Case study summary
Institut Bisnis dan Ekonomi Kerakyatan (IBEKA), Indonesia

2012 Ashden Award winner

IBEKA won a 2012 Ashden Award for its success in developing community-managed hydro schemes; bringing the benefits of electricity for the first time to off-grid areas, and enabling grid-connected communities to earn an income from selling into the grid.

Despite its expanding economy, over one third of the population of Indonesia – including many communities in remote islands or mountainous areas – lacks grid electricity. There is considerable potential to provide off-grid hydroelectricity in these areas, but many schemes have been abandoned through lack of maintenance.

IBEKA's solution was to work in partnership with communities, successfully developing local skills to manage and maintain off-grid hydro schemes long-term, and community ownership to provide a continuing source of income from them. But why just off-grid? Many grid-connected communities have hydro resources and the skills to manage schemes – the problem was that they could not sell electricity to the grid. IBEKA lobbied to change the law so that the national supplier must buy electricity from small grid-connected hydro schemes. It has enabled new schemes to be built under community management, and existing off-grid schemes to be connected retrospectively if the grid expands.

Key information

- Micro-hydro schemes use the moving water from a stream or small river to turn a turbine. The turbine rotates a shaft, which drives an electrical generator, supplying power to a local community or the national grid.
- Off-grid schemes are grant funded. Monthly tariff of typically US$1 to US$2 per household pays for operation, maintenance and a community fund.
- IBEKA sources loans and equity investment as well as grants for grid-connected schemes. Revenue from sale of electricity to the national supplier covers operation, maintenance, loan repayments and a community fund.
- Between 1992 and February 2012, IBEKA installed 2,260 kW of hydro capacity in 57 off-grid and four grid-connected plants, and 2,130 kW is currently in operation.
- About 54,000 people benefit (47,000 off-grid and 7,000 grid-connected).
- Greenhouse gas emissions reduced by about 7,400 tonnes/year CO_2e, by replacing the use of kerosene for off-grid lighting and coal and oil for grid electricity.
- Electric light is much cleaner and brighter than kerosene lamps, making study, housework and leisure easier.
- Access to TV and other communications makes off-grid communities less isolated, and electricity increases opportunities for employment and earning.
- Communities come together to prioritise the use of the community funds, and use them for benefits such as improved healthcare, roads and business loans.

Future plans

- Significant potential for growth of both off-grid and grid-connected systems, under community management, with 10 MW currently under development.
- Increasing focus on loan and equity investment will enable more and larger schemes to be developed in future.

IBEKA is a not-for-profit organisation, founded in 1992. It promotes community development via the provision of local energy, mainly hydroelectricity, also clean water. A core principle of all its work is to develop human resources as well as physical resources. In 2011 it had an income of about US$1.5 million, mainly from grants, and 38 staff.

Indonesia statistics 2007 -11
(World Bank)

GDP: US$2,946/year per person

CO_2 emission:1.7tonnes/year per person

46% of people live on less than US$2/day

35% of people lack grid electricity

Location

"I myself had to study using kerosene lamps, so I wanted the children to have good light to study. I want our people to have more knowledge and communications and opportunities to earn more while still living in the villages."
Abah (King) Ugi of the Kasepuhan

Hydroelectricity has brought light and communications to the remote hillside village of Ciptagelar, home of the Abah (King) of the Kasepuhan people.

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Case study
Institut Bisnis dan Ekonomi Kerakyatan (IBEKA), Indonesia

Background
Despite a rapidly growing economy and thriving cities, over one third of the population of Indonesia lacks grid electricity. Many people live in scattered communities on remote islands. Even on the densely-populated main island of Java, there are mountainous areas where the grid has not reached.

Rainfall is plentiful throughout the year in many parts of Indonesia, so there is considerable potential to provide electricity using off-grid hydro schemes. But a survey by GTZ (the German development agency) found over 1,000 micro-hydro plants that had been abandoned through lack of maintenance.

IBEKA works in partnership with communities to develop off-grid hydro schemes that stay in use. Through long-term involvement IBEKA makes sure that the community has the skills to manage and maintain the scheme, and community ownership which brings a continuing source of income. And IBEKA has used grid expansion as a new opportunity, with communities now owning and managing grid-connected hydro schemes as well.

The organisation
IBEKA (Institut Bisnis dan Ekonomi Kerakyatan: the people-centred business and economic institute) is a not-for-profit organisation, founded in 1992 by engineer Iskandar Kuntoadji, the husband of Executive Director Tri Mumpuni. Its mission is to promote community development via the provision of local energy, mainly hydroelectricity, and also clean water. A core principle of its work is to develop human resources as well as physical resources.

IBEKA and the hydro schemes that it builds have been mainly funded by grants from a wide range of sources including central and local governments in Indonesia, the Embassy of Japan, UN-ESCAP and GIZ. In 2011 it had an income of about US$1.5 million and 38 staff.

The programme
Off-grid hydro schemes
IBEKA starts by discussing the opportunity of hydro with the community at a potential site When grant funding is identified a detailed technical design is developed to provide sufficient capacity for community needs. In parallel a plan for the management of the scheme, electricity tariffs, and a structure for community ownership are developed. IBEKA engineers source equipment and build the plant, with help – both voluntary and paid – from community members, at the same time providing training. Once the scheme is commissioned, IBEKA continues to provide support until both the technical and financial management is running smoothly. IBEKA involvement before, during and after construction can last for around 18 months.

Grid-connected schemes
IBEKA recognised that the hydro resources and human resources of local communities could be applied just as well to grid-connected hydro schemes, and such schemes could provide a much-needed additional source of power for the national grid. But in the 1990s there was no requirement for the national grid operator (PLN) to buy the electricity. Lobbying from IBEKA over ten years helped change the law, so now PLN must buy electricity from micro and mini hydro.

IBEKA sources grants but increasingly loans and equity investment to finance these plants. In new plants, development follows a similar pattern to off-grid, but the hydro capacity is made as large as possible, to maximise the financial return. The income to the community enterprise comes from electricity sales to PLN, and community members pay PLN for their electricity use. Where the grid has recently been extended to a place with an off-grid plant, IBEKA can help the community to connect the scheme retrospectively to the grid.

The penstock and powerhouse of the 11 kW hydro plant at Palanggaran. The pipe in the foreground is for pressure release.

The technology in more detail

Off-grid hydro schemes that have been installed by IBEKA range from 0.5 kW ('pico' hydro) to 170 kW. Grid connected schemes are larger, from 15 to 224 kW, with several over 1000 kW currently under development.

IBEKA systems are 'run-of-river' which means that they don't use large dams to store water. Instead a small dam redirects part of the river water along a canal or a pipe to a settling tank (forebay) which is sited above the power house. The outlet from the forebay has a screen to trap silt and floating debris. Water flows out into a pipe (penstock) which is made as steep as possible to transfer water to the turbine. Water leaving the turbine is led back to the river through the outlet pipe (tail-race).

Most schemes use cross-flow hydro turbines: IBEKA has developed standard designs so that they are easy to manufacture and repair locally, and have a lifetime of around 20 years. In small schemes, motors run in reverse are used as generators, because they are cheap and reliable. The demand for power is often very variable in an off-grid scheme, because people switch lights and appliances on and off. An electronic load controller is therefore used to keep the generator output matched to demand at all times.

The technology

How does it work?

Micro-hydro schemes use the moving water from a stream or small river to turn a turbine. The turbine rotates a shaft, which drives an electrical generator.

In off-grid schemes IBEKA constructs a local electricity grid to distribute power from the generator via an electronic controller to individual homes. In schemes that are grid-connected, the output from the controller is connected to the grid, and homes have their individual connections.

How much does it cost and how do users pay?

US$1 = 9,200 Indonesian Rupiah (March 2012)

Costs of hydro schemes vary greatly, depending on the complexity of the site and how easy it is to reach: sometimes in remote areas this is a real challenge because there is no road access for vehicles. Typical costs for IBEKA off-grid schemes are between US$4,000 and US$8,000 per installed kW. Grid-connected schemes are cheaper because they do not have to cover the cost of the distribution system. IBEKA's first grid-connected scheme, 120 kW Cinta Mekar which was installed in 2005, cost about US$180,000 or US$1,500 per kW.

Users do not pay the capital cost of the hydro. For off-grid schemes, grant funding covers all costs including design, installation, community preparation and setting up the cooperative to own the plant. IBEKA works with the community to agree a tariff structure that brings sufficient revenue to cover the day-to-day cost of operation; a maintenance fund; and a community fund. Fees for electricity are paid monthly to the co-operative by each user. Some co-operatives install a meter in each house, others use a less expensive power limiter and have a tariff that depends on the power rating, typically between US$2 and US$10 per month. In others, the fee collector assesses the power rating of appliances that are in use in each household, and a monthly tariff of about 400 Rupiah (US$0.04) per watt is applied. Thus a household using three 5W lights would pay 6,000 Rupiah or about US$0.60 per month

IBEKA sets up a community-managed Social Enterprise to run each grid-connected scheme, and PLN pays this Enterprise between US$0.07 and US$0.13 per kWh for all electricity sold. Community members pay for electricity at the national tariff for low-income households, about US$0.06 per kWh. The sales income (which must cover operating and maintenance costs) can be sufficient to attract private investment for a hydro plant, particularly from socially-motivated investors who do not require a high financial return. Cinta Mekar was paid for by a grant and equity investment, and other grid-connected systems have been funded by loans. IBEKA requires any private investor to guarantee long-term income to a community fund. For example, in one scheme under development, the private investor will share profits with the community fund once the capital cost of the scheme is paid off.

How is it manufactured, operated and maintained?

Generators (usually locally made) and control gear (imported) are purchased. IBEKA trains and pays a group of local people to help with the construction work but the community also contributes labour and materials for tasks like constructing a canal.

Some off-grid schemes run continually, others are shut down during the day-time because people are working on the land. The operator visits twice daily to check the system, switch it on or off, and clear any debris from the intakes. Minor maintenance like greasing bearings is carried out every week, with a major overhaul every three or four years. Grid-connected schemes usually have an operator on site all the time, so the work is shared between two or three people.

IBEKA wants as much expertise as possible to be localised, so that maintenance and spare parts are sourced from near the community and costs are kept low. Operators and construction workers are trained on the job, and training is provided to the whole community. IBEKA also runs courses for other organisations like colleges or University departments, that can provide local expertise.

Community ownership and management

Core principles of IBEKA are that a hydro scheme must be developed with the community, in order to meet its specific needs; that the community should have long term responsibility for management; and that the community should have long-term benefits. For off-grid schemes, a community organisation manages and legally owns the scheme. This could be an existing organisation or a specially established community co-operative. The organisation is responsible for collecting fees, paying staff, and building up the maintenance and community funds. Each year the community reviews performance and prioritises the use of funds.

For grid-connected schemes, the community organisation is usually constituted as a social enterprise. This is responsible for making payments for bank loans or private investors, as well as the operation, maintenance and community fund.

"Normally we have the hydro operating just at night-time because everyone is in the fields during the day. But at the moment, we are leaving it on all the time because there are carpenters building houses in the village, and they are now able to use power tools."
Mr Husin, operator at the 11 kW Palanggaran hydro plant

The hydro operator at Palangarran starts up the plant in the afternoon by opening the inlet valve to the turbine.

Achievements
Between 1992 and February 2012, IBEKA installed a total of 2,260 kW capacity in 61 plants (51 micro/mini hydro and 10 pico hydro). Six early plants (130 kW) are currently out of use. Three of these are awaiting connection to the recently-arrived grid and the other three have problems with reduced water supply.

51 of the operating plants are off-grid and supply 10,400 households. With about 4.5 people per household on average, this is equivalent to about 47,000 people. The remaining four plants (400 kW) are grid-connected and serve 1,500 households, or 7,000 people.

Environmental benefits

Both off-grid and grid-connected hydro schemes cut greenhouse gas emissions. Off-grid schemes replace kerosene for lighting, and IBEKA surveys have found that this averages about 15 litres/month of kerosene per household. Total off-grid savings are therefore about 5,700 tonnes/year CO_2e.

Most of the grid power in Indonesia comes from coal and oil, with average emission about 0.8 tonnes CO_2e per MWh generated. IBEKA's grid-connected schemes generate about 2,100 MWh/year and therefore cut emissions by 1,700 tonnes/year CO_2e.

A further environmental benefit comes from the education that IBEKA provides to communities on protection of water courses, including tree-planting and water management.

Social benefits

The social benefits of bringing electricity to off-grid communities are substantial. Smoky kerosene lamps are no longer needed, and bright electric lights make study and housework easier, and homes more pleasant. Having lights outside houses makes families feel less isolated at night. Radio, television and mobile phones bring information, entertainment and connection to the wider world.

IBEKA requires that some of the income from electricity sales (both off-grid and grid-connected) is used for a community fund, and that each community sets its priorities for using this. At Cinta Mekar the fund was first used to enable all households to connect to the grid, since the poorest households had not been able to afford the connection fee of around US$200. The next priorities tackled were improved healthcare for pregnant women and young children, repairs to the village roads, piped drinking water to all homes, and low-interest loans for buying agricultural inputs or setting up small businesses. The process of shared decision making, as well as the sharing of benefits, helps to bring communities together.

Economic and employment benefits

Households with electricity get cheaper light as well as better quality light. Kerosene in Indonesia costs between US$0.3 and US$1.4 per litre, so a household using 15 litres/month pays between US$5 and US$20. Electricity for lighting can cost less than US$1 per month, so savings are substantial.

Hydro schemes provide temporary local jobs during construction, and long-term jobs for operation, maintenance and fee collection. At Palanggaran, the operator (who checks the scheme twice per day and also collects fees) earns US$20 per month, a significant addition to family income from cash crops which is typically US$30 per month.

The availability of electricity also increases local employment opportunities and productivity. Hydro provides power levels that can run electric tools, so carpentry and metal workshops can expand their business. Jobs like tailoring and agricultural processing can also become more productive.

The water management associated with a hydro scheme can bring additional agricultural benefits, for instance irrigation that allows an extra crop to be grown, or clean water supply to fishponds.

The tailor in Cicimet now has electric power for his sewing machines.

"It's much easier to make clothes using the electricity rather than the treadle, and it's quicker too. A job that would have taken two hours now takes one-and-a-half. It's particularly good for the oversewing machine, that just flies along now."
Mr Emat, tailor in Cicimet

Electric light makes housework much easier – and harder for Mrs Engkok's cat to steal the food!

"Electric light is really helpful, and you just feel less isolated in the evenings when you look out and see a light in front of every house: before you could barely see anything. And I love having television."
Mrs Engkok, wife of the King's representative in Palanggaran village

Potential for growth and replication

There is a continuing need for off-grid hydro in Indonesia, since over one third of the population is not connected to the grid. IBEKA continues to source grant funding and work with communities to provide off-grid systems.

Given the shortage of capacity on the Indonesian grid, there is also significant potential for grid-connected micro and mini hydro. IBEKA has seven such schemes totalling nearly 10 MW (four times its current installed capacity) under development, and is sourcing loan and investment finance for them. IBEKA itself is investing in grid-connected schemes, to generate a reliable income stream for its work.

IBEKA has demonstrated that community management of hydro systems, and community benefit from them, can be achieved with a range of different financing mechanisms. This model is widely relevant in other countries.

Constructing a fishpond to make use of the water coming out of the Cicimet hydro plant.

"It's difficult to explain, but electricity seems to have changed attitudes in the village. People seem more motivated, maybe that's because it is worth working harder in order to get electrical goods like television."
Mr Engkok, King's representative in Palanggaran village

Steep hillsides make access difficult, but provide excellent hydro resources

"The hydro has brought me a steady job, and I now have electricity at my house – I didn't have it before. The water system enables us to irrigate so we now get three rice crops in a year. And the village roads have been improved by the co-operative."
Mr. Iyan, Hydro operator at Cinta Mekar

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