Commercially Operating Mini-Grid Systems Workshop

October 16-17, 2014

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Overview

An estimated 1.1 billion people lack basic access to electricity, primarily in Africa and Asia. Lack of access to a reliable and sustainable commercial energy supply is an impediment to economic growth and the achievement of health and environmental goals in many developing countries. Mini-grids – small-scale distribution networks that provide power to one or more local communities and produce electricity from small generators using fossil fuels, renewable fuels, or a combination of the two – offer exciting possibilities for reducing the world's energy poverty. According to the International Energy Agency, mini-grids can help meet up to 40 percent of the electricity demand of rural populations globally by 2030.

On October 16-17, 2014, the U.S. Department of State, World Bank Group/ESMAP, United States Agency for International Development, and the United Nations Foundation hosted a two-day workshop in Washington, D.C. on the development and implementation of successful, commercially operating mini-grid systems. The workshop focused on proven private sector business models that are already in operation and leading the way in mini-grid deployment. The objective of the workshop was to convene practitioners, government officials, donors, academics, and investors to discuss the latest developments, experiences, and results in successful mini-grid implementation. More specifically, the overall goals of the event were (1) to facilitate knowledge sharing and peer mentoring among private sector practitioners; (2) to inform relevant investors of successful business models that can help them with their investment decisions; (3) to enable the sponsoring organizations to gather information on appropriate business models, financing options, and policies to inform their decisions; and (4) to develop a best practices report that summarizes the findings and lessons learned from the workshop and disseminate it widely.

On day one, experts presented their strategies for successful implementation of commercially viable mini-grids in four panels focusing on business models, financing, regulatory frameworks and policy, and emerging technologies and strategies necessary for scaling up mini-grid deployment. The second day featured small breakout groups with targeted participation that (1) focused on interventions related to business models (2) held in-depth discussions on investment opportunities in the mini-grids arena, and (3) developed recommendations on concrete policy/regulatory measures. Participants had the opportunity to share their experience, discuss best practices, brainstorm new ideas, and network.

Mini-grids are an early stage sub-sector of energy access. The data pool of mini-grid businesses is small since, at the time of the workshop, there were only approximately a dozen examples of mini-grid companies that serve more than three to five villages and had a significant number of customers. The purpose of this workshop was to share emerging learnings from the sector but also to discuss how to catalyze growth.

The workshop videos can be found at the following website: http://www.esmap.org/node/55292.

Executive Summary

The mini-grid sector is crucial in providing clean energy access and alleviating poverty in developing countries, but is hampered by a number of barriers such as insufficient access to capital, an absence of customer demand information, lack of a commercial framework, and policy uncertainty. A commercially viable mini-grid business model is one that is demand-driven, able to sustain itself based on the revenue stream that it generates, and able to expand based on blended finance (i.e. grant and non-grant financing from public and/or private sources). Over the course of the two-day workshop, mini-grid entrepreneurs provided their insights into what is needed to create commercially viable mini-grid businesses, focusing their discussion on four main areas: business models, access to finance, strategies for scaling, and regulatory frameworks.

Sound mini-grid business models that are based on a thorough knowledge of customer demand and willingness to pay, the regional market, and the real costs of the project are necessary to attract commercial capital. Determining customer demand for service can initially be achieved by surveying the local community members. Once a customer base has been established, an accurate customer energy load profile can be determined from the data collected from metering and can be utilized for demand forecasting. Taking a data-driven approach helps the companies better assess the number of people being reached and the real costs to reach them as well as how to manage load. It also helps give investors confidence that there is an established customer base with quantifiable cash flows.

Having standards in systems and processes is important to increase the performance efficiency of a mini-grid business. Given the relative novelty of mini-grid businesses, every village installation requires significant upfront development of a customized distribution model. There is not yet a standardized approach due to the unique challenges that arise given the local context and based on geographic location. Despite these challenges, the mini-grid businesses try to standardize the processes involved with the management and delivery of their electricity service. The companies employ several payment collection strategies, including pre-paid credit, mobile money, and household collection. Some also train and employ local community members to operate and maintain the systems, which results in lower costs and increased overall sustainability. It is also important that mini-grid businesses begin planning and preparing for scaling-up at the outset of their business development process and build relationships at the household level, showing customers that they are trustworthy and committed to providing quality products and services.

Access to the right type of finance at different stages of business development is crucial for scaling mini-grids. There is typically no shortage of money to support mini-grid businesses; the problem is a lack of the *right type* of money. The key is matching the appropriate type of funding (i.e. grants, concessional, and commercial finance) with the right companies based on their stage of development and level of profitability. There are many pilot projects in the early stages of development with sufficient donor grant funding available to them. However, there needs to be greater transparency in donor funding so that the funding is well-coordinated to have the greatest impact in helping to get these small companies to scale. Despite the need for more scaling up,

there is often a lack of finance to help companies that have proven that their business model can deliver impact move their operations to scale. One possible solution to address this issue is to provide blended capital (i.e. a combination of grants and loans) or concessional finance until these companies grow to the point where they can qualify for bank loans. Currently, banks view the mini-grid sector as offering unacceptably high risks. Large development finance institutions could provide funding to intermediaries, which would then conduct the necessary due diligence on the mini-grid businesses in order to appropriately disburse these funds according to a standard set of clear criteria. It is important that the intermediaries have a deep understanding of the local market and can tolerate the high level of risk associated with these companies. Furthermore, streamlining, standardizing, and coordinating due diligence, where possible, helps eliminate the need for constant, time-consuming, analysis of mini-grid companies by potential investors. There may also be a significant need for bridge financing, distinct from working capital, which is required at specific intervals over the course of a company's operations in order to support it until it receives its next tranche of funding or until it closes on a specific loan. Often mini-grid companies have a commitment to receive funding according to a planned schedule, but it may not be readily available when they need it to pay up front costs.

Overall, the mini-grid companies were skeptical of the sentiment that policy measures and regulations that cap tariffs in off-grid areas would be helpful in scaling their business operations. They preferred that the government not regulate the mini-grid sector and expressed concern that regulation would affect business costs and revenue. More specifically, tariff rates and Customs protocols can be a major factor influencing whether a mini-grid business will have a commercially viable operation. In order for mini-grid businesses to be successful, it is essential that governments in the countries where they are operating provide clarity on their tariffs for off-grid energy equipment and have transparency regarding their Customs protocol on an ongoing basis. Mini-grid companies also need policy clarity from the local government regarding its plans to expand the centralized grid, and options for connecting to the grid if and when it arrives, so that they can plan accordingly. Some companies suggested that the government should compensate them for the financial losses incurred when the main grid arrives unexpectedly into regions where they have established mini-grids since they are providing a public service. Other companies wanted greater legal certainty regarding their investments in mini-grids in rural communities since currently there is little legal recourse if a rural community decides to renege on the initial terms of an agreement.

Day One Panel Session Summaries

Panel 1: Business Models for Commercially Viable Mini-grids

Moderator: Ms. Christine Eibs-Singer – UN Sustainable Energy for All
Panelists: Mr. Didar Islam – SOLARIC, Mr. Fabio De Pascale – Devergy, Mr. Chris Hornor – Powerhive, Mr. Nikhil Jaisinghani – Mera Gao Power

Brief Company Overviews

- SOLARIC, an R&D driven technology company based in Bangladesh and founded in 2009, focuses on delivering solar energy for household and productive use to off-grid populations.
- Devergy is a social enterprise founded in 2010 which is committed to providing an affordable and reliable source of energy to the off-grid, low-income population throughout Tanzania.
- Powerhive is a technology venture founded in 2011 that partners with utilities and independent power producers to provide access to productive, affordable, and reliable micro-grid electricity for millions of homes in rural Africa.
- Mera Gao Power (MGP) is an Indian company that builds, owns, and operates micro-grids in Uttar Pradesh, India, serving off-grid villages with high quality, dependable lighting and mobile phone charging services.

The panelists emphasized that sound business models that attract capital are key for scaling up rural electrification efforts through the large-scale deployment of mini-grids. Four key takeaways from the panel were: 1) the need to translate lessons learned from other sectors such as information technology, small and medium enterprise (SME) lending, and microfinance to apply them to mini-grid development and finance; 2) to know your customer, for example, their view on ownership, and understand what is affordable and the customer's willingness to pay for services (demand); 3) the importance of standards in systems and processes in increasing performance efficiency; and 4) supporting and replicating successful companies and entrepreneurs, learning from them, and helping them by programmatic efforts which help scale-

up mini-grids through long-term, public-private finance and ease of access to information on energy efficient appliances. Regarding efficiency, SOLARIC noted that there must be efficiency in payment collection, delivering after-sale service, and energy efficiency from generation to load, which occurs through technological innovation. For example, using smart electricity meters to determine demand and manage electricity theft, and using inverters which allow the use of both DC and AC appliances to reduce costs along the entire supply chain.

Several panelists emphasized the importance of selling services instead of energy (kilowatt-hours). MGP remarked that product sales work in some countries and not in others and noted that customers are willing to pay different prices for different services. For example, phone charging in northern India is crucial for communication and entertainment and people there tend to place a higher value on it than basic lighting. Additionally, Devergy suggested a tiered service model, for example, where the customer starts off with basic lighting and cell phone charging, and then incrementally increases to higher levels of service based on greater electricity demand.

The mini-grid companies had the same characteristics of regular start-up companies in their efforts to scale-up. They initially self-financed, raising funds from friends and family. With those funds they were able to launch pilots in a modular and scalable fashion, which enabled them to determine the true costs for infrastructure and to get a better understanding of their customer and technology. Once they got traction, some were able to obtain small grant funding from entities like USAID's Development Innovation Ventures. Then they obtained their first round of private equity seed money. And in the case of SOLARIC, once it had a proven track record with a revenue stream of $12 million per year, it was able to get commercial debt (i.e. bank) finance and raise additional equity. One notable exception to the typical start-up company model is that the mini-grid business model is completely new. Consequently, these companies need to be creative in the laborious tasks of setting up supply and electricity distribution models, an operation and maintenance market, and other market items such as payment collection.

The companies had several different types of payment structures and collection strategies ranging from digital pre-paid DC energy meters, to mobile money, to household collection. The strategy for payment collection is market dependent – based on the customer and location. SOLARIC began with door-to-door payment collection but quickly realized that it was too expensive, especially given potential customer defaults on payment or because of overhead costs due to corruption. To improve its collection efficiency, it switched to pre-paid, code-locked, energy meters but, instead of automating everything, customers can purchase credit at the local level using mobile money in the field. The customer then receives a code to unlock the energy system for use the next month. SOLARIC nano-grid clients pay a flat tariff of $5 per month for a specified load, with those using larger loads (i.e. for irrigation) topping-up their payments. Powerhive, which operates in Kenya, uses mobile-money for everything since it cannot support scratch cards. It has a flexible tariff-model based on the rate at which energy consumption increases. It also provides small loans to some of its customers. Devergy uses a metered solution selling credit for a basic service and allows payment up front followed by top-ups on an as-needed basis. It uses mobile money for collection; most of its customers go through a dealer using cash and then the dealer pays Devergy with mobile money. MGP provides basic lighting and phone charging services at a flat rate. It cost MGP about $40 per household to connect the solar DC micro-grid and less than $1,000 to provide service to a typical hamlet. MGP noted that

there are no prepaid meters and mobile money in northern India so they send people to collect money from each village. The village customers form joint liability groups that are responsible for ensuring timely payment. Household collection is still the cheapest way for MGP to get paid.

The companies shared the sentiment that policy measures and regulation were not helpful in scaling their business operations. Devergy said that small-scale (less than 1 MW) micro-grids should be unregulated. SOLARIC noted that the government is not well-suited to provide electricity services in off-grid areas given its reactive rather than proactive nature. MGP stated that Indian law allows electricity providers to electrify villages without restriction.

The companies also do not heavily rely on banks for financial support. The biggest hurdle is that banks cannot tolerate the high level of risk associated with the mini-grid sector. Additionally, many banks do not have branches in rural areas and so it is difficult for village level entrepreneurs to find funding. When bank funding is available, solar panels and batteries are generally sought as security for the loan. Lastly, most local banks have inadequate long-term funding and an inability to see beyond a period of five years.

Each company engages the local community in its operations to varying extents. The local community is a large part of Powerhive's business operations since it is involved in 80 percent of the construction work, with women making up the majority of the workforce. This gives the community a sense of system ownership. The companies utilize local technicians to do the solar system installations and local entrepreneurs to be their solar system dealers. MGP noted that 98 percent of the people it hires are local but not from the village where the solar installations will take place. This is to avoid problems with dealers clamping down on fellow neighbors who do not pay for the service. MGP also commented that it had difficulty working with local non-governmental organizations (NGOs) to facilitate community engagement because the NGOs often exaggerated the services that MGP would provide such as by advertising free electricity for everyone.

Panel 1 Key Takeaways

- Sound mini-grid business models are necessary to attract capital and must be efficient in payment collection, in delivering after-sale service, and be energy efficient from generation to load.
- Mini-grid companies must focus on selling energy services rather than energy (kilowatt-hours).
- Engaging the local community in the plans and activities for deployment of the mini-grid system is crucial for community buy-in and to form a long-term relationship.

Panel 2: Financing for Commercially Viable Mini-grids

Moderator: Ms. Niki Armacost – Arc Finance
Panelists: Dr. Pepukaye Bardouille – International Finance Corporation, Mr. Chris Aidun – Persistent Energy Partners, Mr. Jonathan Kirschner – U.S. Agency for International Development, Ms. Brinda Ganguly – Rockefeller Foundation

Brief Company Overviews

- The International Finance Corporation (IFC) is the largest global development institution focused exclusively on the private sector in developing countries. IFC's engagement in energy access cuts across interrelated investment and advisory activities.
- Persistent Energy Partners (PEP) is a merchant bank which partners with and invests in businesses that provide clean energy services to off-grid customers in sub-Saharan Africa.
- USAID Development Innovation Ventures (DIV) is an open competition modeled on a venture capital fund which provides grant financing from under $100,000 to $15 million to support breakthrough solutions to development challenges around the world.
- Rockefeller Foundation has a $75 million *Smart Power for Rural Development* initiative focused on supporting energy service companies' efforts to provide clean energy service (via solar and biomass) to rural customers in India.

The panelists remarked that the off-grid electricity service sector is producing innovative business models and that mobile payments have supported the scale-up of mini-grids. They explained that there are many mini-grid businesses in the pilot phase that eventually fail in the *valley of death* (stage two of Figure 1) before they are able to move to scale.

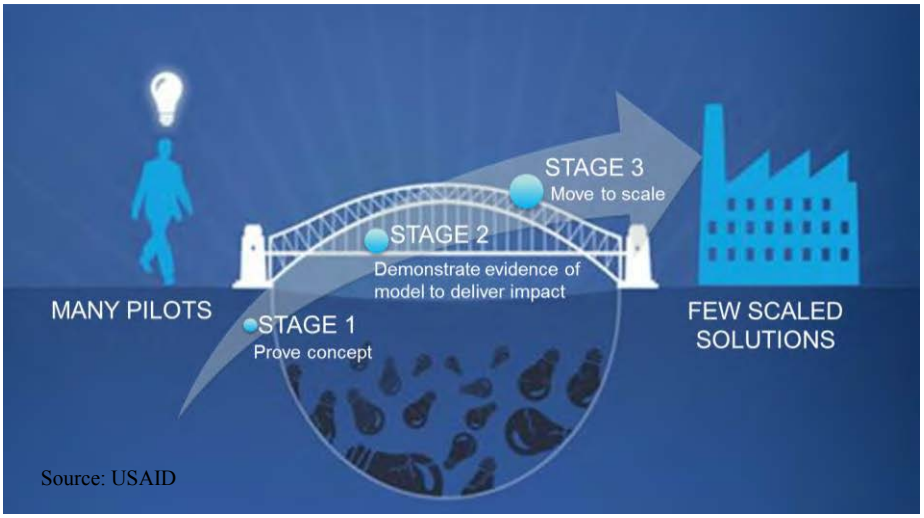


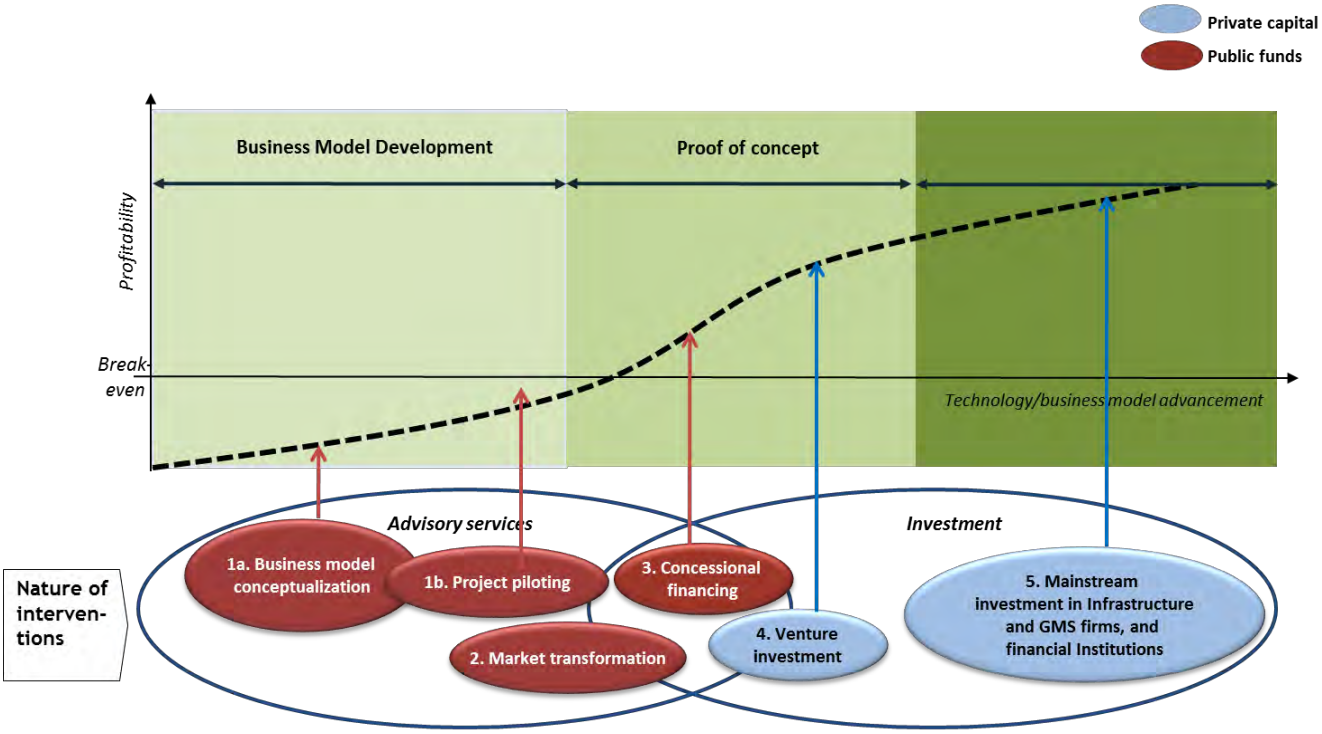
Figure 1: Many mini-grid businesses fail before getting to scale

PEP estimates that on average, mini-grid businesses have a life span of seven years. The problem of scaling mini-grid business solutions is not a lack of money but rather a lack of the *right type* of money. There is no shortage of donors wanting to support interesting off-grid energy activities but the key is matching the appropriate type of money (i.e. grants, concessional, and commercial finance) with the appropriate companies based on their stage of development and level of profitability as seen in Figure 2. At the entry level stage, pre-commercial venture investors like PEP do not invest in these businesses unless the ratio of the average investment per user to the average revenue per user makes sense. IFC invests in mature markets (far right of Figure 2), which currently excludes the mini-grid sector since it is small-scale and high risk. PEP underscored the challenge of helping mini-grid businesses cross the *valley of death* to the commercial finance stage and highlighted the need for financing to bridge this gap. PEP estimated that $30 billion is needed to do this and that this capital must be invested early on to reduce the time frame needed to scale numerous mini-grid businesses.

The panelists also discussed the characteristics that they generally look for in mini-grid companies before they invest. Some features of mini-grid startups that receive investment are as follows: they have a robust and sustainable business model; strong sector knowledge (i.e. thorough knowledge of the customers' willingness to pay); an understanding of the number of customers the mini-grid will serve; an experienced management team, operational capacity; and demonstrated cash flow. However, PEP also noted that "it is all about failure" and that investors must "take a leap of faith" investing in several companies knowing that most will ultimately fail.

The panelists also described some of the risks inhibiting investment in mini-grids, including operational risks, regulatory risks, and the risk of unexpected grid expansion into the area where the mini-grid company is operating. Operational risks include obtaining enough local customers to buy in to the mini-grid service, the complexity of supply chain logistics in getting needed materials through Customs, and the fear that the companies will scale until a certain point but then hit a ceiling and stagnate. Regulatory risks include the government subsidizing or providing free electricity to customers and local laws subjecting the companies to tariffs. Another

regulatory concern is that the mini-grid company will attract the local government's attention as it becomes more successful and expands, leading to regulation or competition. To support the companies in managing these risks, USAID provides technical assistance and The Rockefeller Foundation provides operation and maintenance (O&M) support and policy clarification regarding local mini-grid regulations.



Source: IFC team analysis

Figure 2: Interventions can be mapped along a curve of business model maturity and profitability

Panel 2 Key Takeaways

- Matching the right type of money (i.e. grants, concessional, and commercial finance) with the appropriate companies based on their stage of development and level of profitability is necessary to scale-up mini-grid businesses.
- Typical characteristics of mini-grid startups that receive funding are they have a robust and sustainable business model; a strong understanding of the market; an experienced management team, and demonstrated cash flow.
- Risks inhibiting investment in mini-grids include operational risks, regulatory risks, and the risk of unexpected grid expansion into the area where the mini-grid company is operating.

Panel 3: Emerging Technologies and Strategies for Scaling up Mini-grids

Moderator: Dr. Johannes Linn – Brookings Institution
Panelists: Mr. Unai Arrieta – Trama TecnoAmbiental (TTA), Ms. Allison Archambault – EarthSpark International, Dr. Vijay Modi – Columbia University Earth Institute, Mr. Piyush Mathur – Simpa Networks

Brief Company Overviews

- Trama TecnoAmbiental (TTA), founded in 1986 and based in Barcelona, Spain, is an international consulting and engineering company that specializes in distributed generation through renewable energy sources, energy management and efficiency, and rural electrification.
- EarthSpark International is a non-profit organization working to eradicate energy poverty through business models that deliver sustainable energy services to off-grid consumers in Haiti.
- The Columbia University Earth Institute brings together the people and tools needed to address some of the world's most difficult problems, from climate change and environmental degradation, to poverty, disease, and the sustainable use of resources.
- Simpa Networks is an energy access company that uses innovative pricing and packaged finance models to make energy accessible and affordable to the rural poor in India.

The panelists discussed the technologies and strategies that they use to scale up their mini-grids, which mostly focused on their use-based tariff structures that enable customers to pay for what they use through, for example, pre-paid metering systems, and mobile money. They also stressed the importance of planning and preparing for scaling-up at the outset of their business development. TTA uses a tariff structure based on an energy daily allowance that charges a flat fee based on the equipment and energy usage, thereby reducing transaction costs. TTA utilizes an energy meter, which works using RFID cards, to manage the customer's electricity usage and it receives mobile payment. Earthspark International developed the SparkMeter, a low-cost smart metering system, currently deployed in Haiti, which enables prepayment for electricity and gives the utility the ability to remotely monitor and control their customers' energy usage. Simpa

Networks also uses prepaid metering technology for its solar home systems. Once the customers have paid for the solar home system over a 28-month period, it belongs to them.

The panelists also identified challenges to scaling up which include winning the community's trust, maintaining system affordability, continuously building new rural infrastructure to keep up with growing customer demand, and preventing product theft. Simpa Networks said it is crucial to build relationships at the household level showing customers that they are a committed, long-term company that is providing quality products and services. Concerning affordability, it is necessary to determine whether the business pricing model will operate as pay-as-you-go or as a flat rate for electricity. TTA encountered difficulty adapting its fee for daily energy service model to different countries, commenting that it is important to change the tariff algorithm based on the customers' needs.

For example, for customers who travel often, a purely metered solution may be optimal. Furthermore, having different payment programs in place is important for customers like agricultural workers who do not have a steady stream of monthly income to pay at the end of the month but rather who can only pay during certain days of the month. Producing system components locally can also dramatically reduce the equipment cost since getting materials through customs can add 20-30% to the products' cost. Simpa Networks noted that producing everything locally can be problematic, however, as the company scales up. As a result, it has had to source some equipment like solar panels from China. All of the companies source local talent for installation and O&M to reduce cost.

Regarding creating new infrastructure to accompany market growth, the companies expressed frustration with having to build from scratch each time they move to new villages but highlighted the importance of a standardized approach for speed of execution with scale. The companies sometimes experience problems with theft but they have employed several strategies to dramatically reduce it. Specifically, smart meters can be used to remotely monitor and identify where power is being stolen on the grid and to turn off supply to that area. If the customers are all sharing power from a central generation point, metering has to be done at the source of electricity generation and not the customer's house. Additionally, community policing is effective in this scenario since the customers are all sharing power and so stealing by one customer affects the rest. Creating a sense of ownership of the energy system in the community through community involvement also helps prevent theft. However, this is expensive and technically complex since it adds on several layers of energy conversion. Lastly, the realization that the value of the solar equipment in operation is greater than the value of its separate parts serves as a deterrent to theft.

Panel 3 Key Takeaways

- It is crucial that mini-grid companies plan and prepare for scaling up at the outset of their business development.
- The mini-grid company must determine the optimal use-based tariff structure and payment collection method (i.e. prepaid metering systems, mobile money, door-to-door collection) based on what works best in the region where it is operating.

- Challenges to scaling up mini-grid businesses include winning the community's trust, maintaining system affordability, continuously building new rural infrastructure to keep up with growing customer demand, and preventing product theft.

Panel 4: Regulatory Frameworks and Policy for Mini-grids

Moderator: Dr. Bernard Tenenbaum – Independent Energy Consultant
Panelists: Mr. Mayank Bhargava – NextGen Solar, Mr. Alakesh Chetia – SunEdison, Mr. Yashraj Khaitan – Gram Power, Mr. Mike Gratwicke – Rift Valley Energy

Brief Company Overviews

- NextGen Solar is a U.S.-based, renewable energy company focused on building and operating utility-scale, photovoltaic solar power plants in sub-Saharan Africa to bring plentiful, reliable, and more affordable electricity to remote rural areas. It has operations in Tanzania, Kenya, and Uganda.
- SunEdison, headquartered in California, manufactures advanced solar technology and develops, finances, installs, and operates distributed solar power systems, delivering cost-effective electricity and services to its residential, commercial, utility, and government customers.
- Gram Power is an energy technology company based in Rajasthan, India that is focused on smart metering and monitoring systems for power distribution in rural areas.
- Rift Valley Energy, set up as a 100% subsidiary of Rift Valley Corporation in 2009, is an energy company which develops, owns, and operates industrial-scale renewable energy generation and distribution projects in sub-Saharan Africa.

Regulation affects a business's costs and revenues so it is important that the benefits of regulation exceed the costs. There are three main types of regulation: tariffs, licensing and permits, and quality of service on both the technical and commercial sides. There are also three types of sales: sales to retail customers, bulk sales to the utility, and the sale of backup power. The panelists had different experiences with tariffs regarding these three types of sales. Rift

Valley Energy calculated tariffs without a subsidy for bulk sales and ensured that its retail tariff was set lower than the national tariff. It purchases power under a standard power purchase agreement (PPA) and sells power on a per kilowatt-hour (kWh) basis. Both SunEdison and Gram Power explained that the off-grid electricity sector in India is completely unregulated because the Indian government has a decentralized electricity policy under its India Electricity Act. Prices are established between the customer and the power provider. In the context of India, a $0.05-$0.10/kWh tariff is typical because customers can observe the rates that their grid-connected neighbors are paying. In fact, the Indian government supports private mini-grid developers by providing a 50 percent subsidy on their capital cost. Additionally, the Indian government does not regulate the price that the power producer charges its customers except for when it selects contractors to implement its rural electrification tenders based on the cost to the government. NextGen Solar noted that the electricity rates published by the regulator are not the actual rates that the company must pay once risks like currency fluctuation are taken into consideration. The company then needs to get insurance such as that offered by the World Bank's Multilateral Investment Guarantee Agency, which ultimately increases the cost of business.

The panelists expressed uncertainty about the time frame for expansion of the main grid and discussed the coexistence of mini-grids and the main grid. Gram Power and SunEdison said grid expansion in India is unpredictable and suggested that guidelines for grid expansion would be a useful addition. They also noted that political promises of grid connection can be problematic since they raise a false sense of expectation among potential mini-grid customers who believe they will eventually be connected to the main grid for free. The mini-grid systems are compatible with the main grid but the developers must pay a grid connection fee. Gram Power is able to address the problem of the unpredictability of grid expansion as the Indian government subsidizes its mini-grid infrastructure and so if the government then decides to expand the main grid after doing this, the government will share the financial loss associated with those assets. Currently, there is no framework for interconnection between the mini-grid and the main grid. However, Rift Valley Energy is grid-connected and supplies power when the grid is unreliable.

The panelists also described the unreliable nature of the main grid, which provides an opportunity for the mini-grid operator to supply power. They noted that people are willing to pay for better quality service because villagers in electrified villages often spend significant sums of money on kerosene because of a lack of quality grid service.

Panel 4 Key Takeaways

- Regulation affects a business's costs and revenues so it is important that the benefits of regulation exceed the costs.
- The unreliable nature of the main grid and the customer's willingness to pay for quality service provide an opportunity for the mini-grid businesses to supply power.
- Mini-grid companies need policy clarity from the local government regarding its plans to expand the central grid so that they can plan their business development strategies accordingly and not have to worry about losing their investment once the main grid arrives to a village or region where they are operating.

Key Takeaways from Workshop Breakout Sessions

Finance

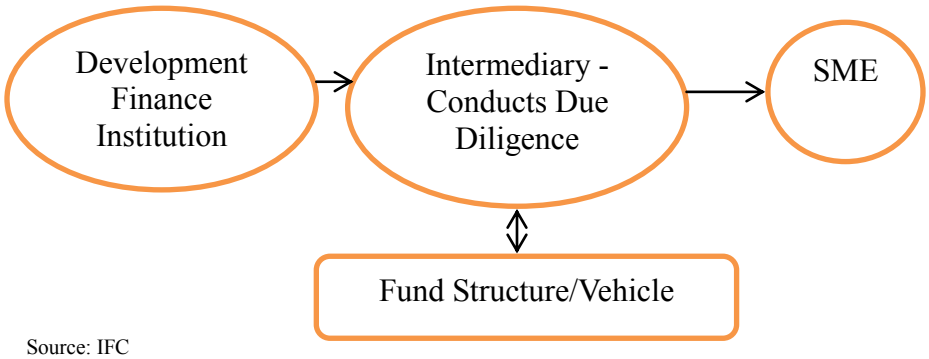
Need for Coordination of Due Diligence Screens and Funding

A major underlying problem for practitioners in the mini-grid space is the need to constantly convince financiers that their company is worthy of funding. Several mini-grid practitioners expressed frustration that they have to repeatedly go through the due diligence process. To increase transactional efficiency, they recommended streamlining this process and standardizing requirements between donor agencies and financial institutions which currently each have their own funding criteria. However, simplifying the due diligence process increases the risk to the investor.

There is also a need for transparency in donor-funder coordination. There are many pilot projects and sufficient early stage grants for them. However, despite the need for more scaling up, there is often a dearth of finance to help companies move to scale, even after they have proven their business model can deliver impact. There are different types of financing (i.e. equity, debt, and grants) and it is crucial that those streams of financing are coordinated in a transparent fashion to make the largest impact in helping these small companies move to scale.

Intermediaries, Loan Guarantees, and Bridge Financing

One possible solution to help small mini-grid companies obtain the necessary funding to scale up is utilizing intermediaries and bridge financing. Large, impact investors like the International Finance Corporation (IFC) cannot tolerate the high level of risk associated with small mini-grid companies. IFC would probably need to see that a company has completed at least 10,000 electricity connections before it felt comfortable enough to invest. In order for the Overseas Private Investment Corporation (OPIC) to fund a small-scale mini-grid business's project, it needs to be vetted through OPIC's due diligence and credit approval process which includes demonstration that the project is commercially viable. As part of that process, OPIC reviews such things as the business plan, financial model, sponsor and construction contractor track record and experience, and project concept, design and technology. In the case of small projects, IFC often works through funds that know the region and the market and are able to undertake their own due diligence.



Source: IFC

Figure 3: An intermediary can lend to the SME

The intermediary would ideally have access to blended capital (i.e. equity, debt, and grants) provided by public and private sector donors and investors. This eliminates the problem of these three finance structures being fragmented in the marketplace. Currently, there are not enough intermediaries in the market to support debt-equity investors. The microfinance sector is a good place to look for relevant solutions to this challenge.

Another potential solution to resolve the problem that mini-grid businesses are having with getting access to commercial loans is USAID's Development Credit Authority (DCA). The DCA uses partial guarantees to reduce risks to generate additional lending to underserved markets and sectors. Since it started in 1999, it has signed 451 guarantees in 74 countries mobilizing $3.7 billion in private financing for over 166,000 borrowers. The DCA provides U.S. Treasury-backed guarantees to lenders in the form of loan and loan portfolio guarantees, portable guarantees, and bond guarantees. In Bangladesh, for example, where the banks have large cash reserves but are not prepared to loan money in this new mini-grid market, these guarantees may help to unlock finance. The DCA offers loan guarantees to cover up to 50 percent of project debt finance, in any currency, which gives the company the flexibility to shop around for bank loans. To access the guarantee, the company needs to demonstrate a two-to three-year track record.

Another obstacle that prevents mini-grid companies from scaling is having access to funding when they need it. Companies need bridge financing, which is different from working capital, at specific times over the course of their normal operations to help sustain them until they receive their next tranche of funding or until they close on a specific loan. Often they have a commitment to receive funding but it is not readily available when they need it and the banks are not prepared to provide commercial loans to these companies. For example, one mini-grid company received a million dollar grant which will be disbursed over a period of three years but the technology suppliers needed the money up front resulting in a funding gap. Delays in receiving funding also mean that the company has trouble paying employee salaries. A couple of possible solutions to address the bridge finance gap are to have foundations provide bridge loans in the short-term and, in the long-term, to have an intermediary provide a bridge loan from a fund structure (Figure 3) based on a predetermined checklist. For example, The Rockefeller Foundation provides guarantees to Indian banks to provide bridge loans to energy service companies.

Business Models and Strategies for Scaling Commercially Viable Mini-grids

Commercially Sustainable Business Models

A commercially viable mini-grid business model is one that is demand-driven, able to sustain itself based on the revenue stream that it generates, and able to expand based on blended finance. In contrast, a non-sustainable business model is one that needs long-term grant money or subsidies in order to continue its operations. However, it is important to realize that mini-grids are being used to serve villages with no electricity access and so there is a public good dimension which may require support from the public sector. Additionally, most of the mini-grid businesses require early stage grant funding to start and to absorb the initial risk associated with the project before they can receive commercial finance.

Challenges to Scaling Commercially Viable Mini-grid Business Models

Challenges to scaling commercially viable mini-grid business models include access to information on customer demand for energy services and forecasting potential for growth; acquiring local talent for installations, implementation and payment collection; and financing mini-grid expansion. The first step is for mini-grid companies to determine market size; potential for market growth; the customer demand for electricity service; and to understand the capital requirements for initiating and then maintaining business operations 15-25 years afterwards. This market research phase is time-intensive but not expensive. Determining customer demand for service can initially be achieved by surveying customers, be they individuals or institutions, at the micro-level and through demand forecast modeling at the macro-level. Once a customer base has been developed, more accurate energy demand forecasting can be done from the aggregated energy consumption data collected from metering over time.

This data-driven approach will give the company a better idea of the number of people being reached by the electricity service and the cost to reach them. It will also help the company to contrast how much energy people think they will use, based on surveys, with what they actually used. Experience has shown that customers rarely adhere to the amount of power that they estimate they will use. Rapid scale up of mini-grid deployment would benefit from access to market demand information *a priori*, either from a local government institution or non-governmental organization. Additionally, the government could identify and authorize clusters of regions of the country which it does not plan on electrifying in the near-term, for large-scale mini-grid development.

Given the relative novelty of mini-grid businesses, village installations will often require significant up front development of a custom distribution model (Note: some mini-grid companies like SOLARIC do, however, offer more of a turn-key approach). There are unique challenges that arise given the local context based on geographic location. For example, when the mini-grid company enters a new village, it has to get community buy-in, train local personnel to install and maintain the physical infrastructure (i.e. wires, meters, solar panels, etc.), lay the groundwork for the distribution model, and establish the payment system. Some customers may prefer to pay for service up front to avoid future payment problems whereas others may be suspicious of the company and refuse to pay in advance. Most companies will not develop the energy infrastructure unless there is some form of up-front payment

Payment method depends on the region. For example, mobile money platforms are widely available in East Africa but are not as common in West Africa. The company also has to make sure that a system is in place for O&M to deliver quality, after-sale service. This is based on the ability of the company to acquire and develop local talent through capacity building and training. As companies scale, they need to have enough human capital to increase production since the goal is to build mini-grids in parallel rather than in sequence.

One company noted that getting authorizations from the local community and government authorities is an important step to build a reliable pipeline of investment projects, but can result in implementation delays. The required authorizations typically take one to two months, and the company uses them to get funding, which can take at least eight months. The problem arises

because by the time the company is finally ready to begin the electrification work, there is an atmosphere of community distrust, since it took so long to start relative to when rumors first started to swirl about the project.

Regarding mini-grid businesses obtaining the necessary commercial capital to scale, the companies stated that their business models are profitable based on customer willingness and the ability to pay for quality service. They are confident that they can scale their businesses but are often unable to translate their success in the field into meaningful language that convinces commercial lenders to finance what they perceive to be a high-risk sector. Despite the fact that few of the companies are ready for commercial capital, since their return rates are below market rates, assistance provided through concessional finance and mezzanine debt (i.e. between debt and equity) can be used to help them scale to the point where they can get loans from commercial banks. It may be easier for a company to get a commercial loan once it has mezzanine debt, since banks view this as a first loss buffer and thus there is less risk. The companies expressed the need for guidance on the required steps and the boxes that they must check in order to receive commercial capital from banks and large financial institutions like OPIC.

Regulatory Frameworks and Policy for Mini-grids

Regulatory Clarity on Tariffs and Customs

Tariff rates and custom protocols can be a major factor influencing whether a mini-grid business will have a commercially viable operation. For example, one company noted that Customs timing is an issue since they never have certainty on how long it will take them to get their equipment through Customs, which leads to implementation delays. Another company stated that there is a need for clarification of the Customs codes in countries where they operate. In Tanzania, for example, there is a blanket exception for solar energy products from the value-added tax. However, the company is unable to figure out how to get that exception, which would automatically result in a 19 percent increase in its revenue. It would also be useful to have policy guidance on Customs definitions for energy equipment terms such as micro-grid and distributed energy.

Given these challenges, the mini-grid company representatives discussed the need for a database or toolkit for each country that lists the relevant Customs tariff rates, the key Customs contact person, and recommendations based on previous practitioner experiences with importing electrification system components into a country and dealing with tariff regulations. The United Nations Foundation has created an up-to-date database on its website (www.energyaccess.org) for all Sustainable Energy for All countries that covers off-grid solar system components. It is currently working on updating this website to include space for notes from those operating in the field to describe their experience importing electrification system components. This added feature will be similar to the idea behind Wikipedia, in that it will help facilitate community-driven, sharing of mini-grid information.

Policy Clarity on Future Grid Expansion

Several mini-grid companies expressed frustration with the lack of policy clarity from local governments regarding their main grid expansion plans. These companies do not know where or when the main grid will expand and this risk adds complexity to their business operations once they have heavily invested in developing energy system infrastructure in a rural area. They need certainty regarding what will happen when the main grid arrives and need to have an exit strategy in place. Some companies suggested that the government compensate them for the financial losses incurred when the main grid arrives unexpectedly into regions where they have established mini-grids since they are providing a public service. Companies reported that people are willing to pay for quality electricity service given the unreliability of the main grid (i.e. frequent power outages). However, the companies noted that they cannot compete against free or heavily subsidized electricity, which is often the case when the main grid arrives based on political promises.

Legal Clarity on Contractual Agreements in Mini-grid Space

Several companies stated that there was legal uncertainty regarding their investments in mini-grids in rural communities. They said that there is little legal recourse available in rural villages if the community decides to renege on the initial terms of an agreement. Some companies have tried to use community advisory boards or have customers sign agreements to address this but even these measures are not foolproof. Companies also noted that they are cautious about forming local partnerships during the early stages of their ventures because this can be risky, but agreed that partnerships to better understand the communities and develop trust are beneficial in the long-term.

Appendix: Organizations Working in/Funding Mini-grid Space

USAID's Powering Agriculture: An Energy Grand Challenge for Development (PAEGC) : In 2012, USAID, the Government of Sweden, Duke Energy Corporation, the Government of Germany, and OPIC partnered to create a $47 million program to support new and sustainable approaches to accelerate the development and deployment of clean energy technologies and innovative business models for farmers and agribusinesses in developing countries. PAEGC supports the implementation of clean energy solutions within the energy/agriculture nexus that will: (1) enhance agricultural yields/productivity, (2) decrease post-harvest loss, (3) improve farmer and agribusiness income generating opportunities and revenues, and/or (4) increase energy efficiency within the operations of farms and agribusinesses - while stimulating low carbon economic growth within the agriculture sector of developing countries. Currently, PAEGC has provided $12 million in funding as well as incubation and business acceleration services to help its initial eleven early stage innovators develop and implement cold storage, decentralized power, solar irrigation, and value-added processing technologies for farmers and agribusinesses in developing countries. In November 2014, PAEGC launched its second Global Innovation Call for innovators and PAEGC will provide up to $20 million in awards to a second cohort of innovators in September 2015 to help them commercialize and scale their clean energy solutions.

USAID's Development Innovation Ventures (DIV): An open competition supporting breakthrough solutions to the world's most intractable development challenges—interventions that could change millions of lives at a fraction of the usual cost. DIV will award $20-$30 million in 2015. It provides funding in three stages, allocated as follows: stage one is up to $150,000, stage two is up to $1.5 million, and stage three funding is up to $15 million. Grants are roughly evenly split between stage one and two and DIV has funded two projects in the stage three category to date.

U.S. Department of Energy's Mini-Grid Quality Assurance Framework: To address the root challenges of providing quality power to remote consumers through financially viable mini-grids, the Global Lighting and Energy Access Partnership (Global LEAP) initiative of the Clean Energy Ministerial and the U.S. Department of Energy (DOE) is partnering with the National Renewable Energy Laboratory (NREL) to develop a quality assurance (QA) framework for isolated mini-grids. The framework will address both alternating current (AC) and direct current (DC) mini-grids, and it will be applicable to renewable, fossil-fuel, and hybrid systems. The QA framework has two components: **(**1) it will define different levels of service—including appropriate thresholds for power quality, reliability, and availability—that are affordable to consumers and can thus ensure more consistent revenue streams for power suppliers and (2) it will specify a common accountability and reporting framework—based on utility models in developed energy markets—that will define a clear process for validating power delivery by providing trusted information to customers, funders, and regulators. DOE is working with public and private sector stakeholders to encourage adoption of the QA framework.

Sustainable Energy for All Clean Energy Mini-grids High Impact Opportunity (HIO): This HIO aims to use Sustainable Energy for All (SE4ALL) as an international framework to multiply the

impact of existing and upcoming efforts in the area of clean energy mini-grids. It focuses on supporting the establishment of an enabling ecosystem for accelerated investment, deployment and replication of clean energy mini-grids towards the target of having 40 percent of all installed capacity to achieve universal access to electricity by 2030 being delivered by mini-grids. It works to address the main barriers to mini-grids through five objectives: (1) Integrating mini-grids in national policy frameworks and regulations, (2) helping facilitate coordination and integration in the mini-grid sector, (3) improving knowledge of what works, (4) increasing development and testing of successful business models, and (5) Increasing mini-grid visibility and recognition as part of a suite of electrification solutions in order to spur public and private financial support. For more information or to join the HIO, please visit www.se4all.org/hio/clean-energy-mini-grids.

United Nations Foundation's Energy Access Practitioner Network: In support of the Sustainable Energy for All initiative, the United Nations Foundation's Energy Access Practitioner Network promotes universal access to modern energy services. With a 2,000 strong global membership, it draws together a wide range of businesses, investors, and civil society organizations working to deliver sustainable energy services in 170 countries – and the economic and social benefits they bring – to communities and households in areas beyond the reach of the conventional grid. It also supports innovative financial and business models, in predominantly market-based applications, that help address development issues such as income generation, health, agriculture, education, small business, and telecommunications.

Asian Development Bank (ADB) Energy for All: The ADB is promoting mini-grids in Asia and the Pacific by increasing ADB's investment in energy access projects and enterprises and by developing strategic partnerships and alliances with other stakeholders. In 2013, the ADB facilitated electricity connections of 1.7 million households and invested $984 million in energy access. The ADB formed the Energy for All Partnership in 2008, to build platforms for cooperation, exchange, innovation, and project development for solutions to widespread energy poverty to drive action towards a goal of providing energy access to 100 million people in Asia and the Pacific Region by 2015. As of 2014, ADB has achieved 85% of this goal, providing energy access to over 85 million people in the region. Energy for All also conducted extensive research, technical/financial feasibility studies, and several pilot projects on innovative mini-grid models in several Asian countries. The annual Energy for All Investor Forum will be held in June 2015 in Manila during the Asia Clean Energy Forum.

The Rockefeller Foundation's Smart Power for Rural Development: Since 2010, The Rockefeller Foundation has been working to promote economic development and to address energy poverty. The model they have supported provides off-grid electricity via mini-grids for lighting and commercial use. With a commitment of $75 million, the Smart Power for Rural Development initiative aims to expand this model to electrify 1,000 villages. The initiative will initially target districts in Bihar and Uttar Pradesh, India where millions of rural households have insufficient and inconsistent access to power. In order to deliver power and economic benefit to these poor communities, The Rockefeller Foundation will support energy service companies (ESCOs) that are using solar and biomass to electrify microenterprises, households, and anchor tenants (i.e. commercial entities that will buy power from ESCOs).

Electrification Finance Initiative (ElectriFI): ElectriFI is a €75 million European Commission initiative to accelerate electrification in developing countries by the provision of subordinated debt (i.e. early stage development risk capital) and by the creation of a center of excellence. ElectriFI's center of excellence will assist in making electrification ventures bankable (i.e. help them to reach financial closure).

DFID-AFDB-ESMAP Facility for Promotion of Green Mini-Grids: This program was launched in early 2015 with funding totaling £75million. The program includes i) a £60 million investment program in Tanzania and Kenya implemented through their respective Rural Energy Agencies; ii) a £10 million fund to facilitate market development in other African countries, and, iii) a £5million Action Learning and Exchange program, implemented by ESMAP/World Bank, which supports knowledge management in the green mini-grids sector.