students the fee is USD 0.11 per charge. The RESCO leases the lanterns to the kiosk owners together with mobile-phone-charging systems for a flat monthly rate that depends on the size of the lantern package. On average a monthly fee of USD 49 per month is paid by kiosks to the RESCO. The RESCO model ensures long-term operation of the services by covering on-going operation and maintenance costs.

**Biogas:** BIRU focuses on farmers with sufficient dung-producing animals (at least 3 cows, 8 pigs or 200 chickens) to ensure feed for the digester. The incentive given to households in Sumba ranges from 60% to 70%. In selected areas the government supports the farmers' investments through government special allocation funds or other programmes. The BIRU digesters are Gold Standard-certified, and carbon credit revenues support the project. BIRU has now evolved into a market-based domestic biogas sector for livestock farmers.

## OBSERVED LIVELIHOOD BENEFITS

### Economic

**Reduced fuel spending and increased energy affordability:** Prior to the project's inception, the diesel and kerosene that were powering the small grids and used for lighting were imported at a high price. The average savings from the avoided use of kerosene is estimated at around USD 3.7 per month per household.

**Income generation and poverty alleviation:** The introduction of improved agricultural practices and the use of bio-slurry as a fertiliser for crops has increased yields and farming incomes. Improved access to energy enables women to weave at night and increase their income. Kiosk owners earn on average 30-40% more than they did previously due to lantern sale and of other products. The increase in the assets of the micro-hydro co-operative enabled it to offer further financial services to community members for savings and loans. Community members have also begun exploring other opportunities including improving post-harvest management of betel fruit, developing handicraft and food processing (banana chips, cashew nuts).

**Job creation:** An estimated 2 710 people (25% of them women) have been trained in the O&M of the systems. Several community members also were actively involved in the construction of biodigesters.

### Social

**Gender equality:** The initiative works with local NGOs to implement women's empowerment activities in communities. The activities ensure gender equity in access to energy, and provide women and their businesses with adequate capacity, including simple book-keeping and management skills. Women are playing an active role in the operation and management of the biogas systems- 30% of bio-slurry operations are managed by women.

**Improved education and skills:** As part of the initiative, several trainings have been organised on increasing awareness of the technologies and allowing the community members to be involved within the energy value chain. In schools, student attendance has increased as a result of a technology-enabled educational programme as well as the opportunity to recharge solar lanterns at school. Teachers also have gained access to training in the use of computers and other equipment, such as printers.

**Inclusive growth and community empowerment:** The initiative has been designed to engage local communities and entrepreneurs, enhance the capacity of local institutions and empower communities by transferring ownership and responsibility for O&M. The micro-hydro facility is owned, operated and maintained by a local co-operative. The owners of the kiosks are responsible for the daily O&M of the equipment and for monitoring the charging system, including interactions with customers.

### Health

**Prevention of diseases and health hazards:** The introduction of renewable energy solutions has reduced indoor air pollution resulting from cooking and lighting. The deployment of biogas plants also has allowed proper management of animal waste.

**Improvement of food security and access to clean water:** The use of bio-slurry and organic horticultural practices has enabled farmers to grow a wider variety of vegetables. Access to energy also has allowed the community to engage in new economic activities such as food processing and packaging, while preserving food for longer periods.

### Environmental

**Reduced deforestation:** The decreased use of firewood for household cooking has helped reduce deforestation.

**Reduced emissions and impact on climate change:** Each digester contributes to an average reduction of 2.6 tonnes of carbon dioxide-equivalent emissions annually; in 2017 the installed biodigesters were projected to save 18 200 tonnes of carbon dioxide-equivalent. Emissions have been reduced from diesel generators, kerosene-based lighting and firewood combustion for cooking.

5

## CLEAN DRINKING WATER PROJECT IN CAMBODIA

### Social entrepreneurship models

#### PROJECT SUMMARY

In 2004, 1001fontaines, a non-governmental organisation (NGO), developed and deployed a social business model of providing drinking water to rural communities in Cambodia, using an off-grid solar photovoltaic (PV) system to power the ultraviolet (UV) purification of local water sources. Over 13 years, 1001fontaines has installed 164 kiosks and facilitated the local sale of clean and fresh water at an affordable price by establishing water treatment and bottling systems at the village level. These kiosks are managed as social enterprises by local villagers to provide safe water to approximately 400 000 people in Cambodia.

#### TECHNOLOGY

Each water kiosk houses a water purification and bottling system, which consists of 85 100 watt (W) solar PV panels and a 12-volt battery powering a small electric water pump, an electronic control box, a series of polyethylene filters and a UV lamp. The water from rivers, ponds and wells is pumped into the purification system, which cleans and disinfects the water through filters and UV light, making it safe to drink without removing beneficial minerals. Once treated in the solar-powered system, the clean water is bottled into disinfected and sealed 20-litre containers and then delivered directly to customers' homes in the village. The whole system has the capacity to purify 600-800 litres per hour.

#### FINANCE AND DEPLOYMENT MODEL

The project is supported largely by donor funds that cover all up-front costs. On average, approximately USD 28 000 is needed to cover the capital expenditures of a new kiosk building, technical equipment, entrepreneur selection and training, and support during the first eight months of a new site. The social deployment model empowers local villagers to operate the water treatment units and to create local enterprises, thanks to the skills training they receive as part of the programme. Every solar-powered kiosk is managed by a member of the village, chosen with the support of the village chief and other local leaders, and trained to become a

### PROJECT SNAPSHOT



Photo credit: 1001fontaines

**Location:** Multiple locations in Cambodia

**Starting year:** 2004

**Implementing agency:** 1001fontaines and Teuk Saat

**Beneficiaries:** 60 000 households and 120 000 students

**Relevant policy and regulatory support:** Deregulated

**Key takeaway:** Off-grid renewable energy solutions can play a key role in enabling access to clean water services in rural areas. Deployment models based on social entrepreneurship enhance inclusiveness and sustainability of projects, while creating new income-generating opportunities.

skilled entrepreneur. Two assistants are also recruited for each kiosk. Once a production site is operational, each site aims to reach 1 500 beneficiaries, a level that ensures sufficient sales revenues to cover all expenses, estimated at about USD 0.016 per litre, including operators' income, maintenance costs and shared service costs.

Operational sustainability is bolstered by three regional support teams in hub towns around Cambodia. Each team supervises a portfolio of 60 to 80 sites, providing continuing support in the form of entrepreneur coaching and guidance, as well as accounting and management supervision. Each regional team has a laboratory for regular water quality testing, and storage facilities to support operators with maintenance and spare parts supply. In exchange for the support, each operator pays a monthly fee to its regional support office, in line

with the micro-franchise approach. In March 2017 1001fontaines and its local NGO, Teuk Saat, which is responsible for the implementation and monitoring of the project, have been registered as a Clean Development Mechanism project and are generating carbon credits. The carbon revenues will be used to fund the further deployment, including setting up of new kiosks, supporting overheads and financing a *Water in School* programme.

## OBSERVED LIVELIHOOD BENEFITS

### Economic

**Reduced costs and increased water affordability:** The solution is designed to provide affordable drinking water services in rural Cambodia with tariffs fixed at USD 0.016 per litre.

**Income generation and poverty alleviation:** The kiosk operators earn a monthly salary of approximately USD 100, and the average revenue of entrepreneurs is about USD 158 per month. The community benefits from a re-investment of 20% of the kiosks' annual profits.

**Job creation:** Seventy-five Cambodians (including 15 women) are directly employed, and another 466 villagers (of whom 24% are women) have earned income as water sales entrepreneurs and operators.

### Social

**Gender equality:** Time saved from treating water (estimated at about 22 hours per month) can now be spent for other income-generating activities, thus offering new opportunities for women.

**Improved education and skills:** The provision of safe drinking water in schools has helped to reduce student absenteeism by 55-75% in primary schools.

**Inclusive growth and community empowerment:** The community benefits from a business model based on villagers' empowerment and from training sessions to build entrepreneurship skills among community members.

### Health

**Improvement of food security and access to clean water:** The project's focus is to ensure access to 1.5-2.0 litres of clean drinking water per person per day at the most affordable price possible. Associated health benefits include a reduction in water-related diseases from 33% to 62% (depending on the water source on which the person previously relied).

### Environmental

**Reduced deforestation:** The use of solar-powered water purification systems reduces the demand for firewood to boil water (which otherwise amounts to 5 kilogrammes per day per household), thereby contributing to a lowering of the rates of deforestation.

**Reduced emissions and impact on climate change:** The reduced use of firewood to boil water contributes to the mitigation of approximately 7 000 tonnes of carbon dioxide annually.

## 6 MICRO-GRID IN THE PHILIPPINES

Lighting and cooling services

### PROJECT SUMMARY

In 2012 the United States Agency for International Development (USAID) awarded a grant to Solutions Using Renewable Energy (SURE) Inc. to support the development of a renewable energy micro-grid power system that now serves an otherwise completely unserved coastal area of Roxas in Green Island, the Philippines. The project also aims to tackle a lack of access to fresh water through an electrical water pump and to boost the local fish market with an ice machine, both of which are connected to the micro-grid. The project was completed in 2013, and in February 2014 USAID transferred the project's ownership to a local social enterprise – the Palawan Center for Appropriate Rural Technology (PCART) – to ensure the micro-grid power system's on-going operation and sustainability.

### TECHNOLOGY

The micro-grid was designed to provide 24-hour electricity to 50 households. The power plant, with a capacity of 25.5 kilowatts (kW), consists of a 20 kW biomass gasifier running on coconut shells and wood chips, 3 kW of wind power, 2.5 kW of solar photovoltaic (PV) panels and a lead-acid battery bank.

The project also is responsible for the installation of an ice machine, owned by PCART, with a capacity of 900 kilogrammes of flaked ice per day, which is estimated as the daily quantity of ice needed by the local community to store fish, one of its main sources of income.

### FINANCE AND DEPLOYMENT MODEL

The total technology and up-front costs were fully funded by USAID. The micro-grid power system was implemented in partnership with both the local

## PROJECT SNAPSHOT



**Location:** Philippines

**Starting year:** 2012

**Implementing agency:** USAID

**Beneficiaries:** 50 households

**Relevant policy and regulatory support:** Deregulated

**Key takeaway:** A renewable energy micro-grid can lead to a range of development benefits, from addressing the basic electricity needs, to expanding economic opportunities, to laying the groundwork for future development objectives.

government unit of Roxas town and the local non-governmental organisation PCART to ensure that local stakeholders were active participants in the design and execution of the system. The connected households pay a flat monthly fee for electricity to power two light-emitting diode (LED) light bulbs, one electric fan and one television.

## OBSERVED LIVELIHOOD BENEFITS

### Economic

**Reduced fuel spending and increased energy affordability:** The flat fee for the electricity (approximately USD 4) needed to power two LED bulbs, one television and one fan is one-third less than the price paid by villagers in other districts where diesel generators are used to power only two light bulbs.

**Income generation and poverty alleviation:** The increased access to ice reduces spoilage of fish, lengthens the window of time that fishermen can sell their catch by two days and increases incomes by 30-50% for residents who rely on fishing for their livelihood.

**Job creation:** Some of the local community members were hired by SURE in the construction of the powerhouse.

### Social

**Improved education and skills:** A reliable source of energy has facilitated the installation of a photocopy machine to serve the needs of the local school. In connected households, students can now study at night, using LED bulbs.

### Inclusive growth and community empowerment:

The villagers provided labour to prepare the site and to construct and install the power plant.

### Health

**Prevention of diseases and health hazards:** The use of LED lights powered by the micro-grid in the schools has prevented fatigue, eye strain and poor visual performance from the use of traditional kerosene lamps.

### Improvement of food security and access to

**clean water:** The installed water pump enables the community to benefit from a more affordable water source, thus enhancing water security.

### Environmental

#### Reduced emissions and impact on climate change:

New light bulbs electrified by the renewable energy micro-grid power system displace the use of kerosene lamps by villagers, thus reducing associated emissions.