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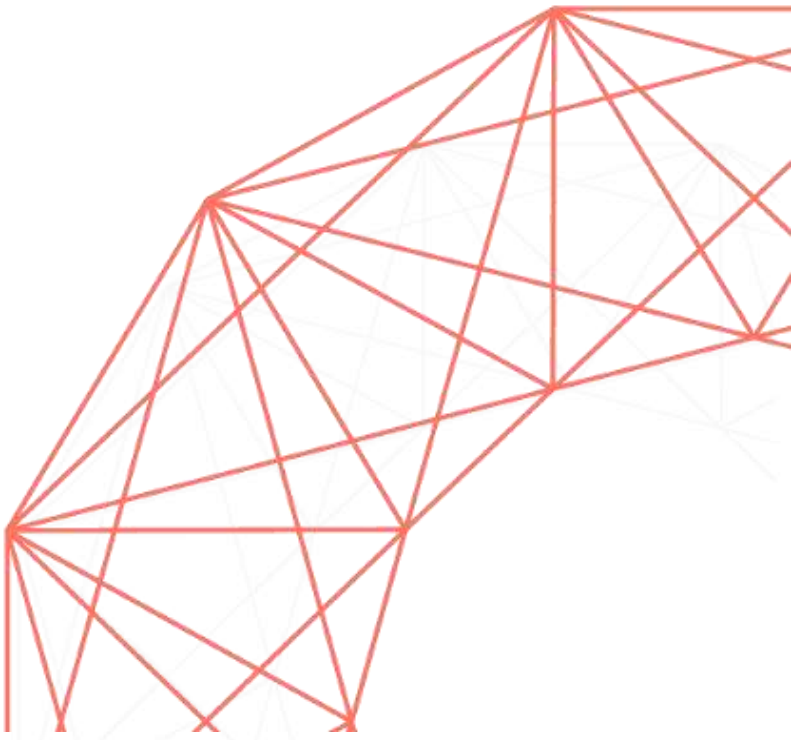
"CONNECTING POLICY, TECHNOLOGY & FINANCE THROUGH KNOWLEDGE"

Deep Dive Workshop on Energy Access using Innovative Mini-Grid Solutions

Room 4713, Level 4,

Sands Expo and Convention Centre, Singapore



Contents

Opening Remarks 4

Session 1: Challenges and Risks in Deploying Renewable Energy Mini-Grid Technologies 5

Session 2: Government Role: Policies and Regulation to accelerate deployment of Renewable Energy Mini-grids 8

Session 3: Private Sector Role: Innovations & Success Stories in the Development of Sustainable Mini-Grid Projects 11

Session 4: Innovations in Finance: Creating a 21st Century Mini-Grid Sector 16

Annex 1 – Participant List 19

Annex 2 – Speakers List 20

Annex 3 – ADB List 21

The Deep Dive Workshop on Energy Access using Innovative Mini-Grid Solutions was held on 1 November 2019 and held in conjunction with the Asia Clean Energy Summit (ACES) 2019.

Clean energy mini-grids has been identified as the least-cost option for 44% of the people without electricity in Asia-Pacific and is hence one of the most important sub-sectors to focus on to achieve a cleaner energy mix for the region. A clean energy mini grid can supply an entire rural community with enough basic needs, while generating enough power for productive uses.

The ADB's strategy 2030 directs the bank to sustain its efforts to eradicate extreme poverty and expand its vision to achieve a prosperous, inclusive, resilient and sustainable Asia and the Pacific. To move forward with this effort, the Deep Dive Workshop on Energy Access using Innovative Mini-Grid Solutions aims to discuss the factors, innovative business models and finance approaches, using technologies available, that could unlock additional investments in mini-grids, especially by the private sector, and create a modern and sustainable 21st century mini-grid industry as a viable solution to providing energy access in Asia and the Pacific Region and also assess the roles of both public and private sector to determine how they can work together to achieve the common goal of aligning with UN's Sustainable Development Goal 7 (SDG 7), which aims to attain universal energy access by year 2030.

A total of 15 participants and 15 resource speakers from 6 countries were present for the workshop.

Opening Remarks

Dr Dae Kyeong Kim, Senior Energy Specialist (Smart Grids) at the Asian Development Bank gave a presentation on the '*Role of Micro-Grids in Energy Transition*'. Dr Dae Kyeong introduced the difference between mini-grids and micro-grids. His presentation also spoke about the comparisons between the two scenarios of the Energy Transition of the 'Step by Step Scenario' and the 'Leapfrogging Scenario'. Dr Dae Kyeong went through the Smart Grid Evolutions which consists of the Fully Centralized System Based Smart Grid, Distributed System Based Smart Grid, Microgrid System Based Smart Grid and Hyper Distributed System Based Smart Grid.

Dr Dae Kyeong also enforced that microgrids are the building block of the future grids and is an enabler of renewable energy expansion.

Mikael Melin, Senior Energy Access Specialist at Sustainable Energy for All gave a presentation on '*Achieving Universal Energy Access*'. Mikael enforced that 840 million people are without basic electricity access. In 2017, the total population without Access to Electricity in Asia and the Pacific was 232 million, calculated by ESCAP based on data from the World Bank.

Mikael introduced the Integrated Electrification Pathways (IEP) which is a set of inclusive planning approaches and policy measures that support using grid, mini-grid and off-grid technologies to provide electricity and the associated energy services necessary to meet human needs and contribute to sustainable development.

The IEP recognizes electricity access as essential for achieving other development goals, considers all sustainable technologies and delivery models available, establishes high-level political support for coordinated government planning and develops policy measures that encourage private sector investment.

The process consists of establishing coordinating body, soliciting expert engagement, obtaining data using planning tools, developing supportive policy measures and mobilizing finance and building the ecosystem.

Mikael also shared that SEforALL published Integrated Electrification Pathways for Universal Access to Electrification: A Primer as a practical tool for facilitating government and private sector efforts to develop national electrification plans taking a full-systems approach.

Session 1: Challenges and Risks in Deploying Renewable Energy Mini-Grid Technologies

Session 1 discussed challenges and risks by different sector representatives in the Asia-Pacific region – technical, policy and market challenges – that they have encountered in the deployment of mini-grid technologies as a solution in providing access to energy to all. The speakers also presented and discussed how they were able to overcome such barriers.

Dipti Vaghela, Co-founder and Manager at Hydro Empowerment Network (HPNET) spoke about the Social Enterprise for Energy, Ecological, and Economic Development (SEEED) using Mini-Grids and discussed the Issues, Challenges and Vision for Achieving Sustainability surrounding it. Dipti highlighted that a Social Asset Only Model is not sustainable as it operates only for a few hours per day, has low power factors, irregular tariff collection, minimum cash flow, not enough funds for maintenance and repair, weak management and a high risk of abandonment when the main grid arrives. The solution for this is a transition to Productive End Use Social Enterprise.

Dipti also shared about the Social Enterprise for Energy, Ecological and Economic Development where she shared the core elements of SEEED which comprises of Socio-Economic Impact Community Empowerment, Hydro Mini-Grid run as Local Social Enterprise, Livelihood-based Value-Add Productive End Use and Reliable Mini-Grid Technology & Sustainable Watersheds. Dipti ended her presentation to say that Sustainability depends on the transition to Local Social Enterprise and the transition requires affordable financing, local institutional development, and livelihood-enhancing end use.

Debajit Palit, Director and Senior Fellow, The Energy and Resources Institute (TERI) gave a presentation on '*Barriers and Drivers to Deployment of Mini-Grids: Lessons from India*'. Debaljit shared that there has not been a systematic attempt to study the strength of drivers & barriers at different levels (macro/national, sub-national and micro/local level) for rural electricity supply and if policies and actions to encourage development and sustaining rural electricity services are to be successful, understating the nature of the drivers & barriers is essential.

Some issues Debaljit brought up with regards to the deployment of minigrids in India, was that there was lack was rural electrification planning or strategy, political & legal uncertainty, unclear or complicated regulatory processes and approvals, lack of retail regulations – high tariff relative to regulated grid tariff

and the absence of technical standards and quality assurance. These are among some of the issues that Debaljit highlighted.

Debaljit ended his presentation saying that enabling policies and strong state support has been the greatest drivers and the high capital & transaction cost are perceived to be the most important barriers. Convergence with livelihood program & electricity for irrigation are perceived to be a strong driver for mini-grids, however, most mini-grids in India does not support both these applications. At the same time, high cost of electrification, high cost of mini-grid power and customer's inability to pay are considered as barriers. With universal electricity access in India, mini-grid has to focus on energy for livelihood, but to keep power cost within affordability limit, transaction/management cost has to be brought down through better use of technology and lower cost of capital (hardware cost is already down to a large extent).

Richard Harrison, CEO of Smart Power Myanmar gave a presentation on '*Myanmar: Learnings from a promising energy market and strategic imperatives for the future'.*

Richard shared that Smart Power Myanmar's objective is to catalyze the conditions for Future Grid Myanmar to positively impact rural lives and through their work, they try to improve and influence integrated institutional planning and related policies (focusing on the development of optimal electrification methods and models), attract investments for viable energy access models and projects and stimulate replicable demand-side solutions, especially in Productive Use in high-potential rural communities.

The Future Grid Myanmar is an evolved term for "Grid 2.0" – a future scenario where rural energy access and energy use exists as a viable and sustainable balance between communities, developers, local businesses and the national grid, providing reliable, high quality energy to the distribution network and micro-enterprises and the 28 million underserved people in Myanmar. Richard also shared that there is an assumption that mini-grids would operate as sustainable business models within a broader grid infrastructure and went on to explain the barriers, imperatives and interventions that revolves around the mini-grid market.

Richard revealed that the benefits of mini-grids compared to grid electrification is that there is faster roll-out in which the grid electrification typically takes decades – e.g. raising electrification from 80%-90% to 100% took approximately 20 years, in countries such as Brazil, China, Thailand, Vietnam and Indonesia and the mini-grids can quickly be rolled out in the interim to provide a bridge before grid arrival.

Rebecca Symington, Executive Director at Mlinda Foundation and Board Member of The Alliance for Rural Electrification (ARE) moderated the panel discussion for session 1. In the panel discussion the following were discussed:

1. What is the basic concept? The source of energy should be renewable energy, or could it be any kind of energy? Renewable power is of intermittent nature and if the power is fitted into conventional grids, there may be grid-stability problem. There is no chance to create storage capacity on a commercially viable scale. In another 5-10 years, there may not be such developments taking place. For the large-scale storage capacity creation, it may be a far try and with micro grids, then requirement for storage batteries will be on the lower side. We should encourage to have more of the isolated grids with support from the relatively lower-capacity batteries.

Debajit: Renewable energy will be the best solution. India has a large number of mini grids by the private sector which are solar diesel hybrid and that is one of the reasons why they are working in order. Many mini grids which did not function well had an intermittency in renewables. Private sector mini grids uses hybrid together with diesel where the problems about intermittency gets resolved. The better option is to have 2 different types of renewables to resolve the intermittency.

2. The enterprise model was proposed. How can the enterprise model solve the 3 challenges for mini grids; high capital cost, uncertainty in revenue and small project size? How can the new model contribute to these challenges?

Dipti: Capital costs can be lowered when working with locally manufactured technology and local developers. They employ local workforce, we can see across the board when built locally the costs are reduced. When projects are built by local actors and there is not a subsidy, if we partner to make a mini grid without any finance, there needs to be a lot of thinking process on what is going to be the end-use and revenue model. There wont be an idea to do a mini-grid, unless there is revenue and this is why, if there is a change in subsidy and grant, and other ways to make credit happen, automatically, there will be more productive end use and more revenue. Other local practitioners have created a dynamic tariff policies, so during the low-peak hours and non-peak hours at night, they reduce the tariff but they also ensure that revenue is generated 24hours. Some developers in Nepal have a dedicated line for productive end-uses finding all kinds of ways to generate revenue. For small project size, they are done in phases. A

mini hydro can optimally produce 800kWh they will start at a much lower value, generating revenue and self-finance. In Nepal and Pakistan, these mini grids are being inter-connected to regional grids.

3. The question is regarding productive end-uses. Nation building was talked about but, on a smaller-scale, are there any cases or advise for increasing productive energy-use quickly?

Howard: The applied energy lab, it's a laboratory that has been financing and coaching and understanding the performance of 69 productive-use businesses. In about a dozen villages, that are all, except one, a part of the DRD programme, the goal of that exercise has been to understand what kind of energy usage they have, what kind of contribution they make to the viability to the mini grid, and what contribution do they make to the GDP of the village in terms of growth and other benefits. The model is a bit more complicated than simply financing the mini grid. They way we operate in villages is, we help create village committees that is specialized in electrification. If they don't already exist in the DRDs work, we help strengthen them and we help train them. For productive use, a thorough assessment for the state of play in the value chains in that particular village and beyond that village would suggest that if we want larger micro-enterprises, that meaningfully contribute to the market, because we all want to see a viable mini grid business case. The mini grid business has to be viable in order for it to become sustainable.

Session 2: Government Role: Policies and Regulation to accelerate deployment of Renewable Energy Mini-grids

The second session for the Deep-Dive Workshop on Energy Access using Innovative Mini-Grid Solutions, featured select presentations made by governments that have already developed policies, regulations and plans for increasing deployment of mini-grids. These speakers relate their experiences on what are the successes and remaining gaps in the deployment of mini-grids.

The first speaker Badariah Yosiyana, Country Officer, Country and Support Partnerships Division at the International Renewable Energy Agency (IRENA) shared on the '*Policies and regulations for renewable energy mini-grids'*.

Badariah shared that the global population without access to electricity has come down from 1.2 billion in 2010 to 840 million at the end of 2017. An important note that Badariah made was that the grid extension cannot cater to all the unelectrified population and shared that mini-grids has the potential to provide electricity to a wider range of end-use, contributing to multiple Sustainable Development Goals (SDGs), mini-grids can be absorbed into a main grid or may continue to operate autonomously and the right set of policies can create an effective regulatory framework to both incentivize and de-risk private sector investment.

Badariah shared that the number of people served by off-grid renewables has expanded six-fold since 2011, reaching 133 million in 2016 and Small-hydro mini-grids are the most widely deployed and responsible for connecting majority of the end-users to mini-grids, followed by solar mini-grids.

The key regulatory aspects for RE mini-grids consists of legal and licensing provisions, access to finance, cost recovery and tariff regulation and grid-interconnection and (risk of) main grid arrival. There are some

cross-sectoral impacts of off-grid solutions, including RE mini-grids and these consists of, humanitarian response, irrigation and agri-food processing and rural health service delivery.

The second speaker, Marc Louie Olap, OIC-Division Chief, Rural Electrification Administration and Management Division at the Electric Power Industry Management Bureau, Department of Energy, Philippines started off his presentation titled '*Total Electrification of the Philippines by 2022 – Policies and Regulations on Entry of Mini-grid System*'.

Marc's presentation revolved around the Philippines Rural Electrification Scenario, the Governing Laws, Policies and Directives and the Way Forward. Rural Electrification refers to the delivery of basic electric services and based on a 2010 census, 20.6 Million Households have electricity out of 22.72 Million Households in the Philippines. The Grid Electrification Programs and Off-Grid Electrification Programs were implemented for this electrification accomplishment for opportunities for mini-grid systems to enter the Philippines.

As of June 30, 2010, the current electrification status in the Philippines is that 22.56 Million Households have electricity out of 22.98 Million Households in the country. Marc touch-based on the Power Development Plan 2016-2040, where the Department of Energy aims to accelerate execution of TEP in the attainment of 100% electrification of targeted and identified households by 2022 (based on a 2015 census).

Marc shared that the Department of Energy Secretary has issued a Department Order on 24 May 2018 entitled, "Creation of task force to ensure access to electricity for the communities that remain unserved and underserved by the distribution utilities". Solutions under the electrification strategies are subdivided into – Household Electrification, Grid Electrification and Off-grid electrification where all DUs are directed to submit to their Comprehensive Electrification Master Plan (CEMP) which shall include offgrid electrification solution such as Implementation of Mini/micro-Grid systems.

As a way forward, Marc shared that the Department of Energy has identified potential sites for mini/micro-grid systems in the Philippines. Marc also shared that the aim of strategy in addressing underserved areas is to increase the mini-grid with 4 hours service to a reliable 24 hours electricity services in the Philippines with less cost for the operation of the area.

Chaitanya Prakash Chaudhary, Engineer/Mini-Grid at Alternative Energy Promotion Center, Nepal presented about the '*Government policies and regulations and plans for promoting renewable energy mini-grids*'.

Chaitanya shared that the total electricity consumption in Nepal is 4,102 GWh and the national electricity access has been reached to 77.2% of the total population in Nepal.

Chaitanya brought to attention that there are two entities working in the electrification sector; one is Nepal Electricity Authority (NEA), which is a utility service provider owned by the Government of Nepal and the other is Alternative Energy Promotion Center

(AEPC). 77.08% of the population is electrified by the national grid and 9.75% of the population is electrified by alternative or renewable energy from their own systems and 3.45% of the population, which is about 740,000 households is yet to be electrified.

The AEPC has its focus on the Karnali Province which is least electrified and is looking into developing mini-grids at this province. Nepal is dominated by the hydro-sector, thus they are looking into scaling up off-grid Solar PV as grid expansion is not viable as there are very few consumers in the remote villages and the present off-grid system can be future grid-connected system that will support long distance weak national grid.

Chaitanya shared that the Government of Nepal is looking at 100% electrification in Nepal, in the next 3 years but some of the key issues and challenges for mini-grids development is the sustainability of the mini-grids (O&M and Tariff Management), social conflicts, promotion of PEU (Local Enterprises/MSME), increase in households during installation, risk of system oversize and undersize and climate/disaster resilient mini grids, amongst others.

Peter Godfrey, Managing Director – Asia Pacific at The Energy Institute moderated the panel discussion for session 2. Professor AbuBakr Bahaj, Professor of Sustainable Energy, Head, Energy and Climate Change Division at University of Southampton joined in the panel discussion. The following were discussed:

1. Can centrally-managed energy policy and decentralized mini and micro grid policy work together from a central government level or is there a need to create an independent regulator, that is working alongside the central government or to create a separate set of policies that promotes enterprise value at the local level and the mini & micro grid level?

Bahaj: 22-23 years ago, the World Bank recognized that rural electrification needs to happen in Africa and they created the rural electrification authority which is part of the Ministry of Energy. When many people came up to do mini grid projects, the regulators were concerned with regards to the quality of the installation and also the tariffs that will be imposed. These regulators are independent from the government. There was a very big grid expansion in Kenya, without realizing the consequences of the policy

Session 3: Private Sector Role: Innovations & Success Stories in the Development of Sustainable Mini-Grid Projects

The third session highlighted the different approaches used (i.e. innovative technologies to reduce risks, business models, etc.) in the development of mini-grid projects. The different approaches presented will form as a guide that can be applied and replicated depending on the situation and circumstance of a particular country.

The first speaker in this third session was Hyung- Su Kim, Senior Manager, New Business Department, Korea Electric Power Corporation (KEPCO). Hyung-Su's presentation revolved around the overview of microgrids, project background and implementation of the microgrids and about KEPCO Microgrid EMS.

Hyung-Su explained the reasons on why to choose microgrid being that microgrids improve flexibility and reliability of power grid, helps to mitigate climate change and eases the variability of renewable energy. He went on to show the difference between two types of microgrid; stand-alone microgrid and grid-connected microgrid. Hyung-Su also went through the various components of a microgrid which consists of Energy Management System (EMS), Power Conditioning System (PCS) & Static Transfer Switch (STS).

Hyung-Su went on to explain why Korea adopts the stand-alone microgrid. The cost of energy in Korea in 2014 statistics was 0.142$/kWh in the Island when compared to 0.587$/kWh when using the grid-connected microgrid in the Mainland which was 4 times more as compared to the COE in Mainland.

Hyung-Su shared two different projects that KEPCO was involved in, a stand-alone microgrid project in Ga-sa Island and a Grid-connected microgrid in the Shin-an District.

The second speaker for the session was Malin Östman, Manager (Project Development) at Wärtsilä Singapore. Her presentation revolved around the '*Larger Mini-grids and their future prospects*'.

Malin shared that the vision for Wartsilla was a 100% renewable energy future. Renewables are getting cheap and they should become the new baseload. They should be the baseload of the energy or electricity grids of the future. To balance that intermittency, there needs to be flexibility that could come from energy storage and also from flexible thermal technologies. To become 100% renewable energy, need to replace fossil fuels with renewable fuels or synthetic fuels made by green hydrogen.

Malin concentrated on three components of her presentation for the Small Islands, Mines Captives Industries, Larger Islands and Small & Medium size grids (10MW to 100MW+), where she will talk about why to hybridise and share a few examples and business models for private sector to invest in these decarbonization projects.

Malin shared that in a larger Hybrid Mini-grid, the Engine plant typically provides baseline power and balancing while PV generation displaces fuel. Mini-grids is the hardest application for Energy Storage

systems, because they need to do everything. For spinning reserves, there needs to be more engines running than are actually required to meet the load just to have spinning reserves. Outsource these reserved to Energy Storage as reserves which will allow to shut down one of the operating engines and if that is done, it basically means there can be an increase in the average load that we have on the engine units, which means efficiency is increased, about 2% – 4% increase.

The potential of a multihybrid solution compared to a conventional solution is that there is a 0% to 28% renewable penetration and 32% lower fuel consumption and 32% reduction in CO2 and a 19% reduction in levelised cost of electricity (LCOE). She went through 2 examples which adopts the GEMS Software Platform where there were saving made from integrating wind, solar and batteries, 10% to 33% if energy supplied by wind.

To end her presentation, Malin went through the business models for private sector involvement in larger mini grids. She mentioned that there are challenges faced by the customers in terms that a mini-grid with multiple assets is more complex to operate and the savings and cost reductions are dependent on successful integration of renewables. Hybrids are also highly CAPEX intensive due to multiple asset.

The third speaker for the session was Jaya Wahono, President & Director at Clean Power Indonesia. Hi presentation revolved around '*Accelerating rural electrification in Indonesia with community-based forest biomass*'.

Wahono shared that more than 50 million people in rural communities in more than 40,000 villages and 4000 islands are without access to reliable power, mostly in the Eastern part of Indonesia.

Wahono shared an example which shows the experience of people in Mentawai who do not have access to the Grid. People use kerosene lamps or expensive diesel genset for simple lighting which roughly costs about 10-20 times higher for electricity than what people are paying in Jakarta and other big cities in Indonesia. Some of them received solar PV grant assistance from Ministry of Energy, but they have difficulties in maintaining and replacing spare parts when it breaks down.

The first Community based mini-grid electricity scheme shows about how bamboo farming is sent to the power plant and in return, the local community gets electricity access and lighting and economic activities. The local village provides biomass for power plant and Regional Government will become part owner of the power plant. The Private Developer will then develop and build the source of biomass feedstock, the powerplant and the distribution network. The PLN will finally provide offtaker guarantee and distribute government's subsidy to local communities.

Locals are trained to be operators where every household receives 100 bamboo seedlings and they are given planting activities. Clean Power Indonesia aims to be able to sustain 1.5MW of power in the next 5 years to the whole village (an increase of 10x) where 270 households each receive 100 bamboo seedlings.

The challenges about electrifying remote villages is that government of Indonesia needs to assist with accessibility and offtaker guarantee. Wahono shared that 3 remote villages are electrified with bamboo which serves as a direct benefit to the local community.

To conclude his presentation, Wahono summed it up to say that biomass is abundant and bamboo can be planted in the forest areas all over Indonesia. Bamboo is planted once and can be harvested for more than 50 years. There are plenty of job opportunities created for the locals and there is a great GHG emission reduction of up to 3000 tons CO2e per year per village.

The final speaker for the session was Urvi Naik, Monitoring, Learning & Evaluation Associate at Mlinda Foundation. Her presentation revolved around the '*Lessons Learnt from Private Sector-Driven Mini-Grids in South and South-East Asia*'.

Urvi shared the Clean Energy as a trigger for Rural Development – The Mlinda Model. The clean energy in rural areas beyond lighting needs is to improve the commercial viability of the project and increase incomes while reducing carbon emissions. The installation of mini grids with main aim of rural development rather than pure access to energy will create the right socio-economic conditions and bring rural areas on low carbon-based development path that builds resilience to climate change.

Mlinda started work in the clean energy space with pico grids in Sunderbans, West Bengal – 310 pico grids installed. The model then evolved to mini grids from pico grids to cater for productive and commercial needs and the Gumla district of Jharkhand was chosen as it was amongst the poorest areas in India in terms of energy security.

The rural electrification project installs, operates and maintains village-wide solar powered mini grids in rural and tribal Jharkhand. There are 35 villages till date and Mlinda is looking at increasing it to 50 villages by 2020. The objective of the rural electrification project is integrated rural development using energy as a trigger. Each mini grid is approximately 20-23 kW designed to cater for 80% productive and commercial loads and 20% domestic loads. The sustainability and commercial viability of the model depends upon reaching 95% grid capacity utilization is 2 years.

4 main approaches for growing demand to improve livelihoods were identified which will lead to an increase in utilization, address the seasonality of the agricultural loads, improve quality of land and increase in counts.

The first approach is the swarm loads which are small capacity productive loads that is a simple and affordable technology that promotes equitable distribution of wealth. Examples of the swarm loads are welding machines, spice grinders, rice hullers, wheat mills, air compressors and EV batteries which amounts up to 58% in grid utilization.

The second approach is the end-to-end business which is an agri-business based on processing locally grown raw materials and creating market linkages for the final product. The end-to-end business creates a market for raw materials used – income opportunity for the farmers. This amounts up to 30% in grid utilization.

The final two approaches consist of the non-agri loads and the institutional loads. The non-agri loads is a diversification of local economic activity in order to make it more resilient and addresses the seasonality of loads like agricultural pumps. This contributes up to 20% in grid utilization. The institutional loads is powering health, education and banking sector and has partnerships with NGOs/Social Enterprise for

example digital dispensaries and e-literacy and contributes 10%-20% grid utilization. The institutional loads contribute to SDGs and a better quality of life.

Some challenges Mlinda faces is the seasonality of loads, access to institutional finance/soft loans, challenges with dispersed operations, technology improvements and replication and scaling. Urvi concluded her presentation by sharing about the way forward for Mlinda; 1000 villages by 2027 as a part of scaling and replication, preparation for scaling and replication will involve building capabilities in order to help potential partners to replicate the technology optimization, micro-enterprise development and organizational development.

Brian Dean, Head, Energy Efficiency and Cooling at Sustainable Energy for All, moderated the panel discussion for session 3. The following points were discussed during the panel discussion:

1. When we look at the business model, the financing compared to the revenue you get, how much money can you get and how much subsidies do you need in terms of percentage?

   Jaya Wahono: There are many things that comes into a project, not only electricity to the local population but also land restoration, community empowerment etc. But we only invest in the power plant and we are not going to spend money in creating the bamboo forest or build the grids for the first time in that community; that is taken up by other parties. In this case, the grid is being developed or built and maintained by PLN, Indonesia's state-owned company. The bamboo forest will be funded by the Ministry of Forestry in Indonesia, which is part of the land rehabilitation project. There is a new fund created, which is called '*Environmental Fund*'. It's a 5 Trillion Rupiah fund for now, but there is plans to increase the fund to 800 Trillion Rupiah which is about 60 Billion Dollars fund, for land restoration. This is part of our commitment not only to reduce our emissions by 41% but also we are going to create 12.7 million hectares of social forestry, and most of them will be in that remote island. So, our investment in the power plant, will not only bring electricity to 1 or 2 villages but also the whole island.

2. What is the best mix in terms of when we have a hybrid solution in terms of diesel, PV and batteries. What is the optimum mix?

   Malin Ostman: The answer is that it really depends on a lot of things. When I first started looking at hybrids, assuming that we have to produce 24/7 loads of reliable power, a rule of thumb that I used was that we could have 70% of the load as solar and still manage to balance that with the engine depending on what is the overall size and how many units you have available. Typically, we would like to have several units to be able to distribute the load and have that security. However, that was before energy storage became a big thing and now also because it has dropped in price. So, when

energy storage is added into the mix, we have a lot more flexibility and a lot more decrees of freedom and how we design and optimize our systems. Now we can have renewable energy installed capacity that is above the load, which we can charge and shift to achieve higher penetrations of renewables. As to what is the optimum mix for each scenario, it will vary from project to project and the main drivers are things like the fuel cost, as that determines where that trade of point comes, how much can be invested in additional capex displays fuel and as we go above the load, it becomes a curve of diminishing return. Another influencing factor is the availability of land and availability of resources, how much the renewables cost vs the thermal power. Reliability requirements is also a factor to consider for e.g., blackouts.

3. When you say you need to put a software on a smart system, one of the benefits is that it is very robust, it is easy to repair. But when we put a lot of complicated things together, it is much more difficult to maintain and manage. How do you solve this problem?

   Malin Ostman: Rural Electrification design criteria is a bit different and the idea is to minimize the maintenance that is very durable and easy to operate. That can also mean that there are more expensive designs that is sort of customer-tailored products. For larger systems, the software, yes, we would want internet connection for upgrades and for re-purposing it. We can have remote operations of these plants.

4. What are your on-ground capabilities in India? Do you own the design team, do you take care of the entire implementations? We want to know if you use a system to report the SDG goals?

   Urvi Naik: Our operations are based in Ghumal, district of Jharkhand where we have installed and operate 35 mini grids. We have a technical team and an operations team who stay in the villages and work with the community. In terms of reporting on SDGs, we engage with Sambodhi Research and Communications, they conduct the research for us, line assessments to show our progress on economic and environmental indicators. This is how we know where we are on each of our goals.

5. How do you involve your local community? Do you do this in parallel when designing the grids so that you know what is the capacity you would need? Do you have a forecast on your success rates of your projects and then involve the community?

   Urvi Naik: We select the sites after doing village surveys, detailed enterprise and household surveys which informs us on the existing loads in the village and uptakes of potential devices. Then we carry out this exercise called energy-mapping which is basically what is the potential conversion rate to the mini grid electricity, how many hours they run during the day which would give us the per day energy requirements of the village. We add a 20% buffer to account for increase in loads and this is how we get the size of the grids. We build our grids in a modular manner. The connected productive load profile is around twice the size of the grid and because they are not run at the same time, and through the process of road scheduling, we can provide power to many loads.

Session 4: Innovations in Finance: Creating a 21st Century Mini-Grid Sector

The last session, session 4 presents the different financing mechanisms and approaches available that has been implemented in mini- grid project development by different sectors. (PPP, private sector financing, public sector financing, etc.)

The first speaker for the session was Mikael Melin, Senior Energy Access Specialist at the Sustainable Energy for All (SEforALL). His presentation topic was on '*Energizing Finance*'. Mikael went through a few headline key messages on electrification which states that the finance commitments across the HICs in 2017 remain well below projected SDG7 requirements and that the electrification finance is increasing but too slowly. He shared that the finance commitments to HICs for electricity shows positive trends in absolute terms: USD36bn in 2017 versus USD30bn annual average in 2015-2016 but only USD12.6bn of total tracked finance commitments for electrification benefits residential customers which was twice the annual average in 2013-2014 but still 25%> projected requirement (USD51bn).

Mikael's presentation summarized that the off-grid/mini-grids are the most cost-effective way to provide energy access, especially in rural areas. There is an estimated US$220 billion needed to reach universal access by 2030 and a need to increase finance led by private sector, but public sector must also actively engage in scaling up finance: debt facilitation, subsidies, results-based financing. There is also a need to increase and demonstrate economic viability of mini-grids to scale-up financing.

There are positive trends emerging, but it needs much greater investment in centralized and decentralized renewable energy solutions. There is a need to look beyond BAU and grid connected investments to boost financial innovation and make more targeted market enabling investments and policy makers must prioritize emissions free, non-coal fired electricity as part of their integrated energy planning and investment plans.

The second speaker for the session was Surabhi Visser, Head of Investments at Sunfunder. Her presentation topic was on '*Financing Mini-Grids in Africa*'.

Surabhi shared that SunFunder is a solar finance business driving a global energy transformation to solve energy access and climate change. They fun pico-solar, solar home systems and C&I and income generating assets.

Surabhi shared that 10 companies had raised $190m by the end of 2017 which is about a 77% of sector investment. Only 12% of total investment was into the energy access sector and 83% of it was equity-scarcity of debt.

Surabhi shared that the Results Based Financing (RBF) Schemes in Africa has helped provide funding solutions for developers to scale. Programmes have been successfully contracted over 700k connection in at least six countries and each country's programme has adopted different structures and attracted different funders (DFID, SIDA, GIZ, World Bank, etc).

The key takeaways from RBF is that smaller companies can't sustain their businesses while waiting for concessional funds to be deployed. While waiting for concessional money, it is very hard to raise funding and build sites and it is common for developers to spend 2+ years to raise funding for 2-3 sites and this will not scale. The due diligence was heavy and at times incredibly cumbersome, as was time spent helping consultants design the program.

The third speaker for the session was Kapila Subasinghe, Vice-President (Specialized Project Lending)/Head of Consulting at the Development Finance Corporation of Ceylon (DFCC Bank). His presentation topic was about '*Enabling local banks in financing mini-grids*'.

Subasinghe's presentation outlined on why local banks are important but are reluctant at the same time, the risk mitigation involved and the holistic approach. He went through the 5 factors of why the local banks are important in terms of the loan size they provide, the transaction costing, cost of mobilization, outreach that the local banks have and the exchange rate risk.

However, these banks are also reluctant because of the lack of understanding in the technologies used for microgrids, resource assessment and environmental and social concerns. The banks also have their doubts on sustainability, where they have their doubts on the competency of developers, reliability of equipment and standards & regulations. Financial constraints and regional/rural presence are also among some of the factors the local banks are reluctant to finance these projects/companies.

To conclude his presentation, Subasinghe mentioned that we need an enabling environment that creates a conducive government policy, standardized arrangements to minimize barriers to entry and encourage investors to establish links with technically competent professionals.

Dae Kyeong Kim, Senior Energy Specialist (Head) Head, Energy Efficiency and Cooling at Sustainable Energy for All, moderated the panel discussion for session 4. Ruth Ramirez, OIC, Regulatory Affairs Office, National Electrification Administration, Philippines joined the panel discussion. The following points were discussed during the panel discussion:

1. There are funds being delayed. Is there a way around to unlock the funds being delayed?

   Surabhi: It's just the design has taken very long that there is a dedicated pool of funds meant for mini grids and solar assistance in Kenya and the time was taken in designing the programme and figuring out who can manage the funds. They did it differently, rather than the world bank giving approvals, they asked private institutions to be the managers. And for the solar home system segment, its SNV and SunFunder as our processes are faster. The design portion needs to be faster.

2. Is it the fund or the institutional capacity to absorb the fund that is available?

   Mikael: The money is there but the real challenge is how do we unlock that money and get it flowing into the sector. We have been discussing many of the building blocks that needs to be in place for that to happen. The absorption capacity needs to be at the banks level as well as the developers level and then to the consumer level to get that money flowing.

   Surabhi: I do think there is plenty of money out there. There is definitely a point of investor readiness and presenting your case but is also the point of matching the right type of capital to the project. For mini grids, the real challenge is on the operations side and not the construction side. So, for the operation side, that is more targeted towards concessional funding because the intention of the money is to be catalytic.

Annex 1 – Participant List

No.	Title	Full Name	Job Title	Name of Institution/ Organisation	Country
1	Mr	Kapila Subasinghe	Vice President (Specialised Project Lending) / Head of Consulting	Development Finance Corporation of Ceylon	Sri Lanka
2	Mr	Maung Win	Deputy Director General	Ministry of Agriculture, Livestock and Irrigation	Myanmar
3	Mr	Chaitanya Chaudhary	Engineer	Ministry of Energy, Water Resources and Irrigation	Nepal
4	Mr	Lukman Adi Prananto	Vice-President - Group Head	PT. PP Energi	Indonesia
5	Mr	Alex Barton	Dept Head Sustainable Development team	British Embassy Jakarta	Indonesia
6	Mr.	Abhinan	Executive	Schneider Electric	Singapore
7	Dr.	Adam Usad	Energy Center Advisor	ExxonMobil	Singapore
8	Ms.	Zhang Yanhong	R&D Engineer	Meidan Asia	Singapore
9	Dr.	Irene Goh	Director	Nippon Koei	Singapore

Annex 2 – Speakers List

No.	Title	Full Name	Job Title/ Position	Name of Institution/ Organisation	Country
1	Mr.	Jaya Wahono	CEO and Founder	Clean Power Indonesia	Indonesia
2	Mr.	Kapila Subasinghe	Vice President (Specialised Project Lending) / Head of Consulting	Development Finance Corporation of Ceylon	Sri Lanka
3	Ms.	Dipti Vaghela	Network Facilitator and Manager	Hydro Empowerment Network (HP-Net)	Myanmar
4	Mr.	Yosiyana Badariah	Programme Officer	IRENA	UAE
5	Mr.	Hyung-Su Kim	KEPCO Senior Manager	Korea Smart Grid Association	Korea
6	Mr.	Chaitanya Chaudhary	Engineer	Ministry of Energy, Water Resources and Irrigation	Nepal
7	Ms.	Rebecca Symington	Board Member, Trustee	Mlinda	France
8	Ms.	Urvi Naik	Monitoring, Learning & Education Associates	Mlinda	India
9	Mr.	Richard Harrison	CEO	Smart Power Myanmar	Myanmar
10	Ms.	Surabhi Visser	Head of Investments	Sunfunder, Inc	Kenya
11	Mr.	Mikael Melin	Senior Energy Access Specialist	Sustainable Energy for All	
12	Ms.	Ruchi Soni	Senior Energy Specialist	Sustainable Energy for All	USA
13	Mr.	Debajit Palit	Director and Senior Fellow	The Energy and Reources Institute (TERI)	India
14	Mr.	Peter Godfrey	Managing Director - Asia Pacific	The Energy Institute	Singapore
15	Ms.	Malin Ostman	Manager, Project Development	Wartsila Singapore	Singapore

Annex 3 – ADB List

No.	Title	Full Name	Job Title/ Position	Name of Institution/ Organisation	Country
1	Dr	Kee-Yung Nam	Principal Energy Economist	Asian Development Bank	Philippines
2	Dr	Zhai Yongping	Technical Advisor	Asian Development Bank	Philippines
3	Ms	Maria Dona Aliboso	Operations Analyst	Asian Development Bank	Philippines
4	Mr	Dae Kyeong Kim	Senior Energy Specialist	Asian Development Bank	Philippines
5	Ms	Ana Maria Tolentino	Consultant	Asian Development Bank	Philippines
6	Ms	Grace Yeneza	Consultant	Asian Development Bank	Philippines