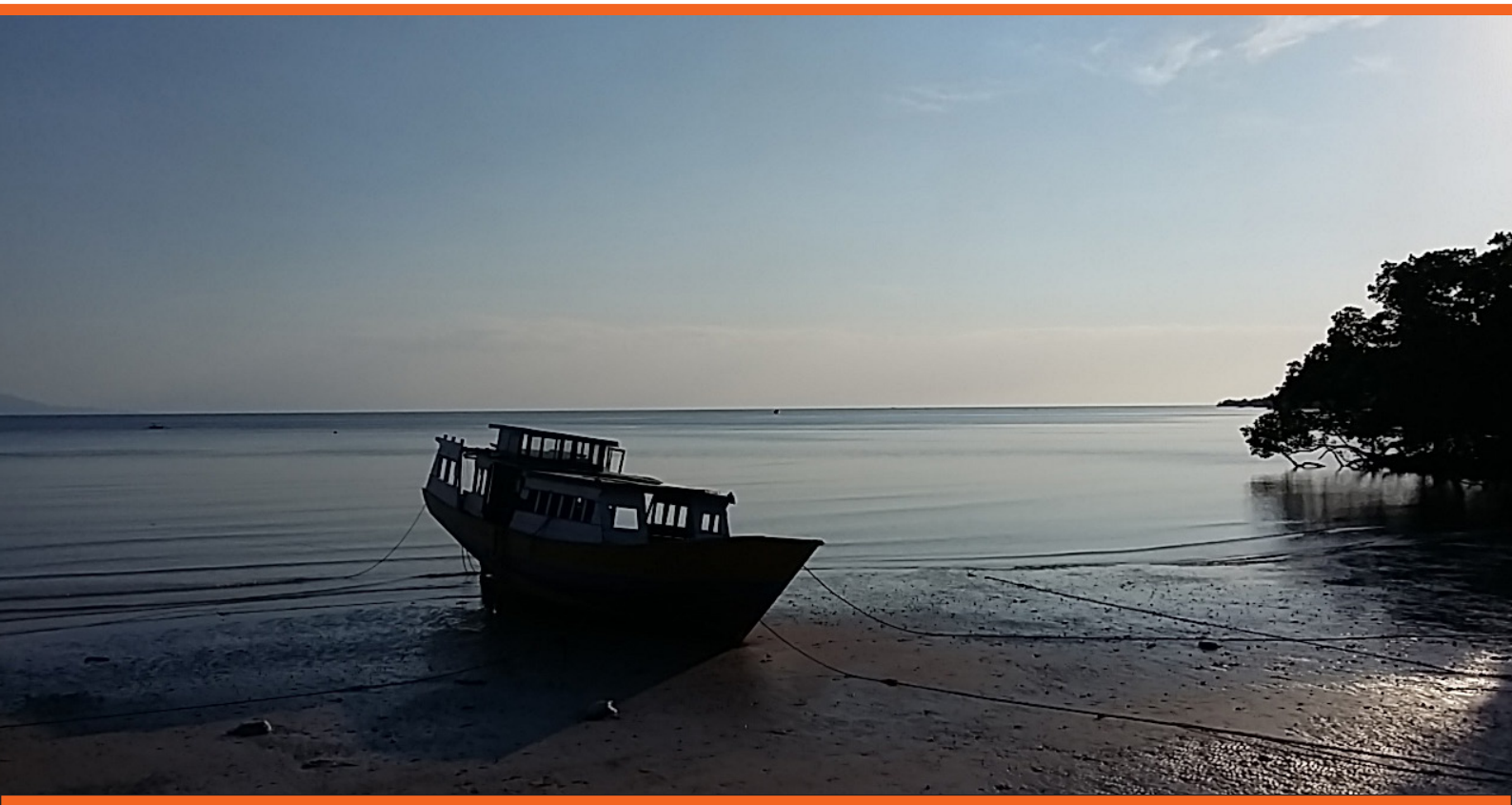
SMART VILLAGES
New thinking for off-grid communities worldwide

Energy for Off-grid Islands: Bunaken Workshop Report



Workshop Report 11

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Smart Villages

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

www.e4sv.org | info@e4sv.org | @e4SmartVillages

CMEDT – Smart Villages Initiative, c/o Trinity College,
Cambridge, CB2 1TQ

Kopernik

Kopernik is an NGO that connects simple, life-changing technology with the people who need it the most. They provide last mile solutions to help the poor in the most remote communities.

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Publishing

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Summary

Electricity is a crucial part of the infrastructure needed to improve the quality of life for island communities in developing nations. This report summarises the information presented at, and conclusions arising from, the workshop on issues related to island electricity access held by the Smart Villages Initiative and Kopernik. The workshop took place on the island of Bunaken, an hour's boat ride from the city of Manado in North Sulawesi, Indonesia. It was part of an ongoing programme of engagement by the Smart Villages Initiative in Southeast Asia. It brought together a diverse group of 25 people working on energy access for off-grid villages in island contexts to review their experiences to date and to identify barriers to further progress and how they may be overcome.

The workshop was held over three days, from 3-5 November 2015. Day 1 consisted of a field trip to visit the hybrid diesel-solar photovoltaic (PV) mini-grid designed to give energy to the island residents. This was followed by a welcome by Chief Wolter Panontongan from Bunaken village, and an introduction to the Smart Villages initiative and concept. Day 2 began with a discussion of community off-grid energy initiatives and government plans for Indonesian island communities, followed by some examples of work being carried out in the Pacific region. This led into the first breakout discussion session. Additional presentations were given that included perspectives from a new business/social enterprise and from people working on water and sanitation issues on islands in the Philippines.

Day 3 continued to focus on different initiatives for achieving island rural electrification, with presentations on Indonesian youth participation for off grid energy, low carbon towns, and a final session on envisioning what would be some desirable characteristics of a "smart island".

Key Points

Key findings and recommendations of the workshop are summarised in the following eight points:

- Community engagement was consistently identified as vital to the success of any project. Without buy-in and the placing of value on electricity services by the community, projects are more likely to fail. Community ownership models, such as those used by the IBEKA and Kopernik organisations, were shown to be successful in off-grid island contexts. Efforts should be made to understand and reflect indigenous knowledge and existing social structures, to harness local skills, and to unlock local potential. "Change should be 70% social and 30% technological".

- The cost of providing electricity to islands is higher than conventional power generation on the mainland, particularly for remoter islands where transport of the diesel used in generator sets (gensets) substantially increases costs. If mainland generation costs determine the tariffs that may be charged on islands, then schemes will not be economic unless heavily subsidised (which may be an unsustainable drain on government funds) and may deter independent power producers. An appropriate balance needs to be struck between affordability to island communities and financial sustainability.

- Solar PV can provide a cost effective alternative to diesel gensets, particularly for remoter islands, though import taxes can reduce its attractiveness. Hybridisation of existing gensets with solar

PV is also proving to be an appropriate way forward on many islands, saving on operating costs while ensuring 24-7 supplies. The relative contribution of diesel and PV needs to be chosen according to local circumstances.

- For island communities in Southeast Asia and the Pacific, there are distinctive energy demands for the types of productive energy uses required, such as providing ice for fishing, or power for copra drying facilities. Electricity for water pumping and in some cases desalination can be major considerations. Treatment of effluents and biomass wastes can provide the opportunity to produce biogas for cooking.

- A key consideration for the long term viability of island electricity systems is their operation and maintenance. Charges to islanders need to cover the associated costs, including the replacement of parts (which need to be readily available), and charging schemes should be enforced. Responsibilities for operation and maintenance should be clear and incentivised. The necessary skills should be established through training schemes.

- Women prioritise energy needs differently to men, so a gendered approach to energy access is required. They have also been proven to be effective entrepreneurs, disseminating renewable energy technologies to island communities. The 'Wonder Women' initiative run by Kopernik is a concrete example of this, where women are trained as renewable energy micro-entrepreneurs, and are able to bring clean energy and economic progress to their communities. Women's groups were highlighted for their capacity to bring change and success, for example in managing payment schemes and community facilities such as freezers for fish.

- The tourism industry can act as a bringer of electricity and education to island communities. More should be done to include island resorts in community energy and environmental projects. Dialogue can be strengthened between local government, NGOs and tourist operators to achieve better outcomes.

- Positive demonstration projects are useful, not only for the communities in which they exist, but as examples to others: 'seeing is believing'. The Sumba iconic island initiative is one such positive example, showing how a combination of technologies, government and non-government agencies, donors, and local communities can combine to achieve better development and economic outcomes through increased energy access that comes from renewable energy.

Introduction

Off-grid electrification for small islands' development presents several distinctive challenges under the broad category of rural electrification. Small island village communities are particularly difficult to reach with traditional grid electricity, and so it is especially important to encourage other means of energy access for them that can act as a catalyst for their development.

With over ten thousand islands, many of which are not grid-connected, Indonesia was ideally suited to host a discussion on island electricity. In 2014, the electrification rate was 84% in Indonesia as a whole. However, in rural areas that rate is much lower: Papua Province is the least electrified with only 36% electrification.

The first Smart Villages Initiative's workshop on island energy was held on 3-5 November 2015 on Bunaken off the north coast of Sulawesi, Indonesia. Its aim was to take stock of experiences of providing sustainable energy services to island communities, to identify barriers and how they can be overcome, and to distil key conclusions and recommendations to be communicated to policymakers, development agencies, and other stakeholders.

This report presents summaries of presentations and discussions at the workshop that involved an inter-regional group of 25 experts from the Pacific, Southeast Asia, and Australia. The experts worked in government, local and international NGOs, businesses, and academia. The agenda for the workshop is presented in Annex 1, and a list of participants in Annex 2. Copies of the presentations are available on the Smart Villages website (www.e4sv.org). This report together with an accompanying policy brief can also be accessed on the website.

Day 1: Field trip

A short field-trip to the Bunaken community power plant was the first event for the majority of workshop participants. This field trip provided local context and a real-world example of some of the issues surrounding island electricity access.

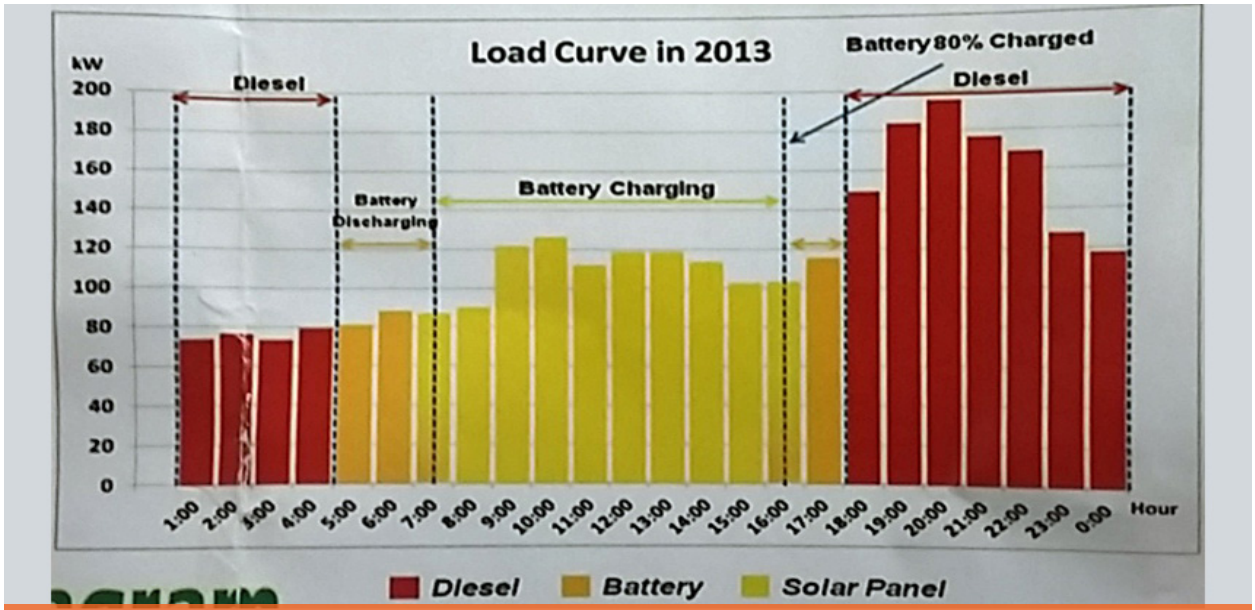
Installed in 2011 by the Indonesian state electricity utility—Perusahaan Listrik Negara (PT PLN Persero)— the power plant consists of a hybrid photovoltaic-diesel system. The plant was designed to provide 24-hour power to the roughly 4000 permanent residents on the island. Before its installation, electricity was supplied by diesel generators with a roughly 12 hours per day service. The new plant has added to these gensets with 1440 polycrystalline silicone modules, each module giving 235 W (338 kW in total). It has a bi-directional inverter with a power rating of 200 kW, two solar charge controllers (MPPT, 180 kW each), and a small battery bank with 900 kWh total capacity. Completing the system are the two existing old diesel gensets (each rated at around 300 kilovolt amps). The system integration components for making the photovoltaics work with the gensets were provided by Optimal Power Solutions (OPS), which also included an AC Switching cabinet along with the charge controllers. An image of an example load curve in 2013 is shown below, indicating the proposed standard operation of the system.

The first thing that was obvious to the group on arrival was that the plant was not in operation at that point in time. The group was informed that both of the diesel gensets had been out of commission for more than two months. Both of the generators were quite old. One of the

Workshop presenters (Julia Macdonald and John Holmes) overlook the Bunaken solar power plant

gensets was made in India in 1988, and the necessary replacement parts for it and the other genset were taking a very long time to make their way to the island.

Increasing demand for energy and the ailing gensets had meant that in the last two years the system had been running for much less than the promised 24 hours . There had been reports of the community expressing anger when the system started breaking down more often. In the two weeks leading up to the visit, the solar PV part of the system had also been out of action and was at that point only providing enough power for one building. Unfortunately, the primary technician from PLN responsible for maintenance was off the island during the day of the visit, but we were told that there was some delay in getting spare parts also for the PV panels. Village leaders stated a desire for more local training and PLN was said to be considering this.



2013 load curve of the Bunaken power plant showing hours of diesel and photovoltaic operation

Day 1: Afternoon Session

Welcome address

Chief Wolter Panontongan

We were welcomed to the island by Chief Wolter Panontongan of Bunaken Village. He spoke of the importance of electricity for improving the villagers' quality of life and the quality of tourism on the island. He said that since the installation of the large hybrid solar-diesel mini-grid the villagers had been broadly satisfied but wanted increased capacity. In a discussion at the end of the evening session, he also noted his desire for the village to have more solar power, particularly solar-powered street lights.

Introduction to Smart Villages

John Holmes & Bernie Jones, The Smart Villages Initiative

Bernie Jones introduced the Smart Villages Initiative, pointing out that over one billion people still do not have electricity, and three billion people still use dirty, inefficient, and harmful cookstoves resulting in over four million people dying prematurely each year. The United Nations, through the Sustainable Energy for All (SE4All) initiative has recognised energy access as a key issue and has set the target of achieving universal access to electricity by 2030. The Smart Villages Initiative aims to contribute to meeting this goal by providing an insightful "view from the frontline" of the challenges of village energy provision for development, and how they can be overcome.

With 70% of the world's poor living in rural areas, smart villages are proposed as a rural analogue to smart cities and will shift the balance of opportunities between cities and villages. While we may expect that their features will be context specific, common features will include access to good education and healthcare, better opportunities to earn a living, greater participation in governance processes, and more resilient communities. All these development benefits are enabled by energy access together with modern information and communication technologies (ICT).

The Smart Villages Initiative is undertaking a series of engagement programmes across six regions in Asia, Africa, and Latin America and the Caribbean. These engagements bring together frontline actors and stakeholders involved in energy access projects in countries located in these regions. Their aim is to identify barriers to the provision of village level energy services for development and to improve understanding of how those barriers can be overcome. Learnings from these engagement events are used to inform policymakers concerned with rural energy provision at national, regional, and global levels.

John Holmes then outlined some of the initial findings of the Smart Villages series of engagements in the context of the newly announced Sustainable Development Goals (SDGs). He noted that all of the SDGs were in some way predicated on access to energy but spoke of Goal 7 in particular. Goal 7 focuses on ensuring access to affordable, reliable, sustainable, and modern energy for all.

Investment in infrastructure is key to achieving the SDGs; however, current investment levels fall well short of the amounts required. There is a need to substantially ramp up investment by an additional US$50 billion or more each year to 2030. This is more than governments can afford, and there is a consequent need to maximise leverage of public sector funding.

Village energy access projects face difficulty in accessing alternative sources of capital like climate funds. Exploring ways to improve access to finance is one of the focus areas for the Smart Villages Initiative.

Stable policy and regulatory frameworks, coupled with a reduction in bureaucratic red

tape, are necessary to attract private sector investment in rural energy access projects. Governments and development agencies can harness the potential of local energy service providers and entrepreneurs through business incubation and by setting up business advisory services to support their activities. Governments and development agencies continue to play a key role in supporting the establishment of mini-grids which, at present, need some form of subsidy to achieve economic viability. Progress is being made in reducing the cost of power from mini-grids, and innovative business models are being developed.

In the case of solar home systems and pico-solar lighting systems, lessons from East Africa and Southeast Asia show that a tipping point has been reached as commercial business models have emerged. However, access to working capital is an important constraint faced by many entrepreneurs.

The success of many local energy projects depends on the ownership of the local communities. Therefore, it is extremely important to invest in understanding the cultural sensitivities, gaining the community's buy in, and building on existing relationships. Capacity building of local communities is necessary for the success of energy access initiatives. John Holmes also highlighted that one of the learning points from the regional engagements is the importance of better coordination and information sharing between development agencies and funders, which is necessary to maximise the impact of development interventions.

There are significant developments taking place on the technological front. The energy escalator approach shows that for solar home systems (SHS), people often purchase a basic level of access, paying by instalments, and then move up the energy ladder. There are also moves to develop low-power domestic appliances using direct current (DC), and there has been a move towards developing low voltage direct current nano-grids. Technological progress has also been instrumental in the reduction of cost of components like solar panels, and it is expected that costs are likely to reduce further in future.

Batteries have been one of the primary stumbling blocks for village energy. The rate of progress has been much slower. Improving the reliability of batteries and reducing their cost is extremely important for the growth of off-grid energy systems.

There is an urgent need to foster closer linkages between researchers based at universities and entrepreneurs involved in off-grid energy provision. Another major issue in many developing countries is poor quality products, especially pico-solar lighting systems and solar home systems. To deal with these problems, effective quality assurance mechanisms need to be developed along with consumer awareness programmes.

In the context of Goal 17 of the SDGs, strengthening the means of implementation, there is a need for better collaboration. To avoid confusion or competition among funders, frameworks should be put in place for cooperation. There is a value to sharing information and experiences. There is a role for the Smart Villages Initiative in doing this sharing across countries and regions. There is also a high demand for government- or donor-funded datasets of resources like wind or hydro capacities.

A focus on capacity building is important, with systematic analysis across all stages and actors, and training schemes to plug gaps. It is also important to develop approaches to monitor development outcomes appropriately.

John Holmes highlighted that there is a need for more case studies of smart villages. "Seeing is believing" with regards to proving the ideas and practices that work for rural development.

Day 2: Morning Session 1

Empowering women in opening energy access in islands and coastal areas

Citra Savitri, Reisky Handika, Kopernik

Indonesia has a population of 255 million people living on 6,000 of Indonesia's 18,306 islands. 80 million people do not have access to electricity. Kopernik connects funders, technology producers, and communities to bring technology to where it is needed. Since it was launched in 2010, Kopernik has reached over 290,000 people in 25 countries. Funders provide the upfront costs of getting technologies to the last mile. Technology producers design, manufacture, and ship the technologies to the last mile. Local partners choose and distribute the technologies and return funds to Kopernik. Kopernik communicates between the parties on the performance of technologies, their impact, and the progress of initiatives.

Wonder Women Indonesia is a programme that supports local women to enhance their quality of life by becoming micro-social entrepreneurs. They sell energy technologies to households: the margin between the price at which the technology is provided to them and their sales price provides them with an income. On being accepted into the programme, Wonder Women are trained in financial literacy, marketing, the operation of the technology and other necessary skills. They then continue to be mentored and supported as they grow their businesses. Kopernik provide backup support if there are problems with the equipment. So far, 803 women have been trained. Women are affected most by energy poverty, and Wonder Women reinvest up to 90% of their income into their families and communities.

Citra Savitri explained that Kopernik has started an advocacy programme that encourages the Indonesian Government and donors to allocate investments to energy programmes that reflect women's needs and creates new economic opportunities for women. Previously, most energy initiatives have not incorporated a gender perspective. Men and women prioritise different technologies: for example, women tend to prioritise cookstoves, while men prioritise light. A current activity is to gather and present to government success stories of women-led energy access initiatives in Indonesia.

Getting to know Wonder Women

Ibu Fauziah and Imelda Lobo

Ibu Fauziah (an early childhood teacher) and Imelda Lobo (a midwife and teacher) are Wonder Women operating in Indonesia: in North Aceh and Sumba Island respectively.

Ibu Fauziah joined the programme in April 2014. She now trains new recruits to the programme in North Aceh (there are 73 Wonder Women there). She has established a flour mill business and a business group that provides savings and loans facilities, which helps others to start businesses. Her best-selling technologies are solar lights, which come in two sizes. When people learn about the durability and safety of the lights, they are less worried about the price: the benefits are significant. For example, villagers can safely collect durian fruits and round up stray animals at night.

Imelda Lobo has run technology fairs in villages in Sumba that show villagers how the technologies work and their benefits, resulting in them being more open to try them. She must first ask permission of the head of the village. People may buy the cheaper technologies such as solar lights straightaway, but usually require more time to consider more expensive technologies such as solar home systems. In this case, she provides her phone

number and makes follow-up calls. Her best-selling technologies are solar lights and biomass cookstoves. One use of the lights is to enable the collection of seaweed at night.

In Sumba island, only 30% of the people have access to electricity, which comes from the biggest city on the island. People in the coastal and mountainous areas have no electricity. A priority after lights is to power TVs and music systems. The culture is different in North Aceh, and the priority is food processing such as rice cookers and blenders as well as laptops.

Various new and renewable energies (Kebijakan dan Program)

Deasy Kurniawati, Directorate of New and Renewable Energy, EBT

Policies on new and renewable energy in Indonesia are developed by the Directorate of New and Renewable Energy in the Ministry of Energy and Mineral Resources. Energy demand is growing at 7% per annum in Indonesia. The potential of renewable energy sources is high, but so far they only contribute 6% of Indonesia's electricity demand. The overall electricity access rate in 2014 was 84.35%, but there is big variability between regions: for example, in Papua Province, it is only 36%.

Provision of electricity is an important government priority as are energy conservation and the diversification of energy sources. The aim is to increase the contribution of renewable energy to 23% by 2025. Several technologies are at the pilot plant stage and feed-in tariffs have been established for renewable energy technologies: biogas, hydro, solar, and wind. Other dimensions of policy to support renewable energy in Indonesia include setting national standards, creating markets, supporting research, capacity building, creating infrastructure, and improving international cooperation.

Central and regional budgets have been created for renewable energy technologies. Central funds may be disbursed directly to projects on the basis of tendering processes or may be allocated to local governments on a block funding basis.

Problems with renewable energy include that costs are high, there is low interest from the private sector, power generation is intermittent, and knowledge transfer to communities is insufficient. When the government has built plants in villages there is often little sense of ownership by the community and their technical capacity to support the operation of the plants is low. Looking ahead, more will be done to empower local communities through external activators. A scheme has been established to recruit young engineers—"patriots"—who will be deployed to remote areas to search for and progress local energy schemes. 80 people have been selected out of 3600 applicants and will receive an intensive training programme, including how to survive in remote communities.

Renewable and island energy activities

Rizki Azikin, Perusahaan Listrik Negara

Rizki Azikin explained that Perusahaan Listrik Negara (PLN) is the state-owned Indonesian power utility. It has 43 GW of installed capacity, 85% of Indonesia's total, and is also the main purchaser of electricity from independent power producers. It is the sole provider of power transmission and distributor of electricity to end customers.

PLN aims to get more renewable energy onto the grid, either generated by PLN or independent power producers (PLN is obliged to purchase renewable electricity from

independent power producers at feed-in tariff rates that apply to power plants less than 10 MW). Diesel generators are the main source of electricity for most islands: typical costs are around US$0.25/kWh but may be more than US$0.30/kWh for remoter islands. The current PLN tariff is US$0.12-0.15/kWh.

PLN prioritises solar-diesel hybrids making use of the existing diesel engines, though old technology can be problematic. Intermittent renewable energy sources are limited to 20% of daytime peak load. Where there is no supply of electricity, PLN's aim is to provide 12 hours of supply. Where there is a limited existing supply, they aim to provide a reliable 24-hour supply. PLN receives a lot of proposals from independent power producers, but as PLN can only sell electricity at up to US$0.15/kWh, this is the maximum they can pay as they have to break even.

PLN has developed solar PV for islands in a number of stages, starting with six locations on tourist islands (of which Bunaken is one). The next step in 2012 was nine locations on frontier islands (in reality only five were undertaken), then the aim in 2013 was schemes in 100 islands (but only six have been tendered, the largest being 6 MW due to be completed in 2016). The planned next step is schemes on 1000 islands.

In response to a question about the operational problems with the Bunaken power plant, Rizki Azikin indicated that PLN is aware of the problem of maintenance (another plant has been abandoned and a lot of the off-grid power plants are not working effectively). PLN has introduced a capacity building initiative to train local operators, and all plants now have to submit regular operational reports.

Rizki Azikin delivers her presentation for Perusahaan Listrik Negara

Day 2: Morning Session 2

Tonga off-grid electrification

Ofa Sefana, Tongan Department of Energy

Ofa Sefana, from the Tongan Department of Energy gave an account of the government's renewable energy access initiatives and activities in which he has been involved in the islands of Tonga.

The Tongan government aims for the contribution of renewable energy in power generation to be 50% by 2020. The current proportion is around 8%. They aim to increase energy access (up from 83% in 2012) and to reduce transmission line losses (currently at 10%). Some key facts about Tonga are that: many households rely heavily on external assistance; households spend US$8 on kerosene for lighting every month; people use a lot of diesel for water pumping—many communities still rely on underground water; and commercial activities are curtailed due to high fuel costs.

Rules and policy are not always respected in the South Pacific. In the late 1980s and early 1990s, community ownership of energy production failed, as did government ownership. Ofa Sefana stated that there needed to be a compromise found. Now the government plays an advisory role. Representatives from each community are involved in the decision making process.

Solar freezer systems, which play a key role in communities enabling fish catches to be preserved, are actively managed by community groups. There is a lot of business activity, such as the sales of ice cubes for fishermen. The freezers have been distributed in some communities on the basis of the number of households. Everyone is keen to have one.

For remote island electricity, the government and communities are not yet thinking a lot about mini-grids, though there will be four trialled in 2016.

In terms of management, technicians will collect payments and address failures and complaints.

Regarding community facilities and productive uses, schools are powered with solar energy, and electricity is also used in relation to fishing and making crafts.

Ofa Sefana showed a video that detailed how some of the programmes work. The funding for the solar panels for schools came from the Australian and Italian governments.

In a discussion of disconnection policies, Ofa Sefana said that if the electricity bill is not paid for two months, the electricity supply will be cut off. The disconnection policy must be enforced. The meters are located, and maintenance carried out, outside the home to enable better enforcement and access. One must also ensure the technicians are not misusing funds. In terms of the schools, the parent-teacher associations pay US$8/month for each school's power.

Pacific Energy Systems Programme

Anare Matakiviti, International Union for Conservation of Nature (IUCN)

Anare Matakiviti detailed some of the many sustainable energy projects and achievements that he and his colleagues have been a part of in the Pacific region.

He started by noting that it is important to shift away from the current model of development. He is looking at a development model that is sustainable and promotes green growth.

IUCN works in 12 countries in the South Pacific. They not only focus on providing light, and other similar services but also economic and social development.

There are two critical issues in the South Pacific: climate change and dependence on imported fossil fuels.

He noted examples of ongoing work—in Palau, where there are 73 energy efficient homes, and in Samoa, where they utilise jatropha for biofuel in order to preserve coconut as a food rather than use it as a fuel. Fuel from coconuts requires eight coconuts per litre, which would quickly deplete their food supply. Jatropha has been in Fiji for decades, making it a logical choice.

An example of balancing social, economic, and environmental needs was expanded upon by Anare Matakiviti: Fiji correctional services was paying quite a lot to cook the prisoners' food. They sought to decrease their costs. IUCN proposed that they utilise pig waste as a biofuel. This improved the lives of people living downstream who were coping with the environmental issues caused by the pig farms' pollution of a freshwater stream. This was also a hidden cost to health. The solution included building an artificial wetland where water from the biogas plant could be filtered, thereby ensuring that the water entering the freshwater stream would be clean for those downstream. They also witnessed the return of freshwater flora and fauna after this project. From the beginning, the community was closely engaged in the project.

The Melanesia Million Miracle Programme—increasing energy access in Melanesia

Kuini Rabo, Secretariat of the Pacific Community (SPC)

The SPC is an intergovernmental organisation that works in public health, geoscience, agriculture, forestry, water resources, disaster management, fisheries, education, statistics, transport, energy, human rights, gender, youth, and culture to help Pacific Island people achieve sustainable development.

The Pacific region faces a number of unique challenges. The island populations range from around 70 (Pitcairn Islands) and 1,165 (Tokelau) to 6.8 million (Papua New Guinea). The region accounts for more than 50% of the world's languages. It covers 36% of the earth's surface and suffers from the "tyranny of distance". There are also a large number of extreme weather events in the region, and many of the islands are very vulnerable to changing climatic conditions.

Kuini Rabo described the efforts currently being undertaken as part of the Melanesia Million Miracle (M3P) programme. The aim of the programme is to improve the welfare of one million households in the rural areas of Papua New Guinea, the Solomon Islands, and Vanuatu through rural electrification initiatives that are conducive to the social and economic environment of the target communities. The concrete outputs of the initiative are to: empower local NGOs and communities, particularly women, to engage in income generating activities and become solar technicians; facilitate deployment of new technology in rural communities; create demand, markets and business environments for solar energy services; and reduce carbon intensity, and reliance and spending on kerosene use. The partners are the government departments of energy, selected NGOs (ACTIV-Vanuatu,

Iskander Kuntoadji of IBEKA and Nimas Pratiwi, PT Gerbang Multindo Nusantara (GMN)

Kokoda Track Foundation-PNG and Choiseul Provincial Council of Women Solomon Islands), women's groups, local partners, and soon AusAID.

Current funding from the first year, 2015, has enabled 3,600 people (600 households) to have access to modern lighting (solar pico lanterns) in the rural regions of Melanesia. It has also enabled the establishment of 12 charging stations that serve as solar shops (two in Papua New Guinea, two in Vanuatu and eight in the Solomon Islands).

Women's groups have been critical to the success of projects in Melanesia.

Solar lanterns are kept at the women's centre, and women manage the payments for the lanterns and manage all the bookkeeping. They also get to keep some money to replace the lanterns. At one point, the women's group identified technical problems, but they were given technical support and fuses to solve the problems.

Kuini Rabo noted that it is crucial to have the chief of the village on board: if he supports the project, the village then follows. He advises them of the benefits to women, community leaders, and others. As noted by other presenters, one of the challenges of the Pacific is the relationship between energy/electricity and extreme climate conditions.

It was asked at the end of the presentation whether end users will pay the full cost of the solar lanterns. The goal of the programme is to move away from the handout mentality. It is a sustainable model that is affordable to the users. They also live communally. They pay US$0.50 cents per charge currently.

Day 2: Afternoon Session 1

Key factors in island community energy provision and maintenance

Iskandar Kuntoadji and Tri Mumpuni, IBEKA Foundation

Presenting the experience and philosophy of the Inisiatif Bisnis dan Ekonomi Kerakyatan Foundation (IBEKA), Iskander Kuntoadji and Tri Mumpuni emphasised how they saw off-grid energy provision, and indeed any local development initiatives, as mechanisms for reinforcing and enhancing community social capital. For success and sustainability, it is critical that any such activities are based in, and driven by, the communities themselves.

Many initiatives in the field of rural energy access are still donor-driven or determined by technology. A less flattering description of this approach could be of one motivated by middle-class arrogance and ego. Instead, suggested Iskandar Kuntoadji, a philosophy of humility, empathy, and consciousness leads to productive participatory development as the only way of ensuring long term sustainability of initiatives. “Shut up and listen to the community”.

In a participatory community-based model, the idea and the passion for change need to come from the community itself, and the plans and solutions for that change must be developed in a participatory and bottom-up exercise. It should not only involve all members of the community concerned but also needs to be developed in a way that the members of that community can understand, initiate, and control.

Any community development initiative should be at most 30% technological and at least 70% social. Recognising the challenges that forging a meaningful and sustainable social development plan can bring, IBEKA’s experience is that developing the social side of such a plan takes at least 18 months.

Such a community partnership methodology, suggested Tri Mumpuni, should involve harnessing and unlocking local skills, capabilities, and potential, whether at an individual or a community level. A classic feature of failed off-grid energy projects, for example, is the lack of effective maintenance of the equipment leading to breakdown—if a project uses the paradigm of local social capital development and harnesses and empowers the community’s own ability, they will have the technical ability and social motivation to carry out the maintenance themselves. Similarly, in the planning phases of the project, while a community may be cash-poor and hence unable to contribute to the capital costs of an installation, they are likely to be able to contribute local resources, labour, and skills, which with an appropriate design and plan can greatly reduce capital costs and increase project sustainability.

In this context, Tri Mumpuni emphasised the point that rather than such projects involving transfer of the most efficient or latest technology, a focus instead on community choice of the most locally appropriate and desirable technology (which might not be the most modern but might instead be the easiest to understand, or maintain, or with the most easily locally available spare parts) leads to long-term community support and sustainability.

Focusing specifically on the concept of power for islands, IBEKA felt that there were many similarities between true islands that had no access to the electricity grid, and “islands” without electricity access in otherwise well-connected areas. Emphasising the philosophy of community partnership, participatory development and building and reliance on local skills, Iskander Kuntoadji observed that

IBEKA had evidence that local community members with only two years of elementary school education were successfully able to carry out complex central dispatch and load control functions in community mini-grids in North Aceh—functions that conventional wisdom in grid operations in Indonesia requires a post-graduate degree to carry out successfully.

An important final consideration of this approach to off-grid energy development, suggested Tri Mumpuni, involves the need to reassess development indicators, monitoring and assessment for a project with the community involved. For example, in addition to differences in interpretation of what constitutes success for a given indicator, there may be cultural differences in their value or appropriateness (e.g., whether or not a memorandum of understanding (MOU) is seen by a community as a necessary or desirable thing to have).

Breakout session questions and responses

A breakout session aimed at addressing four key questions (outlined below) for remote island electrification and development involved splitting participants into two groups to discuss viewpoints. A summary of the opinions offered in answer to these questions is provided.

1 What are the main problems faced in establishing reliable energy and water provision for remote island communities in Southeast Asia and the Pacific?

- The main problem is the cost of the technology: poor rural communities often cannot afford the upfront costs of renewable energy systems. Import taxes on technologies add to the costs of energy systems.
- The problem of affordability is exacerbated in Micronesia, where transportation costs are high, which substantially increases the costs of energy, particularly for diesel-based generation.
- Communities generally do not have the capability to operate and maintain systems, which is a key factor in their long-term sustainability.
- While the technologies exist, local communities are often not sufficiently aware of them.
- In some communities, there is a lack of aspiration for the use of advanced technologies and the development benefits they can bring. The passion has to come from the community rather than the proponents of a technology or intervention. For example, a group of students from an environmental engineering department were keen for a community to adopt their filtered water system, but the community did not accept it.
- In the Philippines it can be difficult to get the cooperation of remote rural communities.
- Also in the Philippines, ownership of the land can be a problem for establishing water and energy systems: no one dares to touch the land owners who may be rich politicians who live elsewhere.
- And in the Philippines there are problems of corruption: local politicians favour big projects which are more amenable to a ‘rake-off’, rather than more appropriate village or household level projects.

2 **Which are the most important actions (regulatory, financial, skills etc.) that need to be taken to overcome these problems?**

- 'Seeing is believing': demonstration projects are important to allow communities to see technologies in action, but acceptance and adoption takes time.
- You need to present the information on energy systems and technologies to communities and let them decide for themselves. Use the local mass media to disseminate information and to advocate for the initiative.
- Bring the technology and community together: they need to own it, contribute to its establishment and operation, and have the capacity to run it. It is not just about developing skills but "knowledge" in a broader sense
- Government needs to prepare the ground, options, etc. (the hard and soft infrastructure), then local champions are needed to drive it forward (and to do a "supermarket shop" of the options). Each village has distinctive issues, so local champions are needed with the local knowledge needed to address them.

3 **How should projects be financed (commercial models, government/donor support, community ownership etc.)?**

- In the Philippines, indigenous knowledge is important: nurture local wisdom. Such wisdom can guide how to distribute fairly.
- Being "technology receptive" rather than just accepting technologies is better: makes for a higher level of engagement.
- We should talk about sustainable living rather than sustainable development. People should live with what they need: supply v need paradigm.
- "Commercial models are modern slavery, government models lead to a slavery mentality, community models develop social enterprises, which are best".

4 **How can we ensure that electricity access for villages supports the creation of productive enterprises and increases incomes?**

- Electricity is the backbone of economic development.
- We should question the equation: happiness = increased income. Happiness can come from sharing and giving.
- We should only produce within the environmental carrying capacity.
- We need to search for a new paradigm.

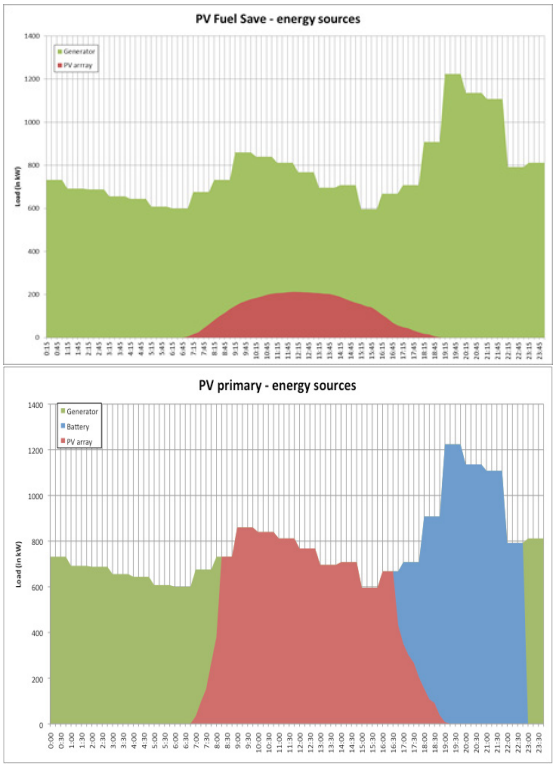
Renewable energy in small island grids

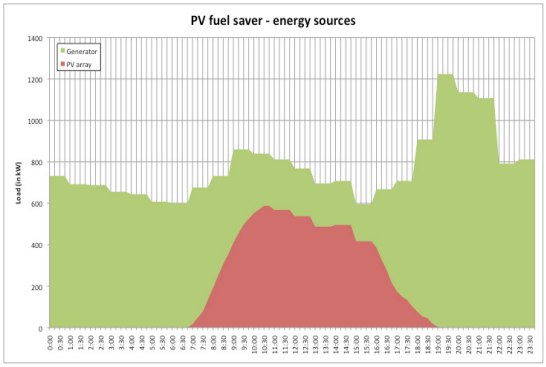
Julia McDonald, IT Power Australia

Speaking on behalf of IT Power (IPT), an international specialist renewable energy consulting firm with over 30 years' experience of advising on, planning, and implementing projects around the world, Julia McDonald began with a description of different types of island grid. Generally speaking, a micro-grid is self-contained and geographically limited. Electrical load can vary from the very small (just a few houses) to the very large (a remote town with a significant industrial power user). Within this definition, different scales of installation can be thought of as mini-grids (100–1,000 kWh/day, e.g., remote islands), small grids (1,000–30,000 kWh/day, e.g., a main island or town), medium grids (30–100 MWh/day), and large grids (100+ MWh/day).

Speaking from ITP's experience of projects in the region, Julia McDonald explained that mini-grids for small, remote Pacific islands, whose population was generally between 200 and 2000 in one or two villages and predominantly for residential energy use, were typically driven by a small power station operated by trained (local) staff. In the past, the power source was typically a diesel generator, but increasingly renewable sources are being seen as more desirable, since they are cleaner, quieter, tend to have improved reliability, and, most critically, have reduced running costs and reliance on imported diesel that is not only expensive but also often involves long-distance and complex supply chains that are particularly vulnerable to disruption from natural disasters and/or geopolitical events.

It is important to realise, however, that renewables tend to have higher capital costs, are likely (depending on the source of energy) to be intermittent and require storage, and can have problems of integration with back-up generators. For maximum reliability of supply, hybrid systems are common, typically diesel/photovoltaic. However, it is important to realise that for diesel generators, small generators or generators that run at less than 30% peak load operate very inefficiently. There are therefore





Sample load curves for different PV system designs (credit: IT Power Group)

This table shows the relative efficiencies, costs, and optimal balance between diesel and renewables for three design options.

three broad design options for diesel/hybrid systems.

PV fuel save: these systems are predominantly diesel supplied, but use photovoltaics to provide up to 10% annual load contribution. They require no storage or specialist integration equipment

PV fuel save plus: these systems are predominantly diesel supplied, but include an intelligent control system and occasionally a small battery bank to enable photovoltaics to make a much larger contribution (around 30% of total load contribution, and 60% during peak insolation).

PV primary: in this case, a larger PV and battery bank, with appropriate control systems, is able to meet the load with all generators off. They can meet up to 100% of the annual requirement but have relatively high integration costs. They are particularly suitable for smaller total loads (where diesel generation is inefficient) or in geographies where diesel costs are unusually high or supply chains are difficult/uncertain (and can therefore lend themselves particularly to remote communities and islands).

Julia MacDonald then described a case study in the northern islands of Tuvalu. Tuvalu is spread across nine small atolls and has a total population of just under 10,000. The main island has 6,000 people, and the others range from 100 to 1,500. The outer islands are only accessible by boat—services typically take around 24 hours to each island, and schedules are irregular, often only every three to six weeks. Frequent boat unavailability and the chance of inclement weather often disrupt shipping, making island supply chains unreliable and expensive.

This was therefore an ideal situation for ITP to overhaul local outer-island electricity grids, which had been powered by diesel generators since their installation in 2001. Operated by the Tuvalu Electricity Corporation, with local operators for each installation, but technicians based centrally in the capital for repairs, the systems often gave only 12–18 hours of power a day. They were vulnerable to breakdowns, diesel shortages and long delays for repairs. In addition, they were expensive, with an estimated cost of energy supply of US$1.20–US$1.50/kWh (and a need therefore to subside the tariffs of around US$0.25/kWh). The aims of the project was to provide 100% renewable energy for the outer islands, for 24 hours a day with improved reliability and reduced operating costs (and to eliminate the need for fuel subsidies).

Load curves were collected by a combination of data logging, analysis of fuel purchase patterns, and power station records. They were used to determine the requirements for the new systems. Evening and night usage plus an allowance for poor sun days determine the size of the battery bank, and the charging requirement for the bank in combination with the daytime load determined the size of the photovoltaic array. Systems were planned in a modular fashion, so that spares could be kept on-island and swapped out when necessary without needing to take the whole system offline. The facilities were also designed for extremely low maintenance operation.

Consequently, the systems installed are quite large for current loads. However, given a design lifespan of 20 years, they will be able to cope both with load growth and with unusually long period of poor sunshine without failing or requiring backup generation. The effective cost of energy has been reduced to around US$0.55/kWh. This is still higher than the tariff, so subsidies have not been eliminated – however they have been cut by a factor of around 5. Local operators have been involved in the construction and trained in system's operation and maintenance. However, they are finding adapting to the new technology challenging.

Day 2: Afternoon Session 2

Impact of energy on tourism and its potential for development in an island context, a case study of Bunaken

Michael Price, The Smart Villages Initiative

Michael Price spoke briefly on the local context of Bunaken, and the relationship that the tourism industry had with community electrification and its benefits.

In the context of the Smart Villages approach, tourism can be seen as a productive use of energy that may in turn enable greater access to energy and greater benefits to development in other areas. One can argue as to whether tourism is a good thing in and of itself, but one cannot argue that it has not changed the face of Bunaken and the many other islands like it. Before the diving boom, the primary industries on the islands consisted of coconut production and fishing. Now, tourism accounts for the majority of income for most islanders on Bunaken and neighbouring Siladen. Michael Price conducted a survey of the local hotel and dive resorts on Bunaken and nearby Siladen, consisting of 12 semi-structured interviews in the respective institutions.

The tourist industry on Bunaken consists of roughly 15–20 resorts in the medium to budget range (US$11–88), all associated with diving. On Siladen there are five resorts all of medium to high-end prices (US$55–275), not all associated with diving.

The questions asked of participants broadly took the form of:

- How do you get your electricity, how much do you get and for how long?
- What do you use your power for?
- Where do you get your water from?
- What are the problems you encounter from being so remote?
- What has been the effect of your electricity supply on the local community? Do you share your power with anyone?

Sri Rezeki, Ibu Fauziah and Tri Mumpuni participate in discussions

On Bunaken, the resorts were all powered by a combination of village power (the solar-diesel hybrid system operated by PLN) plus their own diesel gensets. On Siladen they were powered by gensets alone, and on neighbouring Manado Tua, where there is no tourism and the primary industry is fishing and coconut cultivation, the village is also powered by diesel generators. When the village hybrid system is working on Bunaken, thanks to government subsidies and cheaper generation due to solar PV and larger gensets, the community power supply is approximately 50% cheaper than power provided by the small (around 20 kW) private diesel and petrol generators used by the hotel operators.

The more upmarket resorts on Siladen had much larger gensets in general, with multiple 40 kW generators in each resort required to power the air conditioning.

Electricity was identified by all parties as being key to their business. The most common benefit cited was electricity's ability to bring lighting and the internet. Internet access was crucial for attracting tourists, and for maintaining tourist satisfaction during their stay. Other uses were for water pumping, dive tank refilling, and refrigeration.

Water was universally cited as being difficult to obtain. Drinking water is provided from the "water boat" that comes from Manado several times a day, as well as from rain water during the wet season. Each resort had access to its own or a neighbouring well, but these were all semi-salty, except for one. This semi-brackish water was used for bathing. There is also a desalination plant on the island, but the resorts did not purchase water from it.

Other problems associated with the remote supply chain were frequently brought up. It is seven times more expensive to build on the island than on the mainland and there is a high cost for basic provisions. There are also problems with waste disposal, and removing things from the island.

Siladen Island Resort is an example of the tourism industry providing power for the local populace. It is the largest and most expensive resort on both Siladen and Bunaken by far, with one night's stay costing around €260. It runs two diesel generators of 110kW and 150kW. It is a main source of employment for the 116 families on Siladen. Power is provided for five hours a night to the village, and for more time to the elementary school, as well as for 24 hours a day to the local church. The resort provides these services as recognition that its employees should be happy in order to provide a good service, and also as a condition of its lease of the island's land. It also has begun community environmental education initiatives, to keep the island clear of rubbish.

Tariffs and subsidies were identified by some resorts as being primary drivers of their energy use: one resort's attempts to attain solar panels had been previously thwarted by high import tariffs. Siladen Island Resort stated it would be able to provide more power to the community if it paid the government subsidised rate for diesel.

Michael Price summarised by saying that his small survey illustrated how tourism can be a catalyst for energy access and development of island communities, how energy and water are vital for resort success, and that it is important to integrate development initiatives with tourist operators and communities.

Electricity Access for islands in Nusa Tenggara Timur

Yasmina Safitri, Nimas Pratiwi, PT Gerbang Multindo Nusantara (GMN)

GMN is a privately owned renewable energy system integrator based in Indonesia that deploys a variety of renewable energy technologies. Yasmina Safitri gave an overview of their solar plans and activities for rural electrification, helped by Nimas Pratwiwi, who also demonstrated some of GMN's pico-solar products. The areas that GMN works in include: PV-diesel hybrid electrification, drinking water and small irrigation, PV-diesel hybrid grids for base transceiver stations, pico-solar and solar home systems. The idea for GMN came from Prof. Chayun Budiano while he was lending pico-solar systems to fishermen.

The Research and Development team is based in Surabaya, Indonesia and focuses on a number of product developments. GMN is also now working with a bank to create better access to microfinance for their potential customers.

A current priority for GMN is lighting up rural villages in the Nusa Tengara Timur (NTT) region of Indonesia by replacing kerosene with pico-solar and solar home system solutions. NTT is one of the poorest provinces in Indonesia, with an electrification rate of less than 40% and around one to two million people without electricity access. It consists of around 500 islands and has a lot of hot dry winds blowing over from Australia. Primary industries are dry land animal husbandry and agriculture, traditional weaving, and fishing.

The current approach for the region is to provide pico-solar lighting and mobile phone charging to replace kerosene. There are a number of challenges to doing this, but also a number of solutions, or "thinkable way-outs".

Fishermen and others in similar industries do not have fixed stable incomes, and therefore lack capacity for upfront payment. The pico-solar product being offered is at a comparatively high price but is well-liked by customers. Finance is identified as a means of solving the problem of upfront costs, either through soft loans from local banks and investors, or microfinancing. The other solution is to lower the cost of the products. This can be achieved in part by switching to locally assembled products, as import taxes account currently for 30% of the price of a solar lantern.

GMN is in the initial stages of engagement with local stakeholders, and will partner with Fosera, a local wood packaging firm.

Nimas Pratiwi gave a demonstration of the current pico-solar products. It is 1.7 million Indonesian rupiah, IDR (approx. US$125) for a one-lamp pico system, that has a modular design and is imported from overseas. The company is working on its own design at the moment.

It was remarked from the audience that it is good news that GMN is moving into this space to increase competition for the current two main companies in Indonesia—D-Lite and SunKing—and thus bring the price down for everyone.

Improving the water supply, sanitation and hygiene (WASH) situation in the Philippines

Lyn Capistrano and Apolonio Jimenez, The Philippines Center for Water and Sanitation

Lyn Capistrano and Apolonio Jimenez from PCWS gave an overview of their activities focused on rural communities in the Philippines.

PCWS engages in activities combining policy recommendation, awareness raising, capacity building, hygiene promotion, environmental protection, and strengthening partnerships to

A simplified, low-cost wastewater treatment plant composed of biogas digester, anaerobic filter, gravel filter, planted gravel filter, and lotus pond designed for small spaces.

ensure access to potable water and improved sanitation.

Lyn Capistrano detailed the history and aims of PCWS. It used to be known as the International Training Network (ITN) when it started in 1990 as a project of the Netherlands based International Institute of Infrastructure, Hydraulics and Environmental Engineering (IHE). Towards the end of Dutch Government funding support in 1998, the remaining personnel registered the project organization with the Philippines' Securities and Exchange Commission as the Philippine Center for Water and Sanitation—The ITN Foundation.

Since 1998, PCWS has been supporting itself through its professional fees—rather than donor money—obtained from training, technical support, research, advocacy, and consultancy services provided to UN agencies, local governments, NGOs, national government agencies, corporations, and communities. They are advocating for water supply, sanitation, and hygiene (WASH) to be thought of as a fundamental human right.

Apolonio Jimenez went over some of the examples of WASH technologies that they were helping communities install in the Philippines. He started by stating that a lot of people in local communities knew how to fix things but lacked the financial means.

There is also a lot of work being done on low-cost WASH technologies. "Ferro-cement" is an example. It is 80% cheaper than reinforced concrete for the required applications and is used by PCWS in the construction of iron removal filters, biogas digester sceptic tanks, rainwater harvesting systems, and others. Biogas digester tanks detain wastewater and biodegradable matter including kitchen wastes and faecal matter. Through anaerobic (without oxygen) conversion processes, the organic matter is made to produce methane gas that can be used for cooking.

Adding a biomass gas component to projects has been more successful, as sanitation by itself is "not very popular". An iron removal filter will cost around US$25, three cubic meters of rainwater catchment US$50-75, and a bio-sand filter is less than US$2.

The Philippines has roughly 20 typhoons a year, so it is vital to increase communities' resilience to disasters. Water resources must be managed carefully. Drilling too many wells leads to salt water intrusion in island contexts. PCWS is looking for research partners to focus on desalinization issues.

PCWS has been interested in how people and communities have responded to sceptic tank biogas digesters, initially expecting uptake to be difficult, but in the north of the Philippines, people have been open to their use. The more Muslim regions (e.g., Tawi-Tawi and Sulu) were more cautious, and religious leaders were approached for discussions.

Apolonio Jimenez concluded by noting that sustainability of water and sanitation infrastructures—such as a simple wastewater treatment facility—needs social infrastructures, such as citizens that are aware and protective of the land, and people powered efforts initiated by households and communities, etc. Even a small area of land can make a massive difference as it can link together protected forests, wetlands, and other vital ecosystems that still survive.

The Sumba Iconic Island Initiative

Adi Lagur, Hivos

Adi Lagur from Hivos summarised activities occurring as part of the Sumba Iconic Island Initiative. It is described as a ground breaking, globally replicable initiative to provide energy to people and businesses on the island of Sumba that is 100% renewable.

Sumba was chosen because it had a low electrification ratio (around 25%) and 36,000 off-grid households. It had rich renewable energy resources. The project also had the initial support of provincial and local governments, as well as the state electricity provider (PLN).

Initially begun as a collaboration between the NGOs Winrock and Hivos, the project quickly pulled in more stakeholders from government, the private sector, local civil society, multilaterals, international NGOs, and international donors. Included among these 20-30 organisations are the Dutch and Norwegian governments, the Asian Development Bank, IBEKA, and Pertamina (the state oil and gas corporation).

There is a roadmap plan for achieving 100% renewable energy by 2020 that consists of the following workstreams: wind power plant (grid-based); wind power plant (off-grid); biofuels (existing feeds); household systems (off-grid); communal hydro (off-grid); communal PV (off-grid); grid extension and integration; small-scale hydropower; household biogas; improved cooking stoves; biofuels (new feedstocks); biofuels (ethanol); biomass (boiler-turbine); biomass gasification; biogas waste streams; and technical assistance. There are regular stakeholder meetings.

The island has high potential for renewable power sources, with figures in the vicinity of 10 MW for hydropower, solar PV, wind and biomass

By August 2014 the electrification ratio was at 40% and the renewable energy portion was 10% (4.87 MW) - the majority of that coming from a hybrid wind-PV system.

As well as significant efforts for grid improvements and extensions, there is also work needed on isolated grids. Only 154 out of 352 villages are electrified. They are working together to find community based solutions. In one instance the initiative and PLN are revitalising a broken existing mini-grid.

Adi Lagur noted some case studies from the island. The island has a long (six to nine months) dry season and is trialling some solar PV water irrigation pumps. The systems are 1.2 kWp and can pump 60 cubic meters of water per day. They are trialling machines for corn shelling (which save one to two hours of productive time per day), flour grinding and rice hulling.

Such examples are improving economic development on the island. This is also evidenced

through: increased yields from irrigation and organic fertilizers, improved options for post-harvest processing and handling, and development in the biogas sector.

Looking forward, there will need to be increased acceleration to reach the 2020 target of 100% renewable energy. Changes and improvements to existing policies can attract further investment. The roadmap must be revised to fit with the targets. When successful, Sumba will show a replicable concept aligned with stakeholder interests that could be used on other islands.

Adi Lagur noted that the model is to a certain extent a money-driven development approach. The local leaders must spend a lot of time consulting together, and externally, on what the best ways are to spend the money for the given aims. He was asked how such a large number of donors had been attracted to the project, to which he replied that they had simply invited the donors to be a part of the initiative.

Day 3: Morning Session

Bitung low carbon model town

Ratna Nawang Sari, The North Pole Group

Ratna Nawang Sari, from the North Pole Group, spoke of developments occurring in the town of Bitung, not far from Manado city, the closest city to the island of Bunaken. The special economic zone (SEZ) around Bitung has been chosen to be an APEC (Asia - Pacific Economic Forum) model town. The key objective of the APEC initiative is to provide a feasibility study and advise on how to design an attractive and innovative low carbon development plan by providing a specific selection of mitigation measures in energy, industry, commerce, housing, transportation, AFOLU (agriculture, forestry and other land use), and waste.

The core businesses of Bitung are based on fish and coconut, including the processing of their derivatives, and assorted industries based on agriculture.

The selection of low carbon measures is based on a multi-criteria assessment tool. The result of using these quantitative tools is a prioritised list of low carbon measures with the highest positive impact and the highest potential to be successfully implemented for Bitung following best international evaluation practices.

A main objective now is to develop a geothermal power plant for electricity generation to be supplied to both the special economic zone and Bitung city itself. The current planning indicates that the geothermal power plant will be installed out-of-boundary of the Bitung zone with an overall power capacity of approximately 120 MW. The geothermal power plant will most likely be located in the mountain "Dua Saudara" and will provide a primary energy source for Bitung in its long-term vision.

Use of on- and off-grid PV panels on buildings is also a priority. As a result of the installation of solar PV panels on rooftops, greenhouse gas emissions reductions will be achieved from the electricity generated by the on-grid solar PV installations (residential and commercial sector) and the electricity consumption avoided from the power grid by the off-grid solar PV installations.

Implementation is planned to be finished in 2030. The low carbon model town is not a concept unique to Bitung; multiple other towns are being trialled in Southeast Asia.

Crowd-lighting Indonesia

Sri Rezeki

Sri Rezeki spoke of her project to crowdfund in aid of providing lighting and energy for off-grid communities. There are limited channels for youth empowerment and participation in Indonesia, in particular youth have limited funds to support the needed efforts in rural electrification. Through crowdfunding, they can contribute to the problem of low electrification rates collectively.

The youth of Indonesia constitute roughly 25% of the total population. They usually participate in crowdfunding for film projects or music projects. A goal of the project is to make rural electrification a "pop" issue, similar to films or music, so that the issue is raised in the youth consciousness. A strategy to use that could be useful is inducing a celebrity to tweet about, or raise the cause, publicly.

There are two project types: "Fund the Villages" and "Back the Idea".

The "Fund the Villages" scheme will raise funds for an electrification project in selected communities, such as providing 100 solar lanterns for 100 households in Maluku. The collected funds will cover up-front costs, technology installation, and the setting up of a local agent (a "local lighter"). The "Back the Idea" scheme will fund the development of new innovative electrification ideas or products. There are benefits for both the rural communities and the "crowd".

The project has a five-year plan. The goals at the end of the five years are to have 100 rural communities equipped with electrical equipment, 100 "local lighters" running their own businesses, and 10 innovative electrification ideas/products supported.

People can work together on a voluntary basis—the principle of "Gotong Royong"—to help achieve these aims.

In discussion, it was raised that the project must consider how it will interact with government. It was also pointed out that it is important to target different demographics for different things, and not to let the mailing database of participating youth stagnate.

Workshop participants pause for a group photo

Imagining a Smart Island

A second breakout session again split the participants into two groups. The groups were asked to identify components that they see as essential for creating an ideal "Smart Island", given a context that the island is remote and relatively small in a developing country. Participants were encouraged to brainstorm freely and creatively.

What components does your ideal off-grid island/village community have?

Group 1 Vision

- The community provides its own energy using the island's natural resources. Each island will have its own unique resources.
- Energy schemes will initially meet basic needs. New sources of income are needed for children's education, etc., so new income generating possibilities enabled by energy access are important.
- There is a "no waste" policy for everything.
- Rainwater is harvested.
- There is an island cooperative that owns key assets, supports trading, and manages the community's money. All people on the island are equal owners of the cooperative. The cooperative is the focus for ownership and management.
- People take pride in their island, love their island, and have a sense of belonging. They live in harmony with nature.
- Energy developments and building a smart island need to be preceded by developing social capital. Knowledge and acceptance first need to be built.
- A smart community should know what it is doing and appreciate the risk associated with a "business as usual" lifestyle. It aims for a greener lifestyle. It is people-focused development.
- There is a strong emphasis on capacity building and knowledge transfer.
- There is a visionary community leader who ensures that everyone is on the same page: they have a common vision.
- The island, its community and infrastructure, is resilient to climate change and natural disasters (does this happen automatically or is there a need for additional measures?).
- An appropriate balance is achieved in land use between food for the islanders and crops to sell (for energy, palm oil, etc.). The crops grown are appropriate to the island's conditions.
- The community works productively with private developers (they can be part of the solution) rather than fights with them (you can never win).
- Poverty is not the issue: the real problem is communities that are disconnected from their environment and natural resources. The modern world has a problem in that it has just one concept of wealth.
- If the community doesn't want to be changed you should walk away.

Group 2 Vision

- For an island like Bunaken, with 6,000–10,000 people, there would be a number of anchor industries, namely fishing and tourism, along with some coconut cultivation. This imaginary island has two communities and two tourist outlets.
- There would be solar mini-grids for ice production for the fishermen. In Tonga, fishermen used to spend US$500 a week on ice before they were able to make their own. The women would make ice blocks and sell them.
- Power is sourced from a diverse range of wind, solar, and biomass.
- There are drying and air circulation facilities for copra and cassava, along with seaweed drying.
- There is an emphasis on adding as much value to locally produced commodities as possible before exporting.
- There are solar pumps for irrigating (for instance cacao plants)
- There is a "Smart Eco Resort" where tourists stay for long periods and are more engaged. There is close collaboration between the resort and community. Ownership of some of the electricity provision lies with the resort and is sold at cost to the village
- The village has an elementary school with good computer and internet access and there is a focus on education, including environmental education.
- Plastic bags are banned on the island. All organic and non-organic waste is separated so that organic waste can be used for biogas, or be put into biopore holes.
- There is a large rainwater catchment to try and avoid having to rely on desalinisation plants and extra costs associated.

Closing Remarks

John Holmes, The Smart Villages Initiative

John Holmes concluded the workshop by noting that a report of the workshop would be disseminated to all attendees. It is hoped that attendees will in turn disseminate this report and an accompanying policy brief to their relevant contacts. The Smart Villages team hopes to continue to collaborate with workshop participants and relevant people in Southeast Asia as part of their ongoing engagement in the region. There will be a number of further workshops in neighbouring southeast Asian countries focusing on a variety of topics related to off-grid development and electrification, including cookstoves and the energy-water nexus.

The findings from this and the other workshops will be published and communicated to a variety of stakeholders, at various events, including final events for the United Nations and European Union. All materials will also be available on the website www.e4sv.org. John Holmes closed by thanking the co-organisers, Kopernik, and the workshop attendees.

Annex 1: Workshop Programme

Tuesday, 03 November

1200 **Optional field trip to Bunaken village solar generation plant**

1630 **Opening address and welcome**
Chief Wolter Panontongan
Group Introductions
Workshop participants
Introduction, aims of workshop and the Smart Villages Initiative
Dr. John Holmes and Dr. Bernie Jones

1900 **Welcome dinner and reception**

Wednesday, 04 November

0900 **Empowering women in opening energy access in islands and coastal areas**
Citra Savitri, Reisky Handika, Kopernik

0920 **Getting to know Wonder Women**
Ibu Fauziah, Imelda Lobo

0945 **Various new and renewable energies, (Kebijakan dan Program)**
Deasy Kurniawati, Directorate of New and Renewable Energy, EBT

1015 **Renewable and island energy activities**
Rizki Azikin, Perusahaan Listrik Negara, PT PLN Persero

1045 **Break**

1115 **Tonga off-grid electrification**
Ofa Sefana, Tongan Department of Energy

1145 **Pacific Energy Systems Programme**
Anare Matakiviti, International Union for Conservation of Nature, IUCN

1215 **The Melanesia Million Miracle Programme—increasing energy access in Melanesia**
Kuini Rabo, Secretariat of the Pacific Community (SPC)

1245 **Lunch**

1345 **Key factors in island community energy provision and maintenance**
Iskandar Kuntoadji, Tri Mumpuni, IBEKA

1430 **Breakout session on key questions for island electrification**

1500 **Renewable energy in small island grids**
Julia McDonald, IT Power Australia

1530 **Break**

1600 **Impact of energy on tourism and its potential for development in an island context, a case study of Bunaken**
Mike Price, Smart Villages

1630 **Electricity access for islands in Nusa Tenggara Timur**
Yasmina Safitri, Nimas Pratiwi, PT Gerbang Multindo Nusantara (GMN)

1700 **Improving the Water Supply, Sanitation and Hygiene (WASH) Situation in the Philippines**
Lyn Capistrano and Apolonio Jimenez, The Philippines Center for Water and Sanitation (PCWS)

1730 **The Sumba Iconic Island Initiative**
Adi Lagur, Hivos

Thursday, 05 November

0900 **Bitung low carbon model town**
Ratna Nawang Sari, The North Pole Group

0915 **Crowd-lighting Indonesia**
Sri Rezeki, State Ministry of National Development Planning

0930 **Workshop discussion—Imagining a smart island**

1030 **Closing remarks**

1100 **Close**

Annex 2: Workshop Participants

Name	Organisation
John Holmes	Smart Villages, UK
Bernie Jones	Smart Villages, UK
Molly Hurley-Dépret	Smart Villages, United States / Belgium
Mike Price	Smart Villages, UK
Tim Walsh	Solar Energy Research Institute of Singapore, Singapore
Citra Savitri	Kopernik, IndonesiaImelda Lobo, Indonesia
Ibu Fauziah,	Indonesia
Reisky Handika	Kopernik, Indonesia
Tri Mumpuni	IBEKA, Indonesia
Iskander Kuntoadji	IBEKA, Indonesia
Eriell Salim	Independent Energy Consultant, Indonesia
Sri Rezek,	State Ministry of National Development Planning, Indonesia
Deasy Kurniawati	Directorate of New and Renewable Energy, Indonesia
Rizki Asikin	Perusahaan Listrik Negara (PT PLN Persero), Indonesia
Yasmina Safitri	PT Gerbang Multindo Nusantara (GMN), Indonesia
Nimas Pratiwi	PT Gerbang Multindo Nusantara (GMN), Indonesia
Lyn Capistrano	The Philippines Center for Water and Sanitation (PCWS), The Philippines
Apolonio Jimenez	The Philippines Center for Water and Sanitation (PCWS), The Philippines
Kuini Rabo	Secretariat of the Pacific Community (SPC), Fiji
Anare Matakiviti	International Union for Conservation of Nature (IUCN), Fiji
Ofa Sefana	Tongan Department of Energy, Tonga
Julia McDonald	IT Power Australia, Australia
Ratna Nawang Sari	The North Pole Group, Indonesia
Adi Lagur	Hivos, Indonesia
Chief Wolter Panontongan	Bunaken, Indonesia

Annex 3: Imagining a Smart Island Infographic


SMART VILLAGES
New thinking for off-grid communities worldwide
KEY TO MAP
• INDONESIA (17,508 islands)
Rural electrification rate = 76%
(according to state electricity supplier PLN in 2012)
• THE PHILIPPINES (7,500 islands)
Rural electrification rate = 81.5%
(World Bank database 2012)
• MALAYSIA (878 islands)
Rural electrification rate = 99%
(World Bank database 2012)
PHILIPPINES
MALAYSIA
MALAYSIA
BORNEO
INDONESIA
CELEBES
SUMATRA
PAPUA
JAVA
TIMOR
THE VILLAGE HAS AN ELEMENTARY SCHOOL WITH GOOD COMPUTER AND INTERNET ACCESS
SCHOOL
BUILD A COMMUNITY RESILIENT TO CLIMATE CHANGE AND NATURAL DISASTERS
THERE ARE SOLAR MINI-GRIDS FOR ICE PRODUCTION FOR THE FISHING INDUSTRY
NEW INCOME GENERATING POSSIBILITIES ARE IMPORTANT
BUILD A COMMUNITY THAT AIMS FOR A GREENER LIFESTYLE
PEOPLE LOVE THEIR ISLAND AND HAVE A SENSE OF BELONGING
THERE IS A STRONG EMPHASIS ON CAPACITY BUILDING AND KNOWLEDGE TRANSFER
www.e4sv.org
@E4SmartVillages

SMART VILLAGES

New thinking for off-grid communities worldwide

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