Workshop Report

Enabling energy supply for low-income markets through mini-grid solutions

2nd International Conference on "Micro Perspectives for Decentralized Energy Supply" 2013

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Enabling energy supply for low-income markets through mini-grid solutions

Side Event within the framework of the 2nd International Conference on "Micro Perspectives for Decentralized Energy Supply" 2013 (MES 2013) from Feb. 27th to Mar. 1st in Berlin, Germany

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I. Introduction

Mini-grid solutions have been identified as one of the most promising method of improving access to electricity in rural areas, and have been hailed by the United Nations as the missing link in providing access to energy for all. The flexible nature of installations, as well as the tail end of generation potential inherent within these solutions, offers an interesting bottom-up approach to rural electrification. Nevertheless, there are a number of challenges that still need to be addressed in order to ensure the sustainable, large-scale implementation of these systems in developing countries.

This workshop brought together 39 experts from the practical and academic sides of this topic in order to explore the current issues, identify barriers, and suggest possible solutions regarding mini-grids. It took place on February 27th 2013 at the Reiner Lemoine Institut in Berlin within the framework of the 2nd International Conference on "Micro Perspectives for Decentralized Energy Supply" (MES 2013).

In different working groups the participants discussed questions concerning the electricity demand and development, financing and features of different operation models. In the document at hand, the results of the different working groups will be presented.

II. Working Groups Demand Side

During the morning session of the workshop, four different working groups were formed in order to explore a number of questions and challenges identified in relation with the demand side of the projects. Many mini-grid projects find it very challenging to deal with questions that depend very closely to the behaviour or, better said, future behaviour of the end-users of the electricity, once the electricity is made available by the new grid. Some of the issues addressed were:

- How to estimate demand and project demand development?
- Why are projections of demand not often realised?
- Which factors affect the willingness to pay?
- Which roles play productive and consumptive uses of electricity?
- How can microfinance affect the demand?

The four working groups were formed around different starting situations, depending on what type of electrification (if any) is present in the area before the project starts.

a. Non-electrified areas

In the session targeting the Non-electrified areas a group of scientists and practitioners discussed a variety of issues in the broad field of demand assessment, willingness to pay, microfinance and other topics in regard to the implementation of mini-grids in areas where until now there is no electricity available in the households.

First, the participants underlined the very important role of the projection of demand and its development. Without a sound estimation no one can decide whether a mini-grid might be an appropriate electrification solution or not. This projection should also include site-specific issues and the barriers that occur within national politics and regulatory framework. It was stated that, in general, poor people consume very few electricity and a too high estimation of a demand development in non-electrified areas is very common. An increase of electricity demand normally comes only together with economical growth.

The very important role of the projection of demand and its development was underlined. This projection should also include site-specific issues and the barriers that occur within national politics and regulatory framework.

Also, the demand assessment depends strongly on the person that is undertaking it as well as his or her methods, fluctuating between a roughly prepared excel sheet and two years of field research. To adjust the capacity of both generation and storage the calculation should be done for power and energy.

Besides the demand that does not consider the economical situation of the households there might be a different willingness to pay for electrical services. The theoretical willingness to pay may be found out asking a simple question but during the session it was mentioned that another real research issue is the ability to pay. A usual way to find out this ability is to estimate the money that people have been spending for the energy services that will be substituted by a potential mini-grid.

Different opinions existed among the participants related to the problem of a tentative enforcement to make people pay for the agreed tariffs, even if they have very little income. Some practitioners have the experience that people are able but not willing to spend considerable shares of their income for electricity, others disagreed and said that for example in India people tend to pay if they are able. Moreover, if people consume very few electricity they generally pay very high amounts per unit when a mini-grid is implemented because the O&M costs are high.

This is why everyone agreed that those tariffs need to be communicated upfront to create the correct mind-set at the end-user's side. Otherwise people do not consider electricity as a business model – they will just accept it as a resource like water and do not understand why they should pay for it. Therefore a strong relationship with the community is needed; top-down approaches tend to underestimate problems in this regard. Including social scientists in an upfront research may be a way to avoid those issues.

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In non-electrified areas it happens that people haven't even seen electricity before. In the process of electrification, first things that they will ask for will be lightning and mobile charging. It is often argued that mini-grids in the following will enable productive use but the experts stated that potentially productive people, i.e. business men and women, often moved away from non-electrified spots. On the other hand, it's not always possible to distinguish between productive and consumptive use. Someone explained that education during night times enabled through electrical lightning could be considered both productive and consumptive.

Shortly before the lunch break it was concluded that a discussion straight about mini-grids without considering alternatives like SHS is not useful within the context of non-electrified areas.

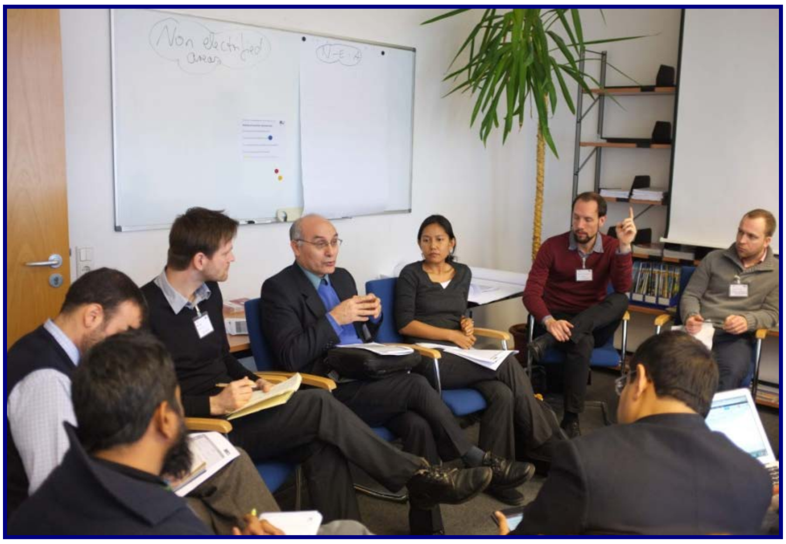
b. Pico-electrified areas

In pico-electrified areas, participants stated that the status quo consists of a limited generation already in place together with certain appliances used by people and a herefrom evolving demand. Along with these basic services and also because of them comes a certain willingness to pay for further services. However, participants gave the example of a quick needs assessment in Honduras where people were more willing to spend more money on further electrification by a Solar Home System on paper then what they actually were in reality. This kind of overstatement has therefore to be considered when doing a survey. On the other hand, workshop participants agreed on a correlation between income and energy. Therefore, the willingness to pay could increase with the energy supply as the income increases. In this context, it is important to identify if the total energy expenditure is linked to the increased income or the other way round and to assure that no links are missing in this correlation that would prevent this trend. Finally, the energy expenditure or load will also correlate with available financial services and payment structure. Payment regimes need to be available for the community as well as it should be considered to reduce the costs for certain services such as cell phone charging etc. to boost the willingness to pay.

There is a correlation between income and energy. Therefore, the willingness to pay could increase with the energy supply as the income increases. The energy expenditure or load will also correlate with available financial services and payment structure.

Before setting up a mini-grid in a pico-electrified area, it is important to project the demand development carefully. Different approaches have been suggested whereby participants agreed on realizing at least two before putting in place a new project. As a start, planners can have a look at neighbouring villages with the same culture and way of living that have already received electrification and transfer their demand profile to the concerned area.

Furthermore, residential and industrial needs should be considered separately. As the demand can be very case dependent, various key factors have to be determined. Those include the setting (urban vs. rural) and existing industry that might have a certain base load to electrify. Again, to evaluate the progressing of appliances etc., small industries can be differentiated into different economic levels and other regions which have already reached the next level of industrialisation can be taken as an example. In this regard, a crucial part of successful development will be the correct estimation of the economic growth as it relates directly to the future demand growth. One reason for a slowed development can again be found in the lack of finance.



Not least, planners should not try to electrify households or enterprises but rather to electrify certain loads (like the base load of a small industry or the needed energy for cooking in a household).

To best fit the challenging task of demand projection, the design of a multi-phase expansion has been extensively discussed by the workshop participants. It was stated by a participant that "you have to have a system that can continually grow". To answer the question how the demand development can be controlled in order to not overload the system and to deal with uncertainty, the phased expansion seems to be a possible solution. However, planners will need to think precisely about management, logistics and cost of such a model. On the one hand, the net present value of the investment will be lower today and by realizing a project through phased expansion, it will at the same time get more expensive. On the other hand, the realization of a big investment proves to be difficult in the given context. In addition to that, revenue will be delayed when opting for one single big investment and therefore reasons for each option have to be balanced carefully.

From the technical point of view, it is important to establish a local supply chain in order to avoid long travelling distances to get spare parts. Therefore, participants stated that a business connection between a cheap provider of components and a local technician for the assembling needs to be in place. A problematic point here when looking for a local distributor can be the small amount of products as there is not enough demand in remote areas. When a local supply network and technical support is established, work at the community level is needed to assure that there will more than one system installed.

Participants therefore suggested a three-step approach: Pico-electrification of households and companies, establishment of a local supply chain based on these existing systems, extension to a mini-grid. Depending on the size of the system or rather the mini-grid, is has to be decided whether technical support will come from a local technician or from an external partner. Questions asked in this context were: how many systems can one technician install and maintain? And how many systems are needed to sustainably employ the technician? Research is needed on existing industries within the community like milling machines or cell phone shops as those people might be able to support the installation and technical support due to their expertise.

People might get the impression that the installation of a mini-grid for them is only the second best solution as people show bias to think that a true grid connection will be technically better for them than a mini-grid, not taking into account frequent power cuts etc. The hope of a grid connection can heavily affect their willingness to pay and acceptance of a mini-grid.

Last but not least, special attention should be paid to people living close to the grid but not connected to it. Similar to people in non-electrified areas, they might get the impression that the installation of a mini-grid for them is only the second best solution as people show bias to think that a true grid connection will be technically better for them than a mini-grid, not taking into account frequent power cuts etc. The hope of a grid connection can heavily affect their willingness to pay and acceptance of a mini-grid.

In the end, several questions remain unanswered and are in need of further discussion: who makes the decision about the establishment of a project in the end? How in touch are the users with this decision? Users might have a different perspective on how realistic they see certain uses, how can this be included in the planning? How it would possible for them to switch to another resource? What happens to businesses threatened by the installation of a mini-grid (e.g. sellers of kerosene lamps, kerosene or candles)? Can they be re-trained to engage in other business models e.g. selling Solar Home Systems? For all of these questions, a strong community dialogue and a close look at the local value chains are needed.

c. Diesel mini-grid areas

First of all participants agreed that very different circumstances exist, which lead to the presence or the necessity of diesel-based mini-grids. These can range from rural villages via mining sites, islands, and military bases to telecommunication towers. All these applications have very different boundary conditions to be considered when it comes to evaluating the diesel grids.

Generally, power generation via Diesel is deemed to be very expensive (examples of 50 ct/kWh were presented). However, high subsidies are common that alleviate the cost burden for the end user.

Questions about the transition from pure diesel-powered grids to hybrid RES-Diesel grids arose concerning overproduction at times when the sun shines and wind blows. Is there a demand? Is it possible to create a demand by introducing appropriate consumers into the grid (desalination plants, water pumps) or by active demand shifting? Is it even technically possible to shift demands? While for industrial applications this might well be the case, in rural areas where the main application is lighting demand can hardly be shifted. Australia's outback, on the other hand, was mentioned as an appropriate case study where the most prominent load is the application of air conditioning systems that naturally coincide well with times where PV generates the most power.

Modularity of the system was stressed in order to be flexible when demand increases (e.g. because of electrification), new technologies become mature, or simply to be able to divide the project into different phases.

Demand shifting can also be indirectly initiated via corresponding tariffs. However, this requires the existence or implementation of smart meters.

This discussion directly led to the pivotal question about the participating parties: Who is the end-user, who is the investor, who is the customers, who saves money, who loses money. Different combinations can lead to very different business models. E.g. mining companies probably have the money to invest, but want to see extremely short payback times.

The right system configuration was subject of further discussions. Different boundary conditions were discussed. Modularity of the system was stressed in order to be flexible when demand increases (e.g. because of electrification), new technologies become mature, or simply to be able to divide the project into different phases. Retrofitting an existing system (low invest, low flexibility, high integration effort) as opposed to building a new system (high invest, high flexibility, no integration effort) were evaluated. Furthermore, the merit of grid stability will be valued differently by consumptive or productive users.

Microfinance does not play a role when the stakeholders are chosen accordingly. However, it does play a role for individual homes and thus might even spark competition between efficiency measurements or solar home systems on the one side and hybridization of diesel systems on the other side.

d. On-grid electrified areas

Participants identified the fact that on-grid electrified areas range from highly dense urban areas to peri-urban areas to rural non-urban areas. It was decided that this discussion would focus on rural non-urban electrified areas connected to the central grid infrastructure. Group participants primarily represented India and Nepal. Firstly, the demand profile of such non-urban electrified areas includes a higher density of appliances and a higher daytime consumption compared with rural non-grid-electrified areas. Even though grid reliability and availability is often low, the preparedness of the population for higher availability is palpable. At least in the examples mentioned from India, populations in these areas tend towards purchasing a wide variety of appliances, even if they remain mostly unused because of lack of reliable energy supply. If the stability and availability of the supply increases, demand would evolve accordingly.

Due to this lack of reliable supply, participants identified a number of coping strategies that on-grid non-urban populations rely on. Batteries with inverter chargers, backup diesel generators, kerosene lamps, and even solar home systems (SHS) are employed to bridge daily power shedding from the grid. In the case of Nepal, it was noted that up to 16 hours of planned daily load shedding occur. These factors represent a continued expenditure on the part of the end-users, in that they continue to pay for liquid fuels and other backup energy system operation and maintenance costs, in addition to paying for on-grid electricity consumption. Therefore, it appears that an even higher willingness to pay exists among these populations compared with dense urban areas or rural off-grid populations. However, although the increased expenditures signify an *ability* to pay, which is higher than what they are currently paying for grid electricity alone, the participants pinpointed a key difference with regard to *willingness* to pay. When it comes to grid electrification, explained the participants, the willingness to pay is only as high as the normal subsidized rate per kWh that is paid anywhere else in the country. This rate becomes a perceived benchmark for a grid-based tariff, regardless of whether the electricity is delivered from a central national grid infrastructure or from a locally run mini-grid.

> For on-grid non-urban populations.. when it comes to grid-electrification.. the willingness to pay is only as high as the normal subsidized rate per kWh paid anywhere else in the country. This rate becomes a benchmark for grid-based tariff, whether delivered from central grid or mini-grid.

An interesting example highlighted in the India case represented a coping strategy with an entrepreneurial approach. Local community members with diesel generators sometimes energize their community's local portion of the grid during brownouts, charging their neighbours a certain flat-rate tariff, normally based on the number of "points of light" in a household, i.e. a rate based on the number of appliances they have. In fact, the rural electrification strategies utilizing mini-grid solutions (with or without renewable energy sources) and local storage often deliver a more reliable energy supply than the central grid infrastructure. These scenarios, therefore, were identified as a significant potential for rural mini-grid solutions, especially those that can feed in to the national grid. This could have the potential to generate additional income for the mini-grid (feed-in), while maintaining a lower tariff model for the local community (meeting the social expectations of grid-based tariff benchmarks). This inference is supported by the fact that SHS are also becoming increasingly popular as a local coping strategy for lighting solutions during brownouts, thereby supporting activities of local micro- small- and medium- (MSME) energy enterprises.

> These scenarios were identified as a significant potential for rural mini-grid solutions, especially if the ability exists to generate additional income for the mini-grid via feed-in to the national grid.

Finally, microfinance was identified as an opportunity for communities to overcome initial grid connection fees and for the financing of new appliances for consumptive and productive uses. Households and businesses in the identified areas are not guaranteed a grid connection even if the community has transmission access to the national grid. Sometimes end-user financing is necessary to pay for the initial connection and metering solution within the household and/or for interior electrical installations. Similarly, financing new appliances for end-users and micro-enterprises can lead to an increased demand for electricity consumption, and thereby encourage new and innovative models for increased reliability on the supply side and the provision of energy services.

III. Working Groups Operation Models

In the second session of the day, again four different working groups were formed to analyse different operation models for mini-grids. Installing and sustainably operating a mini-grid is very challenging. Barriers occur on technical, economic, political, and social levels. In order to figure out which barriers are the most important for mini-grids and which operation models can overcome these barriers the following questions have been raised:

- Which barriers are important?
- How can the model be improved?

The operation models community-based model, private sector-based model, utility-based model, and hybrid business model have given the topics for the four working groups.

a. Community-based model

During this session, different questions arising when thinking about a community based model for mini-grid realization have been tackled. Initially, participants asked what were the actual advantages of a mini-grid operated by the concerned community itself? How can these advantages be seen in comparison with the private based model? How does the social mixture of the community hinder or promote the success of the project? And what are the disadvantages that have to be considered when thinking about a community based model?

The first aspect found in the discussion that has to be overcome is the technical training of the community. Being considered as a barrier at the beginning, the participants found during the discussion that it can also turn out to be a big potential for the community. Experience from participants working in Nepal shows that although the communities do not dispose of profound technical knowledge at the initial stage, they can easily be trained so that they can operate and manage the system. This way, community based models have already worked well in biogas and solar based projects whereby solar projects are generally maintenance free. Nevertheless, the different levels of knowledge needed for different technologies should always be kept in mind and initial installation should be done by professionals that can be part of the private sector. The accomplishment of the energy system by the community makes them aware of various other challenges they might be able to handle. According to participants from Nepalese projects, such projects can be financed by a mixture of credits (about 5% to 10%), subsidies (about 40%) and direct payment of the community. About 20% to 30% of the investment can be accomplished by the community itself in kind and therefore decrease the need of outside financial support. Thus, the community based model represents not only a way of empowering the community but at the same

Experience from participants working in Nepal shows that although the communities do not dispose of profound technical knowledge at the initial stage, they can easily be trained so that they can operate and manage the system.

time also offers indirect financial support. As people can actively contribute to the project, they develop a strong feeling of ownership and that the project belongs to all of them together. Nevertheless, political issues inside the community have to be observed carefully and could be one argument for the supporters of other operation models to not include people from inside the community in the project.

As a solution to the often mentioned problem that in a big group nobody will feel responsible in the end, the participants suggested an approach that has already been successfully tested in practice. While the whole community is in charge of fundamental decisions concerning the project during village meetings, regular work will be done by a small number of specially trained staff. The decision making group has to take in account economic aspects of the system and set up rules for the usage times of different loads to make the system work economically advantageous. As mentioned above, in order to form a functional decisive group, special attention has to be paid to inhomogeneities within the community due to different religions, castes, capital or others.

Comparing the private and community based model, workshop participants actively discussed the issue of loans that are taken by all the community to finance the project opposed to one private investor. What happens if not enough money is collected to pay back the loan used to finance part of the system? From field work, participants shared the experience that people feel strongly committed to their system and are interested in using and maintaining it once they have contributed to it somehow. In comparison, a private model could as well run out of funding but in contrast to the community based model the concerned people will not have developed a feeling of ownership in order to save the project. Although the financial capital will stay in the community, there is a risk that human capital will not. Being well trained to manage and operate the system, community technicians might leave the village to work somewhere else. This leads to the conclusion that along with the bottom-up electrification approach there is a strong need to develop all social and economic aspects within the community.

In order to form a functional decisive group, special attention has to be paid to inhomogeneities within the community due to different religions, castes, capital or others.

2500 total systems with a total installed power of 25 MW within 14 years in Nepal are encouraging examples to further pursue and study this kind of operation model.

b. Private sector-based model

The discussion taking place around the private sector based model has been divided in three categories by the participants: the political barrier, the economic and financial aspect and the technical barriers.

Political circumstances pose a big challenge for the private sector based model. Ideally, the political framework in which the system is developed should be stable at least as long as the amortization period of the project or longer. Obviously, it was pointed out by participants that governmental policies in general are not under the control of the investor and especially changing electrification programs can highly affect private investment plans. In contrast to the community based model, technical barriers were not considered to be very relevant in this model. The choice of technologies can be very broad due to the broad technical competence of the company. In consequence, however, good solutions might be too expensive for actual realization or the demand might be overestimated. Concerning the financial issues, high capital costs and high overhead costs due to non standardized products and a poor knowledge base in the banking sector lead to possible risks in project implementation.

From a social perspective, participants have commented the difficulty to change the attitude of locals towards the private companies. As they are generally seen to be in funds, locals might not see why to pay them.

c. Utility-based model

The utility based model provoked a very diverse discussion on the advantages and disadvantages of this model. Utility-based systems are defined as state-owned. While on the one hand, the utility based model to build up mini-grids was seen by the participants as the best option due to the utilities experience in the field, existing permits and the exact idea they have of the realization of such a project, on the other hand arguments were presented converting it to the worst option. Among those were the claims that utilities do not have the necessary money and motivation to implement the project and above all do not enjoy a very good reputation in low-income countries. Furthermore, several technical, economical, social and political barriers were identified during the discussion. They will be lined out in the following together with possible solutions brought up by the workshop participants. However, it is important to mention that some of the points can be very country specific and can not be generalized for all circumstances.

The public utility model is not considered as a profit oriented model in general which could cause a non innovative attitude towards the grid operation and therefore lead to stagnation in development.

From a technical point of view, the more PV is in a diesel grid, the more the grid quality decreases due to lack of inertia in the grid. When pursuing the goal of security of supply and good grid quality, this challenge can be tackled by either a bi-directional flywheel or an energy management system.

The public utility model is not considered as a profit oriented model in general which could cause a non innovative attitude towards the grid operation and therefore lead to stagnation in development. Being part of the government, the model can profit of government payment structures to facilitate the operation.

From a political perspective not many advantages of this model were mentioned by the participants. It was described as being affected by corruption and personal interests to a big extent.

Finally, participants pointed out that state owned enterprises are not widely accepted and appreciated by the concerned population. Nonetheless or perhaps because of that, utilities should get engaged in the operation of mini-grids to better their image by showing their qualities and advantages in the project.

d. Hybrid business model

The hybrid business model combines all three of the above mentioned models and is therefore able to compensate their particular weaknesses. By profiting from the respective advantages of all business models, the hybrid business model can represent a coping mechanism for specific difficulties and bring together the benefits of the single models.

Advantages that can be taken of the inclusion of a public player are the available elaborated risk management as well as the relatively easy access to additional capital or rather subsidies. Grid extension poses an already mentioned risk for the establishment of mini-grids and their public acceptance. By including utilities in the operation model, this uncertainty can be mitigated and the knowledge concerning the time and place of grid extension improved. On the other hand, grid extension might also force other well working models into the inclusion of public utilities and therefore the hybrid model in the first place. Private players included in the operation of a mini-grid contribute in an important manner to the efficiency and innovativeness of the project. Private participants might open up new market opportunities and sell additional services and products to the end user apart from and additionally to the originally planned system. Last but not least the involved community strengthens the business model through the possibility to enforce financial matters on a local basis and by developing a strong feeling of ownership and thereby responsibility for the system.

By profiting from the respective advantages of all business models, the hybrid business model can represent a coping mechanism for specific difficulties and bring together the benefits of the single models. The sensitive power balance between all three players needs to be sustained carefully.

Although we can see that hybrid models can beat the other operation models to a certain extent by bringing together their specific advantages, they are also facing challenges. As a conglomeration of several local players, hybrid business models might represent an only temporary solution. This can be due to forced dissolution provoked by the possible bankruptcy or buy outs of private companies and changes or problems in the political system. Finally, the sensitive power balance between all three players, the private companies, public utilities, and the community needs to be sustained carefully. Too easily the balance can be disturbed and the system be forced into another single player business model.

IV. Summary

The Workshop "Enabling energy supply for low-income markets through mini-grid solutions" took place on February 27th 2013 at the Reiner Lemoine Institut in Berlin within the framework of the International Conference on "Micro Perspectives for Decentralized Energy Supply" (MES 2013). To examine the barriers and solutions to sustainable, large-scale implementation of decentralized mini-grids in remote areas in developing regions, 39 experts from the practical and academic sides of this topic came together. In different working groups the participants discussed questions concerning the electricity demand and development, financing and features of different operation models.

Different aspects on the demand side and different operation models were discussed by the participants. Generally, it was underlined that the projection of demand and its development play a crucial role in the realization of mini-grids irrespective of the concerned region and chosen operation model. Moreover, the correct mind-set at the end-user's side has to be created to make sure that electricity is considered as a business model. A correlation was found between income and energy whereby the willingness to pay can be strengthened. Still, the willingness to pay seems to be only as high as the normal subsidized rate per kWh that is paid anywhere else in the country. A strong relationship with the community should be established within each operation model as pure top-down approaches tend to underestimate various problems concerning the integration of the end-users. Special attention has to be paid to inhomogeneities within the community due to different religions, castes, capital or others. In addition to that, technical training offers a great opportunity of development for a community not only during the realization of a mini-grid. However, being well trained to manage and operate the system, community technicians might leave the village to work somewhere else. An important idea was the inclusion of social scientists in an upfront research to avoid similar issues right from the start. The importance of the modularity of the system was stressed in order to be flexible when demand increases. A three-step approach consisting of Pico-electrification of households and companies, establishment of a local supply chain based on these existing systems and extension to a mini-grid has been suggested. However, for the successful and sustainable implementation of a mini-grid, planners should focus on the electrification of certain loads and appliances rather than on households or enterprises. Besides, political circumstances pose a big challenge in various different operation models and have to be taken into account carefully. Public utility models, for example, are not considered to be profit oriented in general which could cause a non innovative attitude towards the grid operation and therefore lead to stagnation in development. At this point, the hybrid business model can represent a coping mechanism for specific difficulties and bring together the benefits of the single models.

Finally, microfinance was identified as an important instrument for individual homes to facilitate the use of new electric appliances for productive or consumptive use. In addition to that, initial grid connection fees could be overcome more easily holding the potential of additional income generation by feeding into the grid.

In conclusion, the presented workshop "Enabling energy supply for low-income markets through mini-grid solutions" aimed to serve as a platform for experts from all over the world to promote and advance the international exchange of practical experience and new scientific ideas. The report at hand proves the positive outcomes of an intense working day. Not least the work in small groups has created a positive and productive working atmosphere leading to satisfying results making further development possible.

Thanks to the valuable contributions of all the participants, this workshop could be concluded as a successful next step towards the sustainable access to electricity in rural areas and provision of energy for all.