SMART VILLAGES
New thinking for off-grid communities worldwide

Smart Villages in Southeast Asia: Kuching Workshop Report

Workshop Report 4

KUCHING, MALAYSIA

January 2015

Key words:
Southeast Asia, Off-Grid Energy, Smart Villages, Innovation, Entrepreneurship

Smart Villages

We aim to provide policy makers, 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.

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

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

Publishing

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

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Foreword

Sustainable energy for all is one of the key recommendations of the UN Open Working Group on the global sustainable development agenda beyond 2015. The Smart Villages Initiative aims to feed into their work by providing a comprehensive survey of the ability of off-grid energy to play a leading role in the developing world. In particular we are focusing on the potential for off-grid energy to help in 'last mile' situations. Since this usually concerns remote rural communities we have introduced the term 'smart villages'. Our firm conviction is that providing energy to such communities will catalyse development in all kinds of areas – education, entrepreneurship, sanitation, health, gender equality and democratic engagement – and create an alternative to the migration to cities currently regarded as inevitable.

We are gathering data on the needs and challenges of providing such energy through a series of regional engagements in Africa, South and Southeast Asia, and Latin America. A key part of these engagements involves gathering evidence from – and encouraging dialogue between – those working 'at ground level': local entrepreneurs, village leaders and NGOs, as well as also engaging with national policy makers, funders and international agencies. We expect that by engaging at the grassroots level, and across all the key regions of the world, the Smart Villages Initiative can go further than previous attempts to discover local needs and solutions.

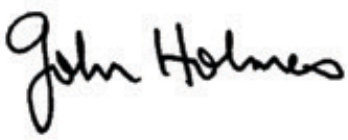
Following our first workshop in Arusha in June 2014, this report describes our January 2015 workshop in Kuching, Sarawak, which initiated our programme of engagement activities in Southeast Asia. By gathering together both local and international experts, we explored some of the barriers to introducing off-grid solutions and the opportunities for overcoming them. As in East Africa, the diverse cross-section of expertise and viewpoints represented at the workshop was remarkable. The combination of village leaders, entrepreneurs, academics, industry and government representatives and NGOs resulted in a rich exchange of experiences and produced new insights into the key issues and how they may be addressed.

In this region, particular importance was attached to addressing cultural issues and to ensuring that development paths build on and are sympathetic to rural traditions. This was highlighted by a field trip to a longhouse community where the village elders emphasised that they regarded electricity, which they were sourcing from a micro-hydropower plant, as essential to ensuring continued social cohesion and meeting the aspirations of their youth. Off-grid energy was also seen as a key to 'clean' power, replacing the lethal kerosene cooking stoves still unfortunately so common.

Nearly all the ASEAN region was able to be represented – workshop participants came from Malaysia, Cambodia, Laos, Vietnam, Thailand, Indonesia, Philippines, Singapore and Myanmar. Gratifyingly, they all felt that there was much value to be gained by continuing to share experiences under the Smart Villages umbrella. This we will do through a series of follow-up activities and then by ensuring lessons learnt feed into a final report to be presented to both local and international policy makers.

Finally we would express particular gratitude to Universiti Malaysia Sarawak (UNIMAS) for hosting the event and providing invaluable input and support, and to Akademi Sains Malaysia, our partner in organising the workshop, without whose engagement and expertise the workshop would not have been possible.

Dr Bernie Jones
Project Co-Leader



Dr John Holmes
Project Co-Leader

Summary

This report summarises the information presented at, and conclusions arising from, the second major international workshop of the Smart Villages Initiative. The workshop took place in Kuching, the capital city of Sarawak, Malaysia, on the campus of Universiti Malaysia Sarawak (UNIMAS), and marked the beginning of a 12-month programme of engagement by the Smart Villages Initiative in Southeast Asia. It brought together a diverse group of around 80 people working on energy access for off-grid villages to review their experiences to date, and to identify barriers to further progress and how they may be overcome.

Akademi Sains Malaysia (the Malaysian Academy of Sciences), UNIMAS and the Smart Villages project team collaborated to set up and run the workshop. It was funded by the sponsors of the Smart Villages Initiative: the Cambridge Malaysian Education and Development Trust (CMEDT) and the Templeton World Charity Foundation (TWCF).

The workshop was held over three days, from 27 to 29 January 2015. Day one began with an overview of the smart villages concept followed by presentations of five case studies of smart villages, stimulating a discussion of key characteristics and issues arising in advancing the concept. Attention then shifted to rural energy uses in Southeast Asia: a series of presentations led into breakout groups to identify distinctive energy needs, consider how they may best be met, and discuss how energy-access initiatives can effectively be integrated with other strands of development. The official launch of the global Smart Villages Initiative, as well as the Southeast Asian engagement, was held on the afternoon of the first day and was followed by two keynote speeches on the village-level energy situation in Malaysia and the socioeconomic impacts of energy access.

The morning session of the second day provided for 12 short presentations, 'elevator pitches', each summarising experiences of implementing village-level energy services and highlighting technologies used, delivery/implementation methods, acceptance rates and outcomes. Parallel sessions in the afternoon on cultural acceptability, biomass and biogas, and system optimisation were followed by two keynote addresses on best practices for village-level energy access programmes and on entrepreneurship.

The final day began with a series of presentations providing additional perspectives on off-grid energy in Southeast Asia, leading into a discussion on what the Association of Southeast Asian Nations (ASEAN) can learn from each other and what common initiatives they might undertake. Breakout groups then discussed four overarching themes of the workshop, focusing on how to establish the necessary framework conditions to support off-grid energy for development. A final panel discussion considered what messages should be given to principal audiences.

Key points

1 To be successful, off-grid energy initiatives in Southeast Asia require an understanding of, and sensitivity to, distinctive local cultures without which local needs and aspirations may not be met, resulting in lack of buy-in and possibly in resistance. This takes time, and requires an interdisciplinary approach involving anthropologists and social scientists. Social audits should be undertaken at an early stage and repeated regularly. In respect of the development outcomes targeted for energy-access initiatives, it is best to aim for incremental improvements that are consistent with what villagers have and value, and that embrace local wisdom. Villagers should be afforded control over their development path, which should build on their unique endowments and strengths.

2 A major part of the effort of any energy-access project should be devoted to engagement, and building good relationships, with the local community, partnering with individuals and organisations who are already known and trusted by the community if possible. This is essential to secure community buy-in and ownership, which are key to achieving successful outcomes. It is appropriate to make use of community resource management systems and in-kind contributions, and to identify, train and support local champions who have the future of the community at heart and a vision for where it should be 10 or more years' time. Resistance may be met at different stages of the project; this needs to be monitored and a flexible approach taken in evolving strategies to deal with it.

3 The use of energy access to support new employment opportunities and productive enterprises should be emphasised and supported in order to secure the financial viability of projects and to enable further progress up the energy ladder. Otherwise, energy services may largely be used for leisure activities or innovations aimed mainly at improving quality of life. While such uses may well be appropriate, coupling them with productive uses is likely to enhance the sustainability of initiatives in the longer-term. Steps should be taken to ensure that the poorer members of rural communities have access to the opportunities arising, not just the more powerful.

4 There is an urgent need for capacity development to enable the benefits of off-grid energy solutions to be maximised. This capacity development includes increasing the awareness of villagers of the benefits of energy access and the possibilities to enhance existing, and to introduce new, productive enterprises. It should also provide for training in the maintenance and use of technologies, and the skillsets needed by new enterprises to provide and use energy services.

5 Information and communication technologies (ICT) are often an early priority for villagers once they have an electricity supply. Key drivers are a desire for improved education and Internet access: the latter provides a desired connection with the outside world and is seen as a key enabler of new income streams from commerce and tourism. While ICT and Internet access hold some dangers and can be divisive, if appropriately managed they can bring together the young and old, for example in initiatives to preserve indigenous traditions such as music, dances and cooking methods, and local knowledge of biodiversity and life-skills ('living in the rainforest').

6 There are sufficient examples to date to provide confidence that the smart village concept can be delivered and that the

development benefits will flow. 'Seeing is believing' and more good and well-publicised case studies of smart villages are needed. First steps are important, and early successes can have a snowball effect.

7 Supportive policy frameworks should be put in place, but often are missing. They need to facilitate scale-up, which means bringing in private investment. Finances will be more readily available if effective mechanisms can be established to reduce transaction costs, for example by bundling many small projects.

8 Energy initiatives should not be led by technology; rather the choice of technology should be responsive to users' needs. These needs will evolve and so there is a premium on flexible and modular technologies such as solar panels. Micro-hydro systems are often a preferred choice in Southeast Asia given their ability to offer power levels sufficient to support productive enterprises at a competitive cost, but they are somewhat less flexible in meeting evolving needs. Direct Current (DC) nano-grids supplying a cluster of homes are emerging as a promising technology, particularly when combined with low energy DC appliances, but may have limited capability to support productive enterprises. The choice of technologies and the design of energy systems should have regard to their operation and maintenance in remote communities possibly with limited skill levels locally available. Villagers need to be educated in the use of energy technologies, not least to avoid misuse of batteries, a frequent cause of system failure.

9 Energy needs for cooking in rural communities in Southeast Asia are much higher than those for electricity, and there is a good case that cleaner and more efficient cooking technologies should be prioritised in energy access initiatives. Substantial gains in energy efficiency and cleanliness can be achieved with simple technologies and at low cost, so in many ways this is an area where there are 'low-hanging fruits'.

10 Better metrics are needed to inform policy, for example on levels of energy access, as monitoring and evaluation schemes often do not reflect realities on the ground. Evaluation of the effectiveness of energy schemes and of the development impacts that follow should be routinely embedded in all initiatives. Both quantitative and qualitative measures are needed and may usefully include measures of individual and community 'happiness' or well-being. Mechanisms need to be in place to learn from failures that may otherwise not be shared publicly.

11 Workshop participants agreed that there is substantial value in initiatives to share experiences in off-grid village energy access across the ASEAN region, and that the Smart Villages Initiative can play an important role, not least in enabling ongoing links and communication between the various individuals and communities with whom it has engaged.

Introduction

The Smart Villages Initiative launched its year-long engagement in Southeast Asia with a major international workshop in the city of Kuching, in Sarawak, Malaysia, held over three days from 27 to 29 January 2015. This report records the key points that arose in the workshop. Presentations made at the workshop can be downloaded from the Smart Villages website: www.e4sv.org.

The Smart Villages Initiative is evaluating the barriers to energy access in rural communities in developing countries and how those barriers can be overcome. Its focus is off-grid villages where local solutions (home- or institution-based systems, and mini-grids) are cheaper than national grid extension. Its aim is to generate new insights to inform the decisions and programmes of policy makers, donors and development agencies concerned with rural energy access for development.

The workshop was the outcome of a productive partnership between Akademi Sains Malaysia (ASM), Universiti Malaysia Sarawak (UNIMAS) and the Smart Villages project team. It was hosted by UNIMAS on its campus in Kuching, and was funded by the sponsors of the Smart Villages Initiative: the Cambridge Malaysian Education and Development Trust (CMEDT) and the Templeton World Charity Foundation (TWCF).

The Workshop Programme and Workshop Participants, some 80 in total, are set out at the end of this report. The programme included the official launch of the global Smart Villages Initiative, scheduled for the afternoon of the first day to enable the participation of the Malaysian Minister of Science, Technology and Innovation, who led the opening ceremony. Workshop attendees were primarily people working actively to address off-grid village energy challenges in Southeast Asia, though, importantly, they also included experts in off-grid energy for development from Africa, South Asia, Europe and North America. Workshop participants reflected a diverse cross-section of expertise and perspectives, including entrepreneurs, villagers, NGOs, business leaders, regulators, policy makers etc.

Prior to the workshop, on 25/26 January, delegates had the opportunity to visit Kampung Sri Stamang II, a village of 41 families living together in a traditional Sarawak longhouse that has recently benefited from the installation of an 18 kW micro-hydro scheme. As well as an opportunity to see and hear about the technical aspects of the scheme, the visit provided the opportunity to interact with villagers and learn about the impacts of electricity access.

To date, key benefits of electricity access in Kampung Sri Stamang II have been the improvement of individual productivity (rice cookers and washing machines freeing up time to work in the paddy) and lifestyle uses (TV, radio, personal IT). The lack of a local market for entrepreneurs and the length of distribution chains to non-local markets have, so far, limited the establishment of new local enterprises. A key next priority for villagers is an internet connection which they anticipate will open up opportunities for homestay tourism and access to markets for handicrafts. The Malaysian Government provides basic levels of healthcare and education for the village.

Day 1: Morning Session

Welcome

Tan Sri Ir Ahmad Zaidee Laidin, ASM: Chair of the Workshop Organising Committee

Ahmad Zaidee Laidin welcomed participants to the workshop on behalf of Akademi Sains Malaysia and the Organising Committee. He pointed to the ongoing importance of bringing sustainable energy to off-grid villages in Southeast Asia and to the valuable contribution he anticipated this workshop should make.

The Smart Villages Concept

Dr John Holmes, Smart Villages Initiative

Setting the context for the Smart Villages Initiative, John Holmes pointed to the fact that more than one billion people still do not have electricity; three billion cook on dirty, inefficient and harmful stoves; and four million people die prematurely each year as a result. The UN's Sustainable Energy for All (SE4All) initiative aims to achieve universal access to modern energy services by 2030. The Smart Villages Initiative aims to contribute to meeting this goal by providing an insightful 'view from the front line' of the challenges of village energy provision for development and how they can be overcome.

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 particular 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.

Dr Holmes explained that the Smart Villages Initiative is being undertaken by a project team based mainly at Cambridge and Oxford Universities, working in collaboration with

Tan Sri Ir Ahmad Zaidee Laidin welcomes participants

the national science academies and their networks, and with two organisations with extensive hands-on experience of village energy projects for development: Practical Action and The Energy and Resources Institute (TERI). Following a preparatory phase lasting two years, the three-year project commenced in October 2014.

It will run 12-month programmes of engagement activities in six regions (East and West Africa, South and Southeast Asia, South and Central America), which will gather and synthesise the views of leading practitioners and stakeholders in off-grid village energy for development in these regions on existing challenges and how they can be overcome. Advice will consequently be communicated to policy makers, donors and development agencies on what further steps need to be taken in order to accelerate progress to meeting the SE4All target. Dr Holmes concluded with a summary of the main findings of the previous international workshop held in Arusha, Tanzania, in June 2014.

Panel Session 1 – Smart Village Case Studies

The Terrat Village Experience

Mr Martin Kariongi ole Sanago, IOPA

Martin Kariongi, who hosted a visit to the village of Terrat for participants in the Arusha workshop, described the aims of Institute for Orkonerei Pastoralists Advancement (IOPA) to empower community economies in the Maasai region of northern Tanzania. IOPA, based in Terrat with over 1,000 members, operates three major social advancement programmes: pastoral education, livelihoods, and the Terrat social business centre.

Electricity is provided to 246 households, schools, health and religious centres, and to 8 water boreholes by 4 biodiesel generators (total capacity 368 kW) using oil from jatropha and croton. A biogas facility, making use of residues from biodiesel production, is awaiting funding to enable its completion.

Access to electricity has enabled the construction of five milk-processing plants that produce cheese, yoghurt, butter and ghee. These plants have led to the doubling of women's incomes over the last three years. Electricity access has also enabled improvements to education and health services.

Thanks to its electricity supply, Terrat township (population 1,262) has become a business hub for the surrounding 12 villages (total population 7,000). The power supply supports the operation of a community broadcasting station reaching two million people, and the creation by local entrepreneurs of a range of businesses including a welding and metal workshop, a woodwork and carpentry workshop, a computer-based business and training centre, hairdressing salons and mobile phone-charging businesses.

e-Bario Project

Dr Poline Bala, UNIMAS

The e-Bario project is being undertaken by UNIMAS and focuses on a remote community comprising 17 villages around Bario in Sarawak, each with 20 to 40 families living in a single longhouse. The aim of the project is to better understand the conditions under which information and communication technologies (ICT) can support rural development. A power supply that includes a solar PV panel has been established to enable the use of ICT.

Following on from baseline studies that revealed very low levels of awareness of ICT, various ways of introducing ICT to the community, including the provision of computers and Internet access to schools, health centres and community members

have been explored, involving villagers in the research. Benefits have been wide-ranging, including improvements to education (ICT-based and distance learning), healthcare (electronic access to experts in urban health centres), information exchange (community radio), commerce (tourism and e-commerce), and agriculture (improved information on rice production). Through appropriate community engagement, the introduction of ICT has been empowering and has supported the preservation of cultural traditions.

Key lessons have been the importance of asking the right questions (how can technology help rather than how can we use the technology?) and emphasising context in finding the right answer. Also, it is necessary to focus on social, cultural, political and economic profiles of a community, and to integrate new facilities with existing practices.

Long Lamai case study

Dr Alvin Yeo, UNIMAS

Alvin Yeo's presentation first gave an overview of UNIMAS's Centre of Excellence for Rural Informatics, an interdisciplinary research group that aims to research and support the transformation of communities into knowledge-based societies through leveraging ICT innovations. It works with a series of 'living labs' in remote communities across Malaysia using the Centre of Excellence for Rural Informatics's model. The approach involves an iterative and interdisciplinary process of community engagement and needs analysis, planning and design, technology access and deployment, and evaluation and reflection.

Long Lamai is a remote and isolated community in North Sarawak to which ICT has been introduced through a process of engagement and participatory action research that has ensured its integration with social systems. Power has been provided by micro-hydro and solar PV panels. Resulting benefits have included new sources of income (homestays, handicrafts and more boats), population growth due to rural–rural migration, and improved health and education. Initiatives have included the use of ICT to enable the sharing of indigenous knowledge, for example, on plants and nomadic sign language, between generations.

Critical success factors for such community engagement have been identified as finding the right community and champions for all stakeholders, developing a relationship with the community, addressing their needs, having support from the top-management and multi-disciplinary teams. Community-based research may take longer, not least to build the community's trust, which is essential in order to get full involvement and access to 'unfiltered' information.

Energy for Off-Grid Villages in Thailand

Mr Sumate Tanchareon, King Mongkut University

Sumate Tanchareon summarised experiences of off-grid power projects in Thailand, at the Phu Kradueng National Park, Chik Island, and Kiriwong village. A hybrid generation system using solar and diesel has been installed in the Phu Kradueng National Park, replacing a diesel genset that provided power for tourists, rangers and a shop. An integrated approach has been taken, considering also needs for water, heating and data communication; the project started with a workshop with local stakeholders to encourage their participation and to understand their needs. A subsequent workshop was used to teach community members how to operate the system and how to minimise electricity use.

At a village of 112 households on Chik Island, individual diesel gensets have been replaced by a hybrid system (wind, solar and diesel) operated as a partnership between the community (which set up a Village Electrification Committee)

and a rural energy service company. Pre-paid smart meters have eliminated the risk of non-payment. A key to success has been a careful community engagement process involving several workshops.

Based on principles of inclusive innovation and communities of practice, university researchers and villagers from Kiriwong village have enhanced local designs for pico-hydro units to produce a robust design that can readily be adapted to local conditions. As a result, a community enterprise has been developed that designs, builds and sells pico-hydro units to surrounding villages.

National Smart Communities Program

Mr Nik Faizul, MIGHT

The National Smart Communities Program began in May 2010 at the inaugural meeting of the Global Science and Innovation Advisory Council meeting in Malaysia. It aims to integrate community systems for high inclusiveness and multiplier impact, and to connect villages and cities via sub-urban communities.

The Malaysian government, through Malaysian Industry–Government Group for High Technology (MIGHT) and the IRIS Corporation, is implementing the Rimbunan Kasih (sustainable village) model at nine locations in Malaysia (two are completed, two are in progress and five are under negotiation). The model provides for knowledge sharing and aims to improve living standards and accelerate rural growth through modern agricultural activities.

Plenary Discussion

An initial topic addressed in the discussion following the five presentations was the potential benefits and problems arising from ICT in rural communities. Thailand and Uruguay have both implemented one child–one laptop policies, and in the latter case an interesting outcome is that the young are teaching their grandparents how to use the technology. A similar pattern has been observed in Long Lamai where the old and young are coming together to use ICT to capture traditional knowledge about plants, consequently creating new bonds between the generations.

Mr Nik Faizul of MIGHT

A concern is that ICT may result in reduced interpersonal skills. This was addressed in the e-Bario project by designing community-based tele-centres, where people have to interact with each other while using computers. The use of Facebook and similar social websites has created new, virtual longhouse communities. Young people should be trained to use the Internet before being allowed free access, like passing a driving test before being given the keys to the car.

Turning to the distinguishing characteristics of smart villages, it was suggested that smart villages should provide for integrated and inclusive innovation for an improved quality of life. What is 'best' will depend on the context, and what matters are the services that energy provides rather than energy per se. Smart villages are about eliminating energy poverty and keeping people in rural communities, but the view was expressed that generally industries prefer to be grid connected. Smart villages should be inhabited by smart people who can generate a good income, and should be sustainable.

Terrat is a good example of how the availability of energy leads to new businesses. For example, the ability to process milk into a range of dairy products means that Maasai women no longer have to throw away milk during the rainy season. They have substantially increased their incomes as a result. The various development initiatives have meant that 44% of the young people who would otherwise move to the cities have stayed in the village.

The experience of the Malaysian government through MIGHT is that establishing smart villages that are economically sustainable is difficult: substantial levels of government funding are needed to make them a success. Economic opportunities need to be created and cultural issues addressed in order to ensure that those invited to join the project are receptive.

A question was raised about who benefits from energy-access initiatives: too often it is those in power that benefit first and the poorest of the poor miss out.

A concern was expressed that universities need to engage more closely with real-life problems in villages and with the NGOs working on them. Both academics and NGOs need to be trained in how to engage effectively with communities as there can be tensions. In order to sustain projects, local champions are needed who have the future of the community at heart and who have a vision of what needs to happen in the next 10 to 15 years. Experience suggests that such champions may only become apparent after around one year's engagement and they will need to be trained.

Panel Session 2 – Key Energy Uses in Southeast Asia

Micro-Hydro for Rural Communities – Key Uses and Benefits

Mr Adrian Lasimbang, TONIBUNG

TONIBUNG (Friends of Village Development) has implemented 16 micro-hydro (< 100kW) projects in Borneo since 2000, taking an integrated and community-based approach and putting beneficiaries in the driver's seat. Eighty percent of the effort of a project is 'social engineering': making use of existing community resource management systems, in-kind contributions and work strategies ('gotong royong'). This increases community buy-in while reducing costs. In each case, a village micro-hydro committee is established and between two and six local operators are trained.

Funding is still mainly based on grants, but such grants are increasingly difficult to obtain. TONIBUNG is consequently trying to lower costs by reducing reliance on foreign expertise and equipment, and by sourcing materials locally from community in-kind contributions. Payback

is achieved in four to eight years after which the project is handed over to the village micro-hydro committee. Malaysia has the potential to develop hundreds of micro-hydro schemes in Borneo: in order to scale up, more investments are needed in village-based human resources and the accessibility of renewable technologies.

Cambodia Millennium Village

Dr Heng Sokbil, AAET

Heng Sokbil of the ASEAN Academy of Engineering and Technology (AAET) explained that 90% of household energy use in Cambodia comes from wood and charcoal: rural families consume around five kg of firewood per day for cooking, contributing to deforestation and harmful emissions. The Neang Kongrey Stove, introduced in 2001, uses the same raw materials and production skills as traditional stoves, but it is more efficient (saving 0.3-0.5 tonnes of CO2 per year) and pays for itself in around one month. It sells for around 1.25 US dollars (USD) and lasts for one to two years.

Through the national bio-digester programme, 21 bio-digester companies were established in 2009 and 5,600 units have subsequently been installed, each reducing CO2 emissions by four to six tonnes per year. An important innovation of the programme has been the development of a replicable model for micro-franchising of decentralised bio-digester construction services.

Both programmes benefitted the daily lives of rural households and required all stakeholders to work together.

Community–Private Partnership Pro-Poor Infrastructure – Cinta Mekar Micro-Hydro Training Power Plant

Mr Sapto Nugroho, IBEKA

A 120 kW micro-hydro scheme has been installed in the village of Cinta Mekar, some three hours' drive from Jakarta in Indonesia. The scheme, costing 150,000 USD is owned 50–50 between the local community (whose share of the capital cost was granted by UN-ESCAP) and PT. Hidropiranti, a private enterprise that contributed the other half of the capital cost. A further 75,000 USD was contributed by Yayasan Institut Bisnes dan Ekonomi Kerakyatan (IBEKA), a non-profit NGO, for a dissemination and training facility.

A power purchase agreement of .0496 USD per kWh provides the village cooperative with a monthly income of around 500 USD, which goes to electrifying the 122 remaining households, education (scholarships and training for adults), healthcare, seed capital to generate income, village infrastructure and cooperative operational costs.

Rural Electrification in Sarawak

Dr Chen Shiun, Sarawak Energy Berhad

In Sarawak, 2,216 (36%) villages, comprising 40,000 homes and 250,000 people, do not yet have 24-hour electricity. For these villages, any electricity is typically generated by diesel engines for a few hours each day at great expense. The government aim is to achieve 100% rural electrification by 2025. Challenges include financial constraints (off-grid schemes cost around 55,000 USD per household), difficulties of access, sparsely distributed villages meaning few economies of scale, lack of other infrastructure such as water supply and telecommunications, and an absence of technically skilled people willing to work in remote communities.

The main objective is to replace diesel generation with affordable 24-hour power: grid connection is considered the most sustainable option in the long term and is the first choice if a village is sufficiently close to the grid (< 30 km); off-grid solutions are used otherwise. Rural communities are charged at the same rate as urban dwellers.

Sarawak Energy is currently installing 30 off-grid schemes (one micro-hydro, the rest solar hybrid) supplying 66 villages comprising 2,115 households, and ranging from single-village projects at around 100 kW to schemes of around 800 kW supplying a cluster of nine villages. The business model is for a 24-7 service on standard tariffs, government-funded capital expenditure and subsidy of operating expenditure, and operation and maintenance by the utility. Sarawak Energy finds that community-run schemes are not reliable, and sound business cases have not been able to be made for public–private partnerships.

Solar Social Enterprise and Sustainable Living and Learning Centre for Youth

Ms Salinee Tavaranan, BGET

Border Green Energy Team (BGET) has worked on off-grid village energy issues in the northwest of Thailand, close to the border with Myanmar for over 10 years. Here, around 50% of the rural population still does not have access to electricity and there are nine refugee camps. A 250 million USD government initiative in 2004 installed 200,000 solar home systems, but by 2010 80% were disused. A key cause was that the systems were installed, then left without any maintenance scheme or training of local people.

Since 2011 BGET has changed direction, focusing on sustainable business models (giving solar home systems (SHS) away does not work). Key factors in long-term project sustainability are strong community involvement, long-term financial support, reliable technology, trained locals, and impact evaluation. Villagers can buy the SHS outright or take a five-year contract on an annual fee that provides maintenance. Installation of SHS has eliminated use of kerosene lamps and flaming torches; candles continue to be used mainly for religious rites, and flashlights for outside use. Two hundred villages with a total of 37,000 people have been reached.

BGET has established the 'Grace Garden', providing education and vocational skills for orphans, refugees and children at risk, and with a focus on permaculture/sustainable agriculture, renewable energy and alternative technology.

Breakout Session on Key Uses and Needs for Energy in Southeast Asia

Workshop participants divided into four groups to discuss a series of questions on key uses and needs for energy in Southeast Asia. Key points made in their feedback to the plenary are summarised in the following paragraphs.

Group 1

? *How can we achieve an effective integration in Southeast Asian countries between initiatives for energy access and other strands of development?*

The energy system needs to be owned by the right people: those with the incentive to keep it going. If you have a need for the energy, then you will take the initiative to keep it going. This helps to build demand to get sustainability. It is important to identify these people.

It is necessary to look at the unique endowments of the village and find out what the villagers need: you need to spend time in the villages in order to understand.

Early successes are needed: model villages that others are motivated to follow – the 'snowball effect'. A pre-requisite is that the technology must be reliable.

? *How can the rate of progression through higher levels of energy access be increased, and 'lock-in' at lower levels be avoided?*

A key starting point is to look at the needs and desires of the community. Energy needs are dynamic – you cannot accurately predict them – and so you need to have flexibility in respect of expanding the energy supply. A modular system lends itself to this. Different technologies are more or less susceptible to lock-in: micro-hydro can be problematic. Communities may be concerned that they could be locked into off-grid technologies such as solar home systems and potentially miss out on a grid connection.

The first step on the energy ladder (the step-wise process to reach higher levels of energy services) needs to be done well: a bad experience at level 1 can hamper further progression. There is a need for financial models that can cater for progression through the levels.

Group 2

? *How should energy-access initiatives be constituted so as to enable the poorest families in Southeast Asia to escape the poverty trap?*

It is important to ask: What is the energy for? Energy-access issues can be physical (for example, difficult-to-reach communities, the physical set-up of the village, etc.), financial (the need to pay for it in order to value it, but consequent affordability problems), and social (is the community culturally ready for energy (a particular issue for nomadic people), and do they understand how to use it?).

Recurrent practical problems include overuse of energy, misuse of equipment (for example, using PV-system batteries on motor boats), and pilfering or sale of components, particularly batteries, and theft of electricity. Electricity uses are often not productive, and may be antisocial.

Ms Salinee Tavaranan of Border Green Energy Team

? *How can a focus on energy provision and use at a community level result in greater overall value than focusing on individual access?*

Energy access will change cultures so cultural issues need to be carefully considered in advance: What is the community about? What are its unique strengths? What are potential ways of engaging with the village? How can it develop productive enterprises, etc.?

While it is important to look at the needs and desires of the community, it should be recognised that needs are dynamic so energy systems should be flexible. It may be useful to set up a commercial enterprise to pull together the commercial community, perhaps extending over several villages.

Group 3

? *What are the distinctive energy needs of village-level education, healthcare, clean water and sanitation in Southeast Asian countries?*

Basic energy needs for lighting and cooking are universal across all countries. Above the minimum requirements, energy needs differ from community to community and may be quite specific. Differences within a single country may exceed international differences. A key determinant is the existing level of energy access in a given community: different villages have different starting points for new initiatives. Communities may be aware of their own needs and be trying to find solutions, or may need support in understanding and articulating their needs.

In countries with very low levels of rural energy provision, such as Cambodia, energy for cooking is currently a more important need than electricity for lighting because its use is unavoidable, and rural communities currently rely heavily on biomass for this purpose. Simple technologies that improve efficiency will have a big impact.

The distinctive needs of communities, including the variations in energy needs over the day or week, should be assessed at the planning stage: for example, for education a 24-hour supply may not be required. For sustainability, community investment, ownership and involvement are essential for village level-solutions (this is however not applicable to home-based systems). Similarly, sound economic considerations and strong business models are essential. Educated technicians, able to maintain and repair the hardware, are also needed to sustain any investments made.

Communication is considered a fundamental need, and after a natural disaster it is the first service that is reinstated, as it then facilitates the repair of other infrastructures and the arrival of other needed goods. Communication channels are also essential for running all types of businesses (from ordering goods to collecting payments, making contracts and arranging repairs).

? *What are the key challenges and opportunities for meeting those needs, and how do they vary across Southeast Asian countries?*

There is a need to identify which technology fits the needs of the target community, and to consider how those needs can best be met when only a few hours of electricity may be available during the day.

Affordability represents another challenge, since the community must be able to afford the energy provided. Since rural areas may have operated within a non-monetary economy before an intervention, the requirement for money to access energy and the further services and opportunities it provides can be an important barrier.

Government regulation often requires the price of electricity to be the same in rural and urban areas, which generally necessitates some level of cross-subsidisation as it is usually more costly to supply rural electricity than urban. Even so, this represents a challenge, since the purchasing power of rural inhabitants is generally much lower than that of city dwellers. However, since the development of rural economies is perceived to benefit the national economy and increase resilience to some crises (because rural areas are the site of food production, while cities cannot afford to be cut off from supplies), further cross-subsidies may be a way to overcome the economic disparity. But care must be taken in the design and implementation of any handouts and state subsidies.

Group 4

? *What are the distinctive energy needs to support productive enterprises and income generation in Southeast Asia?*

Productive enterprises made possible by access to electricity include food processing (e.g., cleaning rice, making cheese, milling maize etc.), woodworking (boats, furniture, window frames etc.), and welding and metalwork (stoves, security fencing etc.). New requirements also arise from the energy system itself, for example to maintain electrical equipment. The experience of Terrat in Tanzania is that villagers continue to identify new opportunities as they become more familiar with energy's potential.

Demand for IT training can also drive business opportunities on many local levels. For example, online programs offering software tutorials are often ineffective locally because of language differences. The same is true for agricultural and health information offered by national agencies. Translators who make such information and training materials locally relevant could serve their communities and earn a living too. Even in villages where many residents are illiterate, the demand could be met through DVDs, community video presentations and other creative approaches. How can we establish a 'positive spiral' where energy access generates income that can be used to progress up the energy/development ladder?

Education should begin with illiterate villagers, through oral demonstrations, video presentations, DVDs or audio devices. Then, building on that basis, initiatives should work to reach villagers at other levels including those who could be trained as skilled workers capable of running equipment or training others. Education should be tailored to address practical, local issues.

It is important to respect community values and to work closely with communities to learn what they want and fear, and to afford them some control. Technology can help to preserve and even revitalise local culture, for example by recording local music, tribal dances, cooking methods and farming techniques.

Local maintenance is crucial. Terrat set a priority on training local service providers so there would be no waiting for outside help when equipment broke down or connections failed. As far as possible, marry new and old technologies so that entrepreneurs can find familiar footing while they learn. For example, a new solar system can work in concert with an older diesel system.

Financial infrastructure will be essential, from the local level to higher government programmes. Its basic elements could include microloans, cooperatives and barter transactions. Funds and resources that come from the government and/or outside donors should be leveraged to maximise their value. Effective systems will be needed for assessing and collecting fees, for paying maintenance costs and for building savings to cover future replacements. It is important to think long term. The financial plan for replacing batteries should be in place long before they run out.

Day 1: Afternoon Session

Official Launch of the Smart Villages Initiative

The Smart Villages team, workshop participants and members of the media gathered in UNIMAS's auditorium for the official launch of the Smart Villages Initiative, which was led by a group comprising:

- Datuk Dr Ewon Ebin – Minister of Science, Technology and Innovation
- Datuk Haji Talib Zulpilip – Chairman of Sarawak Economic Development Corporation
- Tan Sri Dr Ahmad Tajuddin Ali – President, Academy of Sciences Malaysia
- Professor Sir Brian Heap – Chief Scientific Advisor to the Cambridge Malaysian Education and Development Trust
- Professor Dato' Mohamad Kadim Suaidi – Vice Chancellor, Universiti Malaysia Sarawak
- Tan Sri Datuk Ir Ahmad Zaidee Laidin – Chairman of the Organising Committee for the Kuching Workshop

Ahmad Tajuddin Ali, president of the Academy of Sciences Malaysia, opened the launch event with a welcome address that praised the work of the Smart Villages Initiative and expressed the academy's delight in spearheading socioeconomic development in off-grid areas in Southeast Asia. He reaffirmed the academy's stature as a thought leader with a strong record of rigorous activities in support of Malaysia's socioeconomic agenda, and indicated that the academy looks forward to building on the Smart Villages Initiative through engaging in more collaborative efforts with other science academies. He finished with a call for all ASEAN countries to share their experiences and efforts in addressing the needs of rural communities.

Sir Brian Heap, Chief Scientific Advisor to the Cambridge Malaysian Education and Development Trust and formerly President of the European Academies Science Advisory Council, praised Malaysia as a model for other countries due to the inclusive nature of its development. Malaysia's world-leading efforts, for example, in the areas of natural resource management,

Dignitaries at official launch with workshop participants

knowledge-based cluster formation, and innovative ICT-based rural development initiatives, were further highlighted. Sir Brian continued with an overview of the smart villages concept – the application of scientific knowledge for development with modern energy services as the entry point – and an explanation of how the Smart Villages team aims to learn from and disseminate lessons across regions through a series of six international workshops and follow-up activities.

Following an interactive multimedia presentation on the Smart Villages Initiative, Ewon Ebin, the Minister of Science, Technology and Innovation, congratulated the Smart Villages Initiative for undertaking an international and bottom-up study of modern energy services for off-grid villages and urged all ASEAN countries to proactively share their experiences and efforts.

The minister praised international research efforts that have enabled remote villages to have access to sustainable energy sources, such as micro-hydro, solar photovoltaic, wind turbines, hybrid systems, and the use of biomass from crop waste. Acknowledging that appropriate technologies are available, he stressed the importance of working to empower rural communities and improving their socioeconomic status through ensuring access to sustainable energy sources. To this end, the minister highlighted the activities that the Ministry of Science, Technology and Innovation has been undertaking to empower rural communities. This has included grants totalling 840 million MYR (233 million USD) to carry out more than 1,542 research and development projects, of which a significant proportion has focused on researching sustainable energy and elevating the economic status of rural communities.

The minister highlighted how Malaysia's own 'smart village' projects take an integrated approach that combines environmental and livelihood considerations through the use of environmentally friendly technology. Two flagship projects – the internationally renowned Rimbunan Kaseh project and Borneo's e-Bario Project – were highlighted as particularly exciting and important contributions from Malaysia towards achieving the Smart Villages vision.

Keynote Addresses

Following the opening ceremony, the workshop continued with two keynote addresses.

Micro-Grid Renewable Energy – Experiences towards Rural Electrification

Ir Mohd Azhar Abdul Rahman, TNB

Mohd Azhar Abdul Rahman's keynote address explored rural electrification from the perspective of Tenaga Nasional Berhad (TNB), which is responsible for the generation, transmission, distribution and retail sales of electricity in peninsular Malaysia and the state of Sabah.

Ir Rahman began by outlining the background of economic policy in Malaysia from 1957 until the present. There have been four discrete phases, with each subsequent phase displaying an increased understanding of the importance of rural development in Malaysia's overall economic policy. Most recently, in 2010 the Malaysian government initiated a Government Transformation Plan that seeks to improve the effectiveness of public service delivery. Among the seven pillars of the plan, three are directly related to the welfare of rural communities: improving rural basic infrastructure, improving the standard of living for low-income households and increasing access to quality education. Rural electrification forms a central part of the government's plan to improve rural basic infrastructure. This is reflected by the electrification of at least 140,000 additional households since the

initiation of the Government Transformation Plan.

There are four typical modes of rural electrification in Malaysia. The first is grid extension, which is considered by utilities such as TNB to be the best and generally most economical when amortised over 15 to 20 years. In very remote areas, where grid extension is not feasible, the second mode is a stand-alone diesel genset. This option, however, results in a high cost for the utility as the full cost of electricity cannot be passed on to end users because of legislation. In extremely remote areas where not even a diesel genset can be deployed, the third mode of rural electrification has been the provision of solar home systems. These have been distributed for free by the government to end users and are seen as a stopgap solution. A fourth mode – the use of hybrid, mini-hydro or biogas energy systems – has seen increasing deployment in recent years in cases where grid extension is not feasible.

Ir Rahman continued by providing a case study of TNB's deployment of a solar–diesel hybrid system in the remote Kemar, in the Grik area of the state of Perak. Commissioned by the Ministry of Rural and Regional Development as part of the Rural Electrification Project for indigenous settlements in October 2010 and finished in November 2012, the system consists of a 850 kWp photovoltaic array, a 850 kVA inverter, a 4,500 kWh battery and four diesel gensets (2 at 450 kW and 2 at 350kW). The system was judged to be the most efficient solution to provide 24 hours of continuous electricity supply to 5,000 local residents, as well as health clinics, houses of worship, police stations and a kindergarten.

Stressing the importance of rural electrification, Ir Rahman closed his keynote address by stating some of the benefits of rural electrification. At the country and state levels, these include stimulating private entrepreneurship and investment, technology transfer to local manufacturers, and the creation of permanent and temporary jobs. At the rural community level, benefits include economic development, the provision of basic needs, an improvement in quality of life, and reduced rural–urban inequality.

Socioeconomic Impact of Access to Energy in Remote Communities

Professor Dato' Dr Kamaruzzaman Sopian, *SERI*

The second keynote address of the afternoon was delivered by Kamaruzzaman Sopian of Solar Energy Research Institute (SERI) National University of Malaysia, and focused on the socioeconomic impact that access to energy can have in remote communities. Professor Sopian set the scene by listing four main problems found in many rural communities: rural–urban migration, the abandonment of villages, a lack of rural income-generation opportunities, and a lack of good quality education. Access to modern energy services can help solve each of the four problems. The problem of rural–urban migration could, for example, be solved through the creation of sustainable townships. Abandoned villages would become regenerative villages. Rural income-generation opportunities would arise. Higher quality education would become available through, for example, improved ICT connectivity due to access to modern energy services.

Two examples of how access to energy can transform remote communities were given. The first example focused on a pico-hydro system in Kampung Tuel Kelantan. Pico-hydro systems generating up to 2 kW are viable even on small streams, and are able to provide up to 100 households with enough power for lighting and radios at relatively little cost.

The second example focused on the potential of solar drying to improve the incomes that

rural communities receive on a variety of agricultural products (for example, tobacco, tea, bananas, anchovies, rubber and seaweed). Traditional drying systems tend to involve the use of diesel gensets, take a relatively long time (for example, in the case of seaweed, between 10 and 14 days), and to result in a low-quality product that limits its sale into external value chains. Photovoltaic thermal collector technology, however, presents a transformative opportunity for many rural communities. Benefits include reduced time and cost (for example, for diesel fuel) in the drying process, a higher-quality product, and the opportunity to differentiate through marketing products as 'solar dried'. These benefits outweigh the capital cost with payback periods estimated to range between two and five years, depending on whether the solar dryer is forced or free convection.

Citing a case study in Cambodia where solar dryers were promoted to a community that dried and sold fish, Professor Sopian finished by providing an illustrative example of the complexities and nuances that shape the acceptance of new energy technologies. Under the traditional process of drying fish, fungi develop on the dried fish. Although suboptimal in terms of quality, the local community preferred the smell and taste of dried fish with the fungus present than the more hygienic and higher-quality fish dried with the solar dryer, where no fungus was allowed to develop.

> *"The project is not just concerned with technologies but also how we can help people to realise the potentials of introducing these technologies to society and how to make it more attractive to people.*
>
> — Professor Sir Brian Heap
> Smart Villages

> *"Today, the Malaysian smart village has expanded its concept to that of smarter management of the ecosystem.*
>
> — Datuk Dr Ewon Ebin
> Minister of Science
> Technology & Innovation

Day 2: Morning Session

Entrepreneurial Case Study 'Elevator Pitches'

Twelve short presentations were made, each summarising experiences of implementing village-level energy services and highlighting technologies used, delivery/implementation methods, acceptance rates and outcomes.

Hybrid Solutions/Rural Electrification

Ir Abang Hatta bin Abang Taha, Gabungan Binaan Jurutenaga Sdn Bhd

Abang Hatta bin Abang Taha summarised the experience of implementing a contract from the Ministry of Education to electrify 62 remote rural schools in the Kapit Division of Sarawak. While design for the project was straightforward, transport of materials and supplies was more problematic and incurred a high cost since it had to rely on long boats and on four-wheel-drive vehicles on logging roads. While the electrification project was successful, the positive impact of the project was reduced by the poor state of the school buildings. Fit-for-purpose buildings are required.

Another project, funded by the Ministry of Rural and Regional Development, concerned the electrification of rural villages and longhouses via extension of the Sarawak Energy Berhad (SEB) grid. Technical problems were easily resolved but occasionally projects had to be abandoned due to unresolved issues with the villagers, mostly pertaining to land ownership and the required clearing of land needed. Ir Abang recommended: 'Be ready with cash, a simple written agreement and a chainsaw. Once agreed, pay in cash, sign the agreement and chop the trees'.

SWEPA and Barefoot College

Ms Hanaa Wong Abdullah, SWEPA

Barefoot College aims to empower women who are over 40 years old, illiterate and live in an isolated community. The project, supported by Sabah Women Entrepreneurs and Professionals Association (SWEPA) with additional funding from a number of national and international organisations, provided for a grandmother living in a community of 100 households in Sabah to attend a six-month fellowship

Ir Lalchand Gulabrai shares his views.

at India's Barefoot College, where women are trained in the basic set up and maintenance of solar panel systems. Afterwards, they return to their communities and begin to sell the technology and extend the network by including other women in the scheme.

Challenges for the sustainability of the project include establishing a functional collection system for funds from the community and dealing with fluctuations in the international currency market that affect the price of solar panel systems. The aim is to empower the community as well as the women.

Micro-Hydro Project for Rural Electrification

Mr Mohd Fauzi Ismail, SIRIM Berhad

The majority of Malaysia's population has 24-hour access to electricity, although the level of electrification is higher on the mainland compared to the provinces of Borneo. People in rural and remote regions are acquiring improved access to energy in three ways: using isolated devices and systems for power generation, heating and cooking at the household level; through community-level mini-grid systems; and through grid-based electrification. Poor road connections make the costs of grid extension prohibitively expensive, and similarly diesel-based electricity generation is costly in the long run since diesel needs to be transported. For these reasons renewable energy sources are a cost-effective option for rural electrification of Sabah and Sarawak. However, challenges include.

- Scarcity of skilled labour for the smooth running of micro-grids.
- Acquiring unregistered land on which to build the projects.
- Transportation issues involved in construction on remote sites with no road connectivity.
- High capital costs, discouraging private parties from owning a micro-grid.

SIRIM has established micro-hydro systems in three locations (Sarawak, Pahang and Sabah). Mr Ismail concluded that renewable energy, particularly micro-hydro, will continue to play an important role in rural electrification in Sabah and Sarawak.

Long Pasia Solar-Hydro Scenario

Professor Hew Wooi Ping, UMPEDAC

Long Pasia is a community of about 80 households located in Sabah, reached from Kota Kinabalu after an eight-hour road journey (the last five hours on logging tracks). University of Malaya (UMPEDAC) established a collaborative project with Lightup Borneo (an NGO) to assess the potential of hybrid solar and hydro solutions to improve energy access. Inspection of existing solar home systems (distributed on at least two separate occasions as part of previous government projects since 1997) revealed many problems. These included poorly maintained systems, such as solar panels shaded by trees, covered in dust or broken; damaged and mixed types of batteries; missing charge controllers (leading to direct charging from solar panels); and incorrect wiring of the solar systems. In addition, the frequent cloud cover, especially during the rainy season, meant that the potential for generating solar electricity is low in the area.

Recommendations regarding the solar home systems include the introduction of LED light bulbs, ensuring proper installation and repair of the systems, and preventing the misuse of batteries (undercharging/overcharging). Educational workshops for the community on basic maintenance and wiring of the systems are essential for the sustainability of the project. In addition, the project recommended the introduction of a hydro system using floating hydro-generators to complement solar energy in the region.

Kopernik – Serving the Last Mile

Ms Citra Savitri, Kopernik

Kopernik aims to provide 'last-mile' communities with simple but high-impact technologies: solar lighting systems, water filters and energy-efficient cook stoves that reduce fuel consumption by 80% and generate almost no smoke. The organisation operates by establishing the communities' technology requirements (in consultation with the target communities) and then by raising the funds required for the up-front deployment costs by crowdsourcing via their website. The technology is then distributed via local partners and sold to the communities. Profits are reinvested in the initiative.

For its 'Light up The Philippines' project, Kopernik partnered with the Gelacio I. Yason Foundation – Family Farm School to distribute 400 light units to families on Oriental Mindoro Island, where 80% of households lack electricity. The revenue from the sales will be used to purchase more lights. Impact studies have revealed that 82% of respondents used the lights every day, as a night light, during brownouts and for studying.

Lighting up Off-Grid Rural Communities with Sustainable and Renewable Micro-Hydro Energy

Mr Chen Tzy Wen, Lightup Borneo

Lightup Borneo is a civil society organisation focusing on the delivery of small-scale simple hydro generators of two types: gravity-fed micro-hydro turbine generators and river-powered floating hydro generators. The components of the systems are simple and inexpensive, and the systems are also easy to maintain. The organisation works through the contribution of time and resources from volunteers, and it works in close collaboration with the beneficiary communities.

Sunlabob Renewable Energy

Mr Benoit Dubeau, Sunlabob

Sunlabob Renewable Energy is a commercial company registered in Lao People's Democratic Republic, founded in 2000 for the direct sale of basic solar home systems. Despite early success, the company changed strategy to increase the long-term sustainability of their operations and began exploring different business models. These include:

- Community-based operational models promoting local training and capacity building for the creation of local micro-entrepreneurs (rural franchise agents) and community energy enterprises.
- 'Fee-for-service' business models: rural customers pay for electricity, but not for the infrastructure. This is based on the utility model – sales revenue pays for operation and management – and has been expanded to other products, including solar lantern charging stations, solar and hydro village mini-grids, and water purification systems.

Currently Sunlabob operates in more than 24 countries in ASEAN, the Pacific islands, Africa, and India, generally via competitive tenders. It ensures the long life of its products by pairing high-quality technology with local training and capacity building.

Solar Pumping Solutions

Mr Ben Frederick, MES

Myanmar Eco Solutions (MES) is a Myanmar company providing key state-of the-art solutions for water management and renewable energy production. The team's established local experience and know-how is backed by its exclusive relationship with

Ms Citra Savitri of Kopernik

leading international partners: Moroni & Partners, with very extensive technical experience in renewable energy worldwide; Myanmar Strategic Holdings as the financial partner; and the German solar pump manufacturer Lorentz as the company's sales and service partner.

MES has experience in the installation of solar panels and is currently focusing on solar pumps to increase the availability of water for agricultural production. Solar-powered water pumps pay back in around two to three years and reduce CO2 emissions by about four tonnes each year compared to diesel-powered systems. For increased sustainability, MES provides training to members of the community for basic maintenance and operation, and takes charge of larger repairs. MES also works with local NGOs to promote the development of community water committees and to assist with the collection of fees and management of the pumps. After the payback period revolving funds will be used to scale up.

Ibu Inspirasi – Wonder Women Indonesia

Ms Citra Savitri, Kopernik

Clean energy technologies exist to address three serious problems affecting a large number of rural households: lack of electricity, clean energy for cooking and clean drinking water. Ibu Inspirasi is a Kopernik initiative working with women in Indonesia to make these technologies available.

Indonesia faces particular problems related to the geographical characteristics of the country: it is composed of 17,000 islands. Two thousand of these are served by the project, with suppliers in West and East Java, a consolidation hub in Surabaya and the Kopernik warehouse in Kupang. Transport logistics and costs are major challenges. The equipment is distributed by consolidated shipment to Kupang or Larantuka in East Flores, then by boats to smaller islands, subsequently by road to the project's partners, and then by women representatives to their communities for sale.

Ibu Inspirasi trains local women to sell the equipment, teaches them basic bookkeeping and business skills, and supports them as energy equipment representatives. Three hundred women have benefitted from the scheme, and in the next three years 500 more women will be trained. They are empowered at three levels: as individuals (higher income, new skills and increased self-esteem), in the family (through their financial contribution and asset ownership, and more say in decision making), and in the community (through higher levels of participation and influence on other women).

Corporate Social Responsibility Project, Philippines

Mr Don Mario Y. Dia, SACASOL

San Carlos Solar Energy, Philippines (SACASOL) received 100,000 USD for a corporate social responsibility project sponsored by the Thomas Lloyd Company. SACASOL decided to focus on an education project to provide an off-grid community school with energy and with donated lighting and computers. The pilot project site was chosen with two criteria: it needed to be accessible by road and in a region with no short- or mid-term plans to extend the grid to the area.

Out of five sites considered, Camaniangan Elementary School in San Carlos City, Negros, was selected. Children walk for up to an hour to reach the school, and in the rainy season the road may be impassable due to heavy rains. There is little light indoors, especially during the rainy season. The project commenced in 2012 and was completed in 2014. Solar panels with 600W capacity (donated by Conergy) were mounted on the ground next to a computer lab and a charging room for family phones and donated solar lamps. Depending on available funds, other schools may be electrified in a similar manner. Addressing a question of why LED lights had not been used in the project, the speaker explained the project used donated technology.

Hydropower Technology Development in Indonesia

Mr Gerhard Fischer, Hycom

Gerhard Fischer discussed how hydro-electric technology can be successfully and sustainably transferred using the example of developing hydropower plants up to 200kW in Indonesia. First of all, a bottom-up approach for building capacity in the private sector requires sustained investment for impact. Key elements for success include: a focus on market-driven interventions, strong training and capacity-building components, and the experience provided by the implementation of real projects.

In order for projects to be competitive against subsidised grid energy supplies, it is important to consider not only the energy potential of a project but also the price of that energy. This requires good alignment with the current energy policy of the country. Since the projects need to generate income, policies that make hydropower attractive and provide a predictable future are essential. But, in reality, many projects fail.

The German Federal Enterprise for International Cooperation (GIZ) has supported a number of technology transfer projects in several fields: turbines, development and installation of civil structures, development of control technologies, technologies for productive uses, and institutional aspects. Standardisation and quality control are essential to lower costs, and also for the production and distribution of spare parts. Hycom has designed and installed 400 power plants over the last 10 years in Indonesia and a number of other countries.

The ASEAN HYCOM, a regional hydropower competence centre, provides training and research support to the small-scale hydropower sector. Located in Bandung, an area with long-term experience in the sector, it is operated by PT ENTEC Indonesia and the Technical Education Development Centre (TEDC).

Funding is provided by the Swiss government, the ASEAN-German Mini Hydro Project (AGMHP) and the ASEAN Centre for Energy (ACE). HYCOM offers modules on several subjects aiming to deliver in-depth knowledge as well as holding practical training courses in many different countries.

Research and Development Projects for Rural Community Development in Sarawak – Issues and Challenges

Dr Hushairi Hj Zen, UNIMAS

There are two energy-related groups in UNIMAS: the Centre of Excellence for Renewable Energy and the Institute of Social Informatics and Technology Innovations Energy Group.

The groups have reviewed the challenges encountered during the implementation of hydropower and solar energy projects, and produced a list of recommendations to overcome these. Shared challenges for both types of power sources include: lack of skilled and semi-skilled labour in the villages during project implementation and for system maintenance; land ownership issues; lack of control over energy consumption; logistics challenges and transport costs of materials (related to the poor accessibility of many project sites); lack of documentation on governance and policy specifically for small hydro projects; and community issues (governance and long-term support). A strong capacity-building component is therefore essential, as is the development of guidelines and standard operating procedures for running and maintaining the systems. Also critical is the presence in the community of a local champion.

Plenary Discussion of Case Studies

A key theme in the case studies presented is the provision of light ('let there be light') to rural communities, which is driven by humanitarian and profit motives, and by corporate social responsibility initiatives. A key challenge is the difficulty in recruiting qualified personnel for projects, which affects 80% of entrepreneurs, highlighting the need to increase human capacity in the region.

The discrepancy in the statistics presented in the different case studies on the number of people in the Malaysian Sabah and Sarawak provinces

Dr Gratian Bamwenda contributes a Tanzanian viewpoint

lacking access to electricity was noted. Variability in the data arises from failure to regularly update information, for example after initially successful projects fail. The importance of the development of good metrics to inform policy was highlighted. A determined effort is needed to compile the data required (such as number of people without access to electricity and the number of start-ups and their success rate) and to develop comparative data with the rest of the world.

Private sector involvement in rural energy provision is important, but in India there is still a scarcity of companies selling improved cook stoves despite various initiatives on the ground, largely led by NGOs. New ways need to be found to increase the policy profile of the sector and to improve prospects of financing. Major corporate organisations may provide increased opportunities to fund rural energy-provision schemes (through their CSR budgets) and could also contribute expertise and well-established distribution networks. A participant also pointed to problems in introducing a business plan in a previously not-for-profit initiative so as to improve the long-term sustainability of projects, and discussed issues related to staff difficulties in switching modes of operation.

The current reduction in oil prices was cited as an additional barrier to deployment of renewable energy resources. This was considered to be largely a policy issue, and since natural resources are finite, a long-term strategy for energy provision is required. For example, in Norway investments in renewables increase during times of cheap oil prices.

Conducive policies for village energy provision were also cited as essential in the context of Malaysia, where currently regulations are perceived to act as a barrier, for example, by preventing communities from owning their electricity systems. Clear and supportive regulations, and tax incentives (that allow start-up companies to survive), rather than long-term subsidies, are needed. Business models need to be developed to be scalable.

The importance of linking academic experts to projects on the ground (run by NGO and private sector practitioners) was discussed, including how the Smart Villages project may leverage the involvement of science academies and university networks, and improve linkages between stakeholders.

With respect to energy technology options, PV is a good choice for off-grid applications as there are few ongoing costs, and alongside micro-hydro it provides the best solution for small and remote communities, sometimes in combination. Wind energy has more limited application in the tropics (although may be more feasible in the islands). A few wind turbine projects have been funded in Malaysia, including in north Sabah whether there are strong winds, and there may be further applications of the technology in the Malaysian highlands. Wind and solar can be a good combination. Smart micro-grids can work well. Biomass can be gasified, for example powering a 50 kW system for electricity for a village. Fuel cells can be used for storage and solar systems based on hydrogen, and they are currently used for telecommunications towers in Indonesia. Ocean thermal energy may be a possibility in two decades but not for small-scale applications.

Day 2: Afternoon Session

Keynote Addresses

Hydropower Development in Sarawak – Opportunities and Challenges

Dr Chen Shiun, SEB

Chen Shiun of Sarawak Energy Berhad (SEB) introduced the Sarawak Corridor of Renewable Energy (SCORE) project on off-grid energy. He commented on the premise that energy use is correlated with GDP per capita and that developed countries have all exploited energy to drive their economy. Hydropower was first identified as a resource in Malaysia in 1962 and over 50 sites and more than 20,000MW of potential capacity have been identified. To date, only three sites and approximately 17% of that capacity, 3,438MW have been exploited. Batang Ai Hydro, with 94MW installed capacity, was commissioned in 1986; Bakun Hydro has 2,400MW installed capacity and began in 2011; and Murum Hydro will begin operating in 2015 with an installed capacity of 944MW. There is a potential for 11 more sites in Sarawak. Social and environmental impact assessments are underway for these sites, emphasising the need for environmental conservation, social protection and development of the most economic energy sources.

While there is often criticism of hydropower reservoirs taking land, the combined area covered by the three plants is 1% of the land area of Sarawak, and the additional plants if all commissioned would take another 1%. The recognised advantages of hydropower are that it is renewable/green, has security and flexibility, and promises sustainability and a long life of 100 or more years. Where villages are displaced they must reach 100% community consent and are given compensation in the form of buildings, energy and water provision, and schooling, including transport and adult literacy classes, all provided by the government. Hydropower provides a platform for the government to lift people out of poverty. Three acres of land for a longhouse and 27 acres for cash crops are made available in each case, and fisheries are developed.

There is recognition of the need to learn from experiences and apply these lessons to new projects. As the hydropower capacity is being developed, Sarawak Energy is also using its coal and gas resources to cover the next six to seven years of demand. There is a transmission grid across Sarawak to link all the projects, but many communities are remote from the main grid. Unlike more road-based communities, access is via rivers, which makes extension of the transmission lines to them more challenging. Social development indicators are often low in remote communities: very low income levels, less than 600 USD/year for many families; low life expectancy of only 40+ years; low literacy rates of <20% formal education; and high incidence of child malnutrition. Energy development, he concluded, is a tried and tested strategy in empowering communities to strive for economic independence.

Best Practices and Design Principles for Village Energy-Access Programmes

Professor Benjamin K. Sovacool, Centre for Energy Technologies, AU-Herning

Benjamin Sovacool's presentation (via Skype from Denmark) reported the findings of a one million USD research project that involved 10 case studies of small-scale projects, 6 of which were deemed successes and 4 of which were deemed failures. The work involved assessment of 90 separate facilities and input from over 800 community members. It was therefore a large-scale date collection

project, and used a mixed-methods approach and a socio-technical systems model. The work was based on the principles of SE4All's goals of energy access, renewable energy and energy efficiency, but there is a need to start with energy access before the other goals can be achieved. The approach recognised that there is a progression through different kinds of productive energy access, from meeting basic needs (level 1), through productive uses (level 2), to modern energy uses (level 3).

Professor Sovacool suggested that it is unjust for us to be looking at level 3 access when so many people are trapped in level 1: around the globe, 1.4 billion people currently lack access to electricity and 2.6 billion people still rely on solid biomass as their main energy source. Lack of energy access is also a significant health issue, as wood is the fuel that burns four times – the cooking fire itself, then burning injuries are common, then the fever caused by respiratory disease from exposure to poor indoor air quality, and finally the contribution to climate change. Four million deaths per year are caused by the way we use energy, making it a significant public health issue.

There are four key findings from the research. Finding 1: in terms of an optimal technological portfolio, each country is unique. Finding 2: policy mechanisms or business models can be just as important as technology. Finding 3: best practices or design principles include focusing on net beneficial energy access; selecting appropriate technology and scale; prioritising community commitment; raising awareness; providing after-sales service; emphasising income generation; encouraging institutional diversity; focusing on affordability; building capacity; being flexible; always evaluating and monitoring; and finding or building stakeholder support. Finding 4: a 'third path' has emerged, a new 'sustainable programme' paradigm of energy access that is different from both the previous donor gift model of the 1970s and 1980s and the market-creation model of the 1990s and 2000s.

Entrepreneurship as a Vehicle to Encourage Grassroots Innovation

Professor Howard Alper, Chair of the Government of Canada's Science, Technology and Innovation Council

Reflecting on the important role played by energy entrepreneurs in the smart villages concept, Howard Alper talked about the specific characteristics of entrepreneurs and indicated that entrepreneurial activity requires: a possibility, initiated by new ways of thinking; an emphasis on usability, developed through approaches to learning; and transferability, turning knowledge into action. Entrepreneurship, he said, was whatever made this happen.

He emphasised the many positive characteristics of entrepreneurs, including their drive and hardworking nature, but cautioned that there is a 'dark side' for entrepreneurs who often suffer from confrontations with risk, stress and ego. Risk may be in terms of financial risk, career risk, family and social risk, and psychic risk. Sources of stress may be loneliness, immersion in business, people problems and a need to achieve. Ego may take the form of an overbearing need for control resulting in a sense of distrust, an overriding desire for success and unrealistic optimism.

There is an essential role for creativity: even when technologies are well known their application can be novel. Innovation can be encouraged but financial support is important; there is direct support in many countries that can help develop technology innovation companies. If successful, entrepreneurial firms can have a positive impact in terms of renewing market economies and developing the mechanisms by which people can enter the economic and social mainstream.

Where possible, 'gazelles' – business establishments with at least 20% sales growth every year (for five years), starting with a base of at least 100,000 USD – should be encouraged as they can produce leaders in innovation and twice the

product innovations per employee compared to larger firms. Professor Alper concluded by highlighting two examples he identified from the Arusha workshop report, namely Joshua Kabugo of Embark Energy and Jodie Wu of Global Cycle Solutions, both of Tanzania. He also suggested that the key messages from the workshop report are the need for indirect support from governments and the need for other investors of capital.

Panel Session 3 – Parallel Sessions

In a set of parallel sessions, three topics were discussed by a diverse group of participants. The following paragraphs summarise the key points that arose.

1. Cultural Acceptability

The first group looked at cultural acceptability and had three initial presentations.

Kara Bennett of the Border Green Energy Team (BGET) described the Grace Garden project in Thailand, which broke ground in 2012. It is a vocational and educational centre teaching English language and entrepreneurial skills. The focus is on marginalised youths on the border of Thailand and Myanmar after the area was flooded with 40,000 refugees from Myanmar. Their particular issues are being undocumented and vulnerable to human trafficking, and having no access to education. An important factor in the success of the project has been not giving anything away for free but leading by example, and using the technology themselves. Their strategy is demonstrating the technologies publicly and day to day, so that people can see for themselves.

The site is well located, on the edge of the jungle: villagers walk through the garden to get to the jungle, where they forage every day. Ms Bennett described the way they use the technology to create a permanent physical presence in the community where they live. This allows them to build credibility so that they can go on to other activities. They strive to live what they preach and to live sustainably. They hire locally to ensure continuity. Training involves both theory and hands-on practice: they have trained 16 participants in the spring and will hold further training courses this year. They have expanded their activities, including introducing new chickens; promoting agriculture via composting having installed composting pigpens and toilets; using solar energy and solar cooking; and, sustainably

Ms Kara Bennett of BGET

building the learning centre out of adobe. They anticipate installing another three to five water filter systems this year, and in the future they want to introduce more renewable energy technologies, especially wind and solar.

Citra Savitri and her colleague Norberta Nogo who became an Ibu Inspirasi agent for Kopernik talked together about their project to train women in the community. They focus on water and technology, but also, importantly, on being a change agent, with women becoming income generators. Water is an important part of villagers' lives. They often use well water that has to be purified by boiling to make it drinkable. This uses kerosene, which is very expensive. After clean water, the next priority is a biomass cook stove. Most villagers are farmers and would like to use agricultural waste as fuel for cook stoves.

June Ngo Siok Kheng of UNIMAS described a basket-weaving project using traditional skills to produce high-end products that are sold outside the villages. The project is located in the village of Long Lamai, which is very rich in terms of traditional culture but poor otherwise. So the handicraft project, undertaken jointly by villagers and the university, is crucial. The aim of the project was to gauge the interest of the Long Lamai artisans to experiment with new materials and produce new contemporary rattan products. Artisans were very keen to work together and try new high-end handicrafts. Thirty new participants came to a second workshop, which was seen as a big success.

The new products use metallic threads but pricing is a problem because of transport costs, given the remoteness of the village. Now the issue is how to make new products with local materials, such as combining rattan and bamboo. A collaboration with Tanoti Sdn Bhd, a local handicraft retailer and social enterprise based in Kuching, has been well received because the company's marketing and supply-chain expertise brings income to the community by promoting and selling to Europe, including France and Germany, as well as in Kuala Lumpur. Long Lamai is now marketed as a 'Basketry Paradise'. The hope is to encourage the Penan artisans to stay in the village rather than move to the cities. If the project is successful, it will reduce urban migration of young people from rural areas. Even the men are now interested in participating so that they can take part in the economic activity. As a unique contribution, for example, they are proposing sourcing higher-quality raw materials (rattan) from the rainforest. Since one particularly prized area for rattan is three hours away from the village, the contribution that the men can make in carrying out the journey is useful.

In the ensuing discussion, participants considered the key cultural issues in respect of the adoption and best use of energy technologies. It was found that issues relating to gender are particularly important in Southeast Asian countries. A key concern is that women often are not mobile and may have to deal with unsupportive husbands, who may spend their money on cigarettes and alcohol. Also, in the absence of cooperatives, the women cannot really work with new technologies, they need organisational or social help. Even though women get shunted aside when outsiders come, they tend to understand the importance of productive energy uses better than men. While established cultural norms can be a barrier they can also sometimes be an aid. If the technology agents speak the local language and can show women how the technologies work, such as water filters or solar panels, then women can build up the necessary knowledge and vocabulary for the new technologies. In these cases the technology agents become advocates for the products.

Participants discussed what needs to be done differently in future initiatives on village-level energy access for development. It was concluded that political willingness is crucial, that is, going through the leaders, but the community needs to

Mr Nazeri Abdul Rahman of UNIMAS

think as a whole so that new technology gets the support of the whole community.

2. Biomass and Biogas

The second group looked at biomass and biogas and also had three speakers to introduce the topics.

Tan Chong of UNIMAS talked about 'Objective Orientated Power Supply for Rural Application' (the OOPS project) using a case study of lighting and ICT provision. One of the project sites is the Long Puah electrification project, a longhouse beyond a one-hour boat ride, so difficult to reach. Professor Chong asked whether we are trying to supply too much power and should be more focussed on key needs and priorities. It is growing harder and harder to meet ever-increasing demands for power.

Common energy sources include diesel power generators, micro/pico-hydro systems, wind turbines and solar power. The common problems of power provision in rural areas are that it is logistically challenging, has high recurring material supply costs, there are limited suitable locations for hydro and wind, and schemes usually cannot provide enough power. With the availability of power in a village, more and more power is needed as more home appliances are adopted. There are misconceptions that renewable energy is 'free'. The problems snowball with rural–rural migration: if you have several villages in a given area, villagers will migrate to those with power, which is a big problem because the system wasn't designed to serve the additional people.

Commonly accepted solutions include upgrading the power system to higher capacity, but that is challenging and costly. So, as the demand and supply gap gets larger, frequent blackouts occur due to system overload. The OOPS project is taking a different approach. Rather than trying to generate more power, the project has focused on reducing system dependency. It promotes system modularity to create smaller modules, providing more flexibility to meet evolving needs. Another focus is enabling greater portability. Most off-grid power solutions are not permanent; one day the grid will connect to the village and the system can then be moved to a place that needs it more. Other concerns of the project include enhancing local sustainability, promoting energy efficiency and prioritising local needs.

Nazeri Abdul Rahman of UNIMAS described a project on 'Pelletisation of Musa Acuinata Balbisiana', to turn banana waste on small-scale plantations in Sarawak into fuel. The electricity generated by renewable energy will never run out if sustainable sources are utilised. Bananas are everywhere in developing countries, and they are readily available in the villages. The project involved working with two types of bananas that are grown widely in the region. Agricultural areas have increased rapidly in the region and the amount of biomass waste has increased accordingly. The research looked at the effectiveness of using different waste parts including leaves, tree trunk, and peel: all parts of the banana plant that are typically thrown away but which could be used to produce pellets. The objectives of the project were to identify and estimate the amount of suitable wastes from small-scale banana plantations, create pellets from the waste, and analyse the effectiveness of the process by comparing it with wood and other fuel sources.

The project focused on two Sarawak villages, beginning with a questionnaire asking residents for personal and planting information, estimates of biomass wastes and other relevant data. Wastes were evaluated before and during harvest. It was found that there were substantial quantities of waste before and after harvesting, and that most was left to decay on site. Once made, the pellets were tested on a range of significant qualities including bulk and pellet density, amount of fines, moisture content and calorific value. Along with those measures, they were compared to wood, palm oil pellets and sago waste. The banana waste pellets were not as dense as wood, but bulk density was comparable. They compared favourably to wood on other measures. They were also quite similar on several measures to pellets made from oil palm and sago waste. The pellet structure was good, especially for the 6 mm pellets.

Mr Rahman noted that the biggest problem is with the moisture content of the banana pellets, making them less effective and suggesting that more drying time was needed. Other findings included a potential for the ash to be used as fertilizer. He concluded that banana wastes can be utilised as raw material for pelletisation that would be suitable for commercialisation as well as use at a household and village level. The process can readily be undertaken at a village level where the pellets can be stored and used as fuel for cooking and burned like wood. The density could be improved with higher pressure and temperature during processing. The next steps are to analyse costs and best methods.

Zainal Alauddin of Universiti Malaysia Sabah (UMS) described rural electrification projects using biogas from biomass at scales from 5–20 kW (enough to supply a small village) up to 200 kW. The projects facilitated the development of skills in the villages to run the plants. There are a lot of technologies that could be used, and the choice depends on the situation in the village. Plantations have a lot of waste that can be used, but the palm oil industry would like to charge for frond waste. Biomass gasification is the thermochemical conversion of biomass into combustible gas that can be used to run an engine.

Dr Alauddin's bioenergy lab has conducted research on various types of gasifiers and a range of biomass, including coconut hulls, corncobs and other wastes. The savings that can be achieved by utilising biomass depend on the type of energy used by a village: one rule of thumb is that a village relying on diesel could save 60 to 100% if it switched to gas engines running on biofuel. Under various proposals, villages could use combinations of biogas and diesel depending on needs and past energy sources. Villages would need at least one skilled operator to run the biomass system and one to maintain it. Other non-skilled labour would also be involved for tasks like collecting the biomass.

Dr Gerhard Fischer listens to a group discussion

3. System Optimisation

The third group discussed system optimisation around techno-economic analysis. They concluded that it is necessary to determine the needs of the users and from there determine the appropriate technology to use. They also discussed the hub-and-spoke model and indirect effects.

The group considered how thinking about system design needs to be modified for remote, off-grid applications in Southeast Asia and concluded that there is a case for off-grid schemes for smaller, more remote communities and grid connection for larger, less remote ones. There is a danger of always backing a winning solution such as PV hybrid: instead, there is a need to look at the village situation, geographic conditions and endowments, and to customise the solution to fit the specific energy load needed. The value of socioeconomic analysis must be stressed.

In answer to a question on what key developments are needed and what might be their impact if they can successfully be delivered, the group concluded that it is important to determine exactly what the villagers want. This needs to be decided first and then the technical solution can follow. In terms of a development agenda there needs to be a balance between basic and productive needs. The hub-and-spoke model may be appropriate in some cases. It is important to avoid lock-in and a modular approach can help. It is necessary to recognise that the rural rich and the rural poor have very different load demands.

In order to support sustainable development, electricity access must lead to economic advances. If there is economic activity then the energy system can be self-sustaining. There are different models for different circumstances, for example cooperatives and utilities. Financing and payment models must be sensitive to the situation and able to deal with the initial transition period (typically, the first few years).

Day 3: Morning Session

Panel Session 4: Other Perspectives on Off-Grid Energy in Southeast Asia

Policy Instruments in Facilitating Renewable Energy Off-Grid Investment

Dr Liu Xiying, ESI, NUS

Liu Xiying described a research project underway at the Energy Studies Institute, National University of Singapore (ESI) to evaluate policy instruments intended to facilitate renewable energy off-grid investment in ASEAN. Provisional findings from the literature review undertaken to date are that: government support is crucial and should use diverse instruments; more financial support is needed from outside foundations and donors, and industry needs to be more engaged; and community funding should always be included in financial plans for projects.

A key next step in the project is an expert survey that will focus on the major challenges and risks faced by off-grid energy projects, and that will help establish a policy instrument assessment index to evaluate the effectiveness of policy instruments in addressing those challenges and risks. The index will consider both supply and demand sides, and score instruments according to their feasibility, sustainability and replication. Dr Xiying invited workshop participants to complete the survey.

eHomemakers and NGO Perspectives on Off-Grid Energy

Ms Chong Sheau Ching, eHomemakers & MENGO

eHomemakers is a community network in South East Asia promoting working from home, teleworking and the running of businesses through the use of information and communications technologies. The initiative promotes self-help, business partnerships and entrepreneurship, particularly for remote communities in Malaysia. Energy access is a key enabler.

Chong Sheau Ching from Malaysian Environmental NGOs (MENGO) indicated that NGOs can be very innovative and can often integrate well with communities, but they may be distrusted by governments. Local people may be

Dr Liu Xiying from the National University of Singapore

illiterate, but can have extremely high levels of skill, for example in design, weaving etc. Care must be taken when engaging with communities that it is not just the village leaders that benefit from initiatives, but also poorer and less powerful villagers.

Solar DC Nano-Grids: A Technology Perspective on Village Electrification

Dr Timothy Walsh, SERIS, NUS

Timothy Walsh from the National University of Singapore (NUS) first gave an overview of the work of the Solar Energy Research Institute of Singapore (SERIS) – which has grown rapidly since being founded in 2008 and now employs 160 people – and his own group focusing on off-grid PV systems in South and Southeast Asia. A particular focus is DC (direct current) nano-grids, which can provide the least costly electrification option for remote communities compared to grid extension, AC (alternating current) mini-grids and solar home systems. The DC nano-grids are being piloted in Bangladesh in a project sponsored by GIZ.

The group's concept for DC nano-grids is that one set of PV panels and batteries serves a cluster of households, each house being connected via a low voltage (12V currently, but potentially 48V in future) DC cable and an energy meter. Each household gets a fixed number of watt-hours per day (on a 'use it or lose it' basis), with tiered options available for amount and associated cost. The infrastructure is wholly or partly owned and managed locally, either as a private enterprise or as a cooperative. The DC nano-grid can pay back in less than two years through savings in kerosene, so associated business models are viable without subsidies or donations.

Most modern appliances can run on DC, so conversion losses can be avoided when powered by solar PV by running everything on DC. To the extent that battery storage can be avoided, solar power can be generated at less than 0.10 USD/kWh rather than three to four times that amount, if battery storage is needed. Most components of the DC nano-grids are already available, but smarter metering and control systems are being developed to enable variable tariffs, which can help avoid the cost penalties of storage.

Off-Grid Solutions for Provisioning Energy Access

Dr Jeevan Prakesh Mohanty, TERI

Jeevan Mohanty gave an overview of the work of The Energy and Resources Institute (TERI) on bringing sustainable energy to off-grid communities, and of the projected trends in energy consumption and use in ASEAN to 2035. Energy access is a key enabler of many of the Millennium Development Goals and the Human Development Index correlates with an 'Energy Development Index'.

TERI takes a phased approach in its work to develop practical, cost-effective and sustainable solutions for energy access, catalysing access to a menu of technology options. In India, TERI has harnessed a network of micro social entrepreneurs and places an emphasis on consumer education. TERI's 'Lighting a Billion Lives' initiative has brought lighting to rural communities in 22 of India's states, disseminating more than 105,000 solar lanterns, installing more than 3,000 solar home lighting systems, and commissioning more than 200 solar mini-grids. It has also distributed 20,000 improved cook stoves in 15 Indian states.

Plenary Discussion

Initial discussion focused on Liu Xiying's presentation. It was considered that a survey of policy instruments will be useful, for example in helping to open up discussion with policy makers. But care must be taken not to be too formulaic: flexibility is needed in policy making, and nimbleness in financial decision making.

Reflecting on Tim Walsh's presentation, the breakeven point for DC nano-grids is not sensitive to the number of households, as the hardware at the household level is just proportional to the number of houses, and the PV panel and storage can be readily scaled. There is a problem if houses are spread out as this significantly increases distribution losses. Low-energy DC appliances are an important component of the overall concept. A concern was expressed that low-energy cooling systems for refrigeration are not cheap and require advanced materials.

Discussion turned to the roles of NGOs: there is a wide range of such organisations. They are generally considered to do a good job, and the view was expressed that they should work together with governments who need the NGOs' input.

A general question to workshop participants identified common factors between the ASEAN countries represented in respect of energy-access initiatives and development of renewables. Solar, micro-hydro and biomass are typically prioritised as renewable energy sources. More sustainable and efficient ways of cooking were also identified as a key priority, and alongside access to clean water, might be prioritised over electricity access.

Breakout Discussion of Overarching Themes of the Workshop

Four breakout groups were established, each to discuss a particular overarching theme identified by workshop participants. Summaries of their conclusions follow.

Group 1: How Do We Get Started?

? *What are the best policies for deploying renewable energy projects?*

Relevant policies to support off-grid energy are often missing, particularly for the lower tiers of energy access. The design of policies requires a systematic and rigorous approach that takes into account all the stages of setting up and running an energy project, including defining the potential sources of energy, establishing the community's energy needs and potential sources of funding, and deciding on the ownership of the project and who is responsible for its operation and maintenance.

Scalability is essential since millions of smart villages are needed to satisfy basic global energy needs. Consequently, policies should enable and encourage involvement of the private sector, which will have the drive to make it happen, especially in countries where the public sector lacks the resources to provide citizens with energy. Policies should give clarity on how a small project can relate to, and sell surplus energy to, the large providers. Projects need to be set up to have inherent flexibility as energy demands may change over time.

? *What financial instruments (private and governmental) can be used?*

Low-cost and simple technologies, and use of existing community assets, should be favoured as they reduce project costs and enhance community involvement. The role of governments in providing funding to projects differs between countries. For example, in India the government is providing substantial funding to local governments for rural development. In contrast, public funding available for rural electrification programmes in many sub-Saharan African countries is very low (in Tanzania, less than 3% of GDP), and priority is often given to health and education.

Access to private financing requires development of a business plan and calculation of the internal rate of return, which can often be negative for this type of project. The long payback times and high inflation rates also discourage private investment. Typically high interest rates (23–25%) for micro-finance mean

that this is often not a good solution. Better regulation of the sector is needed.

Although international organisations offer interest-free grants for projects with high social value, these grants are typically very large, in the range of millions of dollars, whereas most rural electrification projects require much smaller investments. Dealing with small investments results in high transaction costs for the funding organisations, so perhaps a solution would be to set up aggregating organisations that can handle bundles of smaller loans for the big investors at low transaction cost.

? *How can we draw up a sustainability plan?*

An essential element of sustainability is the existence of a strong economy, which requires the development of technical skills, both for productive uses of energy (often this also requires guidance on how to set up linkages with markets) and for the operation and maintenance of the technical energy equipment. Without this support, energy is initially used largely for entertainment (TVs and radios).

Further challenges to the sustainability of projects are the rapid changes in the technologies available and the need to update or change obsolete and broken equipment to incorporate advances or new hardware. Modular systems can be easily expanded to respond to increasing future demands. Lack of recycling schemes for toxic waste and broken parts is increasingly a problem.

Poor quality of hardware entering the market is a problem. Such equipment often receives accreditation by and quality control approval from national standards institutions. This can reflect corruption, which is a big problem and should be addressed with policies that increase the accountability of the relevant institutions

? *How can we devise a cultural plan?*

It is critical to establish what a community wants before embarking on the development and setting up a project. The sustainability of a project is critically dependent on community support and involvement. Establishing a cultural plan is therefore a first priority.

Group 2: How Do We Sell the Vision?

? *How should we encourage demand for renewables?*

Set up at least one smart village, so that people can see it and better understand its benefits. 'Seeing is believing'.

? *How can we overcome resistance to change?*

Experiences vary across the ASEAN region. In Indonesia, Kopernik has found it best to first visit a village and cultivate a relationship, working with individuals or organisations already active in the village if possible. But government bureaucracy and powerful officials can still slow things down, and it is important to talk to local leaders to minimise resistance.

The political landscape is changing in Malaysia and rural communities are demanding better governance and more transparency. NGOs may be able to achieve better responses and openness from villagers than government-led initiatives. But they may be seen as anti-government, which can be unhelpful. Perceived political affiliations may also hinder acceptance.

Experiences in Malaysia and India point to the need to differentiate between different levels of government, each of which can be supportive or unhelpful: a national initiative does not necessarily receive the support of local governments and officials. In India, communities may resist if

they consider an initiative to be too innovative: consensus building is needed through discussions with villagers on feasibility and funding to build confidence that the project is doable.

Resistance to change from villagers has been a problem in the past in Vietnam, but the situation has improved in recent years. Initiatives must be seen to have the support of government, so careful communication is required both with local communities and all levels of government. NGOs have an important role to play in helping poorer members of the community to benefit from energy-access schemes.

For an NGO-led project in Sabah, Malaysia, there was resistance because villagers' initial reaction, conditioned by previous donation schemes and unreliable technology, was that solar lights should be given away, not sold. And the community was sceptical about the value of sending one of their women away to Barefoot College to be trained. In this case, it was helpful to bring the local politician into the village to endorse the reliability and trustworthiness of the NGO.

Resistance may be encountered in different forms at different stages of the project. You have to have separate strategies for each phase, and to be prepared to invest more into making change happen at any stage of the project if such resistance is encountered.

? *How should we encourage villagers to start enterprises?*

Experience in Indonesia has been that villagers do not initially know how to use electricity to support the creation of productive enterprises. While villagers have the motivation and drive, they also need training in the requisite skills, and help to get financing – mechanisms for de-risking are important in this context. 'Starter kits' to set up businesses can be helpful. In Vietnam there is also a need for education on the business opportunities that can flow from electricity access, particularly as there is limited experience of social enterprises. Policies need to be put in place to mitigate some of the risks.

The Malaysian government offers grants of up to 250,000 MYR (70,000 USD) to support the creation of enterprises in rural communities. An example from Sarawak, where access to energy and ICT enabled the setting up of eco-tourism and commercial handicrafts in a remote village, point to the value of this scheme. While there was a need for some training, the community was quick to identify the opportunity and to run with it.

Care must be taken to ensure that the poorer people within villages have access to opportunities to establish productive enterprises, not just the headman. A smart village needs to be smart enough to address everyone's concerns. In India, TERI has supported the establishment of over 200 social enterprises in villages. While their engagement usually starts with the headman or religious leader, the next step is to ensure that every household is represented at subsequent meetings.

Villagers should be encouraged to maximise the use of local resources and skills in creating their businesses. They may need support to establish forward and backward linkages. Nearly half of the enterprises set up by TERI are running successfully and the entrepreneurs understand business to a certain extent. However, they do not like complications and need support to ensure that the ideas are transferred to the next generation.

? *What are the ethics of this?*

Responding to a concern that energy-access initiatives may undermine existing ways of life and social cohesion, it was felt that anthropologists should be involved from an early stage

to guide the nature of the engagement. Social audits should be undertaken and repeated regularly. It is important to be sensitive to local views and needs, and to enable incremental improvements consistent with what villagers have and value, and which embrace local wisdom. But it was also noted that views on ethics and human rights issues may differ around the world.

? *How can we give them the skills?*

It is better to provide training rather than to donate money, but this can meet some resistance where a handout mentality has developed. In some senses the starting point can be low, for example literacy, but in other respects, for example indigenous skills, it may be high. Wherever possible, initiatives should be developed in tune with local wisdom.

Group 3: How Will We Measure?

? *What are the parameters for evaluating smart villages?*

In order to evaluate smart villages we need a tighter definition of what a smart village is. For example, is a smart village characterised by the ability of its residents to make informed decisions?

Quantitative indicators may include measures of electricity access (for example, in respect of different tiers of electricity access, or the affordability of energy perhaps measured by the percentage of connections), migration and/or population change (but there are potentially difficulties of measurement due to illegal or circular migration), employment and food security. Indicators need to be flexible given the potential for unexpected or paradoxical impacts (for example, loud music from radios or sound systems enabled by energy access causing friction between the young and old, or men/women reducing their income-generating efforts if their partners generate more income).

Quantitative indicators do not tell us what people think about their quality of life. Consequently, more qualitative indicators could be valuable, but may be difficult to establish. A key consideration is to establish what the villagers want, but they may not be informed of the possibilities. Techniques such as vision mapping may be helpful.

? *How to ensure failures are included as well as successes?*

Failure is part of the entrepreneurial journey, so some failures are necessary and future plans should take these into account. But for the government, politics is more important so failures tend to be covered up rather than publicised. And development agendas (from donors etc.) are inflexible because funding is linked to a theory of change and agreed outputs, meaning failures and lessons cannot be incorporated. A body or mechanism might usefully be established to enable the better sharing of knowledge about failures so that the associated learning can be disseminated to the stakeholder community.

? *How do we assess financial instruments?*

There is a great diversity of financial instruments and many different financial models. Parameters might include feasibility, sustainability and replication. We may expect that different stakeholders have different priorities. For example, a community may prioritise socioeconomic impact whereas the government may prioritise meeting its policy targets at the least possible cost.

Group 4: What Happens Next?

? *How do we encourage synergy between technology providers, governments and NGOs?*

The roles of each need to be mutually understood and accepted ('license to operate'), and be responsive to the needs and situation of the communities in which they are working. The various players should communicate effectively with each other, and all should be subject to similar accountabilities (in particular, to the communities as customers) in respect of reporting and transparency. Smartphones may support the required communication.

There is a wide range of NGOs – some are quite commercial – and sometimes there is hostility between them and the state. Mechanisms need to be in place to complain about the reliability of NGOs and to prevent them from propagating false information to donors about the success of implementation. NGOs may usefully be the channel for community-level information to be communicated to technology providers and donors. The community should be in the driving seat in the choice of technology, not just recipients of NGO technology packages, and in respect of the development direction taken by the village.

? *How can we assist individual countries?*

Countries can usefully learn from each other's experience, so bringing together experts and communities to discuss problems and how they have been overcome can be valuable. Such interactions may take a particular focus, for example, to consider energy access for aboriginal groups in different countries, or ethnic communities that straddle different countries, for example, the Maasai in Kenya and Tanzania.

? *What new technologies are on the horizon?*

There is a portfolio of energy technologies that are complementary, and the selection of a particular technology is dependent on the extent of demand, load and a range of related factors. We should not limit our thinking to electricity, but consider energy provision more generally. It was considered that there are no practical breakthrough technologies available at present.

Comparative evaluations of technology options need to take account of differences between countries in language and analytical methodologies. Lessons may be learned from developing countries: for example, Indonesia might learn from the experience of Germany in replacing inefficient lightbulbs. Evaluation of costs and benefits should take into account new sources of value that can arise from energy provision, for example, the use of solar energy to provide a hot bath to reduce the asthma attacks experienced by children.

? *How do we keep in touch and contribute?*

The Smart Villages Initiative should give further thought to how to promote and sustain communication between workshop participants in subsequent months. This can be of great value. Technologies such as Skype allow for virtual conferences. More generally, despite efforts to date, it is difficult to get information on relevant initiatives internationally and even within one's own country.

Day 3: Afternoon Session

Final Panel and Plenary Discussion

Panel: Chong Sheau Ching, Don Dia, Lalchand Gulabrai, Citra Savitri, Tim Walsh, Alvin Yeo

The final panel and plenary discussion considered what messages should be given to key audiences (for example, national policy makers, ASEAN governance bodies, development agencies, corporate and banking sectors, NGOs etc.) to progress energy access and enable the creation of smart villages in Southeast Asia, and how we can ensure that those messages are effectively transmitted and acted upon. Key points made were as follows:

There is sufficient homogeneity across the ASEAN region to make pragmatic proposals to ASEAN governments. However, such proposals should also recognise the significant differences across the region and even within countries, for example, in respect of economic opportunities, and that the specific needs and possibilities of individual communities will vary. One size does not fit all.

Access to electricity is a social responsibility of government, but to make it happen tripartite arrangements are needed between government, utilities and developers, and there must be community ownership and local champions. The approach should be holistic, interdisciplinary and participatory. A focus on energy services rather than kilowatt hours will achieve impact more quickly.

The energy needs and development paths of villages may well be different from those of cities: they should not lose their traditional wisdom. Low-cost technologies implemented by local people have an important role to play.

More should be done to share experiences across the ASEAN region and with other regions, including an honest reflection on failures (which those involved may be reluctant to share, and which can be difficult to get published). Failures should be accepted as the way to move forward. Civil society organisations can contribute to scaling up successful approaches by learning from each other and avoiding the repetition of mistakes.

Education is a key factor in creating smart villages. A benefit of Internet access is that the consequent connections and exposure increase skill levels.

Positive action needs to be taken to stimulate the establishment of productive enterprises that use electricity, which may require other infrastructure components such as roads and telecommunications. Some taxpayer funds may be needed. Nevertheless, in parallel with economic development, quality of life benefits of energy access are equally important to the beneficiaries. Therefore some notion of energy access and 'happiness'/well-being may be a useful metric.

Following the example of the Malaysian government, we need to build some smart villages to showcase the concept: implementation is the next step.

Workshop Programme

Day I – Tuesday, 27 January

0900 **Welcome by Tan Sri Ir Ahmad Zaidee Laidin, ASM**

0910 **Presentation on the Smart Village Concept by Dr John Holmes, Smart Villages Initiative**

0930 **Panel Session 1 – Smart Village Case Studies**

Moderator: Professor Sir Brian Heap

The Terrat Village Experience by Mr Martin Kariongi ole Sanago, IOPA

e-Bario Project by Associate Professor Dr Poline Bala, UNIMAS

Case Study: Long Lamai Socioeconomic Transformation via a Systemic Holistic Interdisciplinary Participatory Approach by Professor Dr Alvin W. Yeo, UNIMAS

Energy for Off-Grid Villages in Thailand by Mr Sumate Tanchareon, King Mongkut University

National Smart Communities Program by Mr Nik Faizul, MIGHT

1045 **Q&A and Plenary Discussion Session**

Moderator: Professor Ernst van Groningen, ISP

1115 **Tea Break**

1130 **Panel Session 2 – Key Energy Uses in Southeast Asia**

Moderator: Ir Lalchand Gulabrai, ASM

Electricity Supply from Micro-Hydro for Rural Communities – The Key Uses and Benefits by Mr Adrian Lasimbang, TONIBUNG

Cambodia Millennium Village by Dr Heng Sokbil, AAET

Community–Private Partnership Pro-Poor Infrastructure – Cinta Mekar Microhydro Training Power Plant by Mr Sapto Nugroho, IBEKA

Rural Electrification in Sarawak by Dr Chen Shiun, Sarawak Energy Berhad

Solar Social Enterprise and Sustainable Living and Learning Center for Youth by Ms Salinee Tavaranan, BGET

1230 **Breakout Sessions: Key Uses and Needs for Energy in Southeast Asia**

Report back to plenary

1315 **Lunch**

1430 **Official Opening of the Smart Villages Initiative and Workshop**

1430 Arrival of YB Datuk Dr Ewon Ebin, Minister of Science, Technology and Innovation (MOSTI)

1435 Group photo with delegates

1445 National anthem, 'Negaraku'

1450 Doa recitation

1455 Welcome Address by Tan Sri Datuk Dr Ahmad Tajuddin, President of the Academy of Sciences Malaysia

1505 Speech by Professor Sir Brian Heap, Senior Advisor for Smart Villages/CMEDT

1520 Multimedia Presentation

1525 Opening Address and Launching by YB Datuk Dr Ewon Ebin, Minister of Science, Technology and Innovation

1600 **Press Conference, Tea Break and Networking**

1620 **Keynote Address – Micro Grid - Renewable Energy: TNB Experiences towards Rural Electrification by Ir Mohd Azhar Abdul Rahman, TNB**

1640 **Keynote Address – Socioeconomic Impact of Access to Energy in Remote Communities by Professor Dato' Dr Kamaruzzaman Sopian, UKM**

1700 **Adjourn**

Day II – Wednesday, 28 January

0900 **Reflections on Day 1 by Dr John Holmes**

0920 **Entrepreneurial Case Study 'Elevator Pitches'**

Moderator: Professor Howard Alper, STIC Canada

10-minute lightning presentations of projects implemented in Southeast Asia – synopses of technologies used, delivery/implementation methods, acceptance and outcomes.

Hybrid Solutions/Rural Electrification by Ir Dr Abang Hatta bin Abang Taha, Gabungan Binaan Jurutenaga Sdn Bhd

SWEPA and Barefoot College by Ms Hanaa Wong Abdullah, SWEPA

Micro-Hydro Project for Rural Electrification by Mr Mohd Fauzi Ismail, SIRIM

Rural Electrification Using Solar-Hydro Energy — A Long Pasia Scenario by Professor Hew Wooi Ping, UMPEDAC University of Malaya

Kopernik – Serving the Last Mile by Citra Savitri, Kopernik

Lighting up Off-Grid Rural Communities with Sustainable and Renewable Micro-Hydro Energy by Mr Chen Tzy Wen, Lightup Borneo

Sunlabob Renewable Energy by Mr Benoit Dubeau, Sunlabob

Solar Pumping Solutions by Mr Ben Frederick, Myanmar Eco Solutions

Ibu Inspirasi – Wonder Women Indonesia by Ms Citra Savitri, Kopernik

SACASOL CSR Project, Philippines by Mr Don Mario Y Dia, SACASOL

Hydropower Technology Development in Indonesia by Mr Gerhard Fischer, Hycom

Research and Development Projects for Rural Community Development in Sarawak: Opportunities and Challenges by Dr Hushairi Hj Zen, UNIMAS

1200 **Plenary Discussion of Case Studies**

Moderator: Professor Ernst van Groningen

1300 **Lunch**

1400 **Keynote Address – Hydropower Development in Sarawak: Opportunities and Challenges by Dr Chen Shiun, Sarawak Energy Berhad (SEB)**

1420 **Panel Session 3 (Parallel Sessions)**

Parallel Session 1 – Cultural Acceptability

Moderator: Dr Poline Bala, UNIMAS

Panelist 1 – Ms Kara Bennett, BGET

Panelist 2 – Ms Citra Savitri, Kopernik

Panelist 3 – Professor Dr June Ngo Siok Kheng, UNIMAS

Parallel Session 2 – Biomass and Biogas

Moderator: Professor Emeritus Dr Lim Koon Ong, FASc, ASM

Panelist 1 – Associate Professor Tan Chong Eng, UNIMAS

Panelist 2 – Dr Nazeri Abdul Rahman, UNIMAS

Panelist 3 – Dr Zainal Alimuddin b. Zainal Alauddin, USM

Parallel Session 3 – System Optimisation

Moderator: Ir Lalchand Gulabrai, ASM

Panelist 1 – Dr Chen Shiun, SEB

Panelist 2 – Professor Andrew Rigit, UNIMAS

Panelist 3 – Ir Dzainul Khalid, TNBES

Panelist 4 – Dr Che Hang Seng, UMPEDAC University of Malaya

Panelist 5 – Mr Doan Van Binh, VAST

1520 **Keynote Address – Best Practices and Design Principles for Village Energy-Access Programs**
Professor Benjamin K. Sovacool, Centre for Energy Technologies, AU - Herning

1550 **Tea Break**

1610 **Keynote Address – Entrepreneurship as a Vehicle to Encourage Grassroots Innovation**
Professor Howard Alper, Chair of the Government of Canada's Science, Technology and Innovation Council

1630 **Parallel Session Summaries and Discussion in Plenary**

Moderator: Dr Shailaja Fennell

1700 **Adjourn**

1930 **Dinner and Cultural Show (hosted by UNIMAS)**

Speech by Vice-Chancellor of UNIMAS

Talk by Sarawak Convention Bureau

Day III – Thursday, 29 January

0900 **Day 2 Summary by Dr John Holmes**

0930 **Panel Session 4 – Other Perspectives on Off-Grid Energy in Southeast Asia**

Moderator: Dr Heather Cruickshank

Policy Instruments in Facilitating Renewable Energy Off-Grid (REOG) Investment in ASEAN: Lessons from International Experiences by Dr Liu Xiying, Energy Studies Institute, National University of Singapore

eHomemakers and NGO perspectives on Off-Grid Energy by Ms Chong Sheau Ching, eHomemakers and MENGO

Solar DC Nano-Grids: A Technology Perspective on Village Electrification by Dr Timothy Walsh, SERIS

Off-Grid Solutions for Provisioning Energy Access by Dr Jeevan Prakash Mohanty, TERI

1100 **Panel and Plenary Discussion**

Moderator: Professor Sir Brian Heap

1130 **Breakout Groups and Report Back to Plenary**

How do we get started? Chair: Professor Ernst van Groningen

How do we sell the vision? Chair: Richard Hayhurst

How will we measure? Chair: Professor Sir Brian Heap

What happens next? Chair: Dr Heather Cruickshank

Overarching themes of workshop: how can we establish the necessary framework conditions to support off-grid energy for development?

1300 **Lunch**

1400 **Panel and Plenary Discussion**

Moderator: Dr Bernie Jones

Panel: Dr Alvin Yeo, Ms Citra Savitri, Dr Timothy Walsh, Ms Chong Sheau Ching, Mr Don Mario Y Dia, Ir Lalchand Gulabrai

1500 **Summary and farewell**

Workshop Participants

Person	Organisation	Country
YB Datuk Dr Ewon Ebin	Minister of Science, Technology and Innovation	Malaysia
Tan Sri Ir Ahmad Zaidee Laidin, FASc	Akademi Sains Malaysia	Malaysia
Professor Sir Brian Heap	CMEDT/Smart Villages Initiative	UK
Ir Dr Abang Hatta Abang Taha	Gabungan Binaan Jurutenaga SB	Malaysia
Prof Dr Abdul Halim Shamsudin, FASc	Akademi Sains Malaysia	Malaysia
Mr Adrian Lasimbang	TONIBUNG	Malaysia
Tan Sri Datuk Dr Ahmad Tajuddin Ali, FASc	Akademi Sains Malaysia	Malaysia
Prof Dr Alvin Yeo	Universiti Malaysia Sarawak	Malaysia
Prof Andrew Rigit	Universiti Malaysia Sarawak	Malaysia
Nor Azman Bin Atib	Tenaga Nasional Berhad	Malaysia
Mr Ben Frederick	Myanmar Eco Solutions	Myanmar
Mr Benoit Dubeau	Sunlabob Laos	Laos
Prof Dr Benjamin Sovacool	Danish Centre for Energy	Denmark
Dr Bernie Jones	Smart Villages Initiative	UK
Dr Che Hang Seng	UMPEDAC	Malaysia
Dr Chen Shiun	Sarawak Energy Berhad	Malaysia
Mr Chen Tzy Wen	Lightup Borneo	Malaysia
Ms Citra Savitri	Kopernik	Indonesia
Ms Chong Sheau Ching	Malaysia Environmental NGOs (MENGO)	Malaysia
Dr Claudia Canales	Smart Villages Initiative	UK
Mr Dallius Ubin	Ministry of Science, Technology and Innovation	Malaysia
Mr Don Mario Y. Dia	San Carlos Solar Energy	Philippines
Mr Doan Van Binh	Vietnam Academy of Sciences	Vietnam
Ir Dzainul Khalid	Tenaga Nasional Berhad	Malaysia
Prof Ernst van Groningen	ISP, Uppsala University	Sweden
Dr Fitri Suraya Mohamad	Universiti Malaysia Sarawak	Malaysia
Dr Gerhard Fischer	HYCOM	Indonesia
Dr Gratian Bamwenda	Tanzanian Academy of Arts and Sciences	Tanzania
Ms Hanaa Wong Abdullah	SWEPA	Malaysia
Dr Hazami Habib	Akademi Sains Malaysia	Malaysia
Dr Heather Cruickshank	Cambridge University	UK
Dr Heng Sokbil	ASEAN Academy of Engineering and Technology	Cambodia
Prof Hew Wooi Ping	UMPEDAC	Malaysia
Prof Howard Alper	STIC/University of Ottawa	Canada
Dr Hushariri Hj Zen	Universiti Malaysia Sarawak	Malaysia
Prof Dr Ibrahim Ngah	Universiti Teknologi Malaysia	Malaysia
Jacey-Lynn Minoi	Universiti Malaysia Sarawak	Malaysia
Dr Jeevan Prakash Mohanty	The Energy Research Institute	India
Dr John Holmes	Smart Villages Initiative	UK
Dr June Ngo Siok Kheng	Universiti Malaysia Sarawak	Malaysia

Ms Julia Vitullo Martin	Media consultant	USA
Ms Kara Pearl Carlson Bennett	Border Green Energy Team	Thailand
Prof Datuk Dr Kamaruzzaman Sopian, FASc	Universiti Kebangsaan Malaysia	Malaysia
Ir Kartina Hasim	Tenaga Nasional Berhad	Malaysia
Prof Dr Khin Tun	Universiti Malaysia Sarawak	Malaysia
Prof Krishan Lal	Association of Academies and Societies of Science in Asia	India
Ir Lalchand Gulabrai, FASc	Akademi Sains Malaysia	Malaysia
Dr Le Truong Giang	Vietnam Academy of Science and Technology	Vietnam
Dr Liu Xiying	National University of Singapore	Singapore
Prof Emeritus Dr Lim Koon Ong FASc	Universiti Sains Malaysia	Malaysia
Mr Martin Kariongi ole Sanago	Institute of Orkonerei Pastoralist Advancement	Tanzania
Mr Nazmi Lao	Akademi Sains Malaysia	Malaysia
Mr Meredith Thomas	Smart Villages Initiative	UK
Ms Michelle Kwa	Institute of Strategic and International Studies	Malaysia
Haji Mohd Fauzi Ismail	SIRIM Berhad	Malaysia
Ir Mohd Azhar Abdul Rahman	Tenaga Nasional Berhad	Malaysia
Ms Norberta Nogo	Kopernik agent	Indonesia
Mr Nazeri Abdul Rahman	Universiti Malaysia Sarawak	Malaysia
Mr Nguyen Hoai Nam	Vietnam Academy of Sciences	Vietnam
Mr Nik Faizil	Malaysia Industry–Government Group for High Technology	Malaysia
Ms Padmini Karananidi	Akademi Sains Malaysia	Malaysia
Dr Poline Bala	Universiti Malaysia Sarawak	Malaysia
Mr Richard Hayhurst	Smart Villages Initiative	UK
Ms Salinee Tavaranan	Border Green Energy Team	Thailand
Ms Sandy Evans	Smart Villages Initiative	UK
Mr Sapto Nugroho	Institut Bisnis dan Ekonomi Kerakyatan	Indonesia
Ms Seetha Ramasamy	Akademi Sains Malaysia	Malaysia
Dr Shailaja Fennell	Cambridge University	UK
Ms Sharon Schmickle	Media consultant	USA
Ms Siti Nurhanaa Abdullah	Sabah Women Entrepreneurs and Professionals Association	Malaysia
Ms Sri Rezeki Fauzi	Institut d'Études Politiques de Paris	Indonesia
Mr Sumate Tanchareon	King Mongkut University	Thailand
Prof Dr Tan Chong Eng	Universiti Malaysia Sarawak	Malaysia
Dr Tariq Zaman	Universiti Malaysia Sarawak	Malaysia
Dr Terry van Gevelt	Cambridge University	UK
Dr Timothy Walsh	SERIS, National University of Singapore	Singapore
Dr Usa Boonbumroong	King Mongkut University	Thailand
Prof Ir Dr Wan Ramli Wan Daud, FASc	Akademi Sains Malaysia	Malaysia
Mr Yao-Hua Law	Scidev.net	Malaysia
Ms Yap Li Ling	Sabah Women Entrepreneurs and Professionals Association	Malaysia
Mr Yeo Eng Khean	Lightup Borneo	Malaysia
Prof Dr Zainal Alimuddin b. Zainal Alauddin	Universiti Teknologi Malaysia	Malaysia

SMART VILLAGES

New thinking for off-grid communities worldwide

This publication was made possible through support from the Cambridge Malaysian Education and Development Trust and the Templeton World Charity Foundation. The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the Cambridge Malaysian Education and Development Trust or the Templeton World Charity Foundation.