CLEAN ENERGY SOLUTIONS CENTER
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Mini-grids for Energy Access in Sub-Saharan Africa: Status and Lessons from Tanzania

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Webinar Panelists

Estomih N. Sawe	TaTEDO
Maneno JJ Katyega	TaTEDO
Lily Odarno	World Resources Institute

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Sean Esterly — I am Sean Esterly with the National Renewable Energy Laboratory. Welcome to today's webinar, which is hosted by the Clean Energy Solutions Center in partnership with the World Resources Institute. Today's webinar is focused on the mini-grids for energy access in Sub-Saharan Africa, status and lessons learned from Tanzania.

One important note of mention before we begin our presentations is that the Clean Energy Solutions Center does not endorse or recommend specific products or services. Information provided in this webinar is featured in the Solutions Center's Resource Library as one of many best practices resources reviewed and selected by technical experts.

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that in the question pane and submit it there. Then we will present those to the panelists during the question and answer session.

If you are having difficulty viewing the materials in the webinar portal, we will be posting PDF copies of the presentations at cleanenergysolutions.org/training, and also an audio recording of today's presentation will be posted to the Solutions Center training page within about a week of today's broadcast. Just a reminder, we will also be adding the recordings to the Solutions Center YouTube channel where you will find other informative webinars, as well as video interviews with thought leaders on clean energy policy topics.

We have a great agenda set for you today. It's centered around the presentations from our guest panelists, Estomih Sawe, Maneno Katyega, and Lily Odarno. These panelists have been kind enough to join us to provide an overview of the recent World Resources Institute and TaTEDO study. It's on the status of mini-grids in Tanzania. Before speakers begin their presentations, I will just give a quick overview of the Clean Energy Solutions Center initiative. Then following the presentations is when we will have the question and answer session where panelists will address those questions submitted by the audience. Then we will have some quick closing remarks and a brief survey for attendees today.

So this slide provides a bit of background in terms of how the Solutions Center came to be form. Solutions Center is one of 13 initiatives of the Clean Energy Ministerial that was launched in April 2011. It was primarily led by Australia, the United States, and other CEM partners. Some outcomes of this unique initiative include support of developing countries and emerging economies through enhancement of resources and policies relating to energy access, no cost expert policy assistance, and peer-to-peer learning and training tools such as the webinar, you are attending today.

There are four primary goals for the Solutions Center. The first goal is to serve as a clearinghouse of clean energy policy resources. The second is to share policy best practices, data, and analysis tools specific to clean energy policies and programs. The third goal is to deliver dynamic services that enable expert assistance, learning, and peer to peer sharing of experiences. Then lastly, the Center fosters dialogue on emerging policy issues and innovation from around the globe. The primary audience is typically energy policy makers and analysts from governments and technical organizations in all countries. But, we also strive to engage with the private sector, NGO's, and also civil society.

One of the marquee features that the Solutions Center provides is the no-cost expert policy assistance known as Ask an Expert. Ask an Expert program has established a broad team of over 30 experts from around the globe who are each available to provide remote policy advice and analysis to all countries at no cost to you. So for example, in the clean energy topic of rural electrification, we are very pleased to have Ibrahim Rehman, a director of the Social Transformation Division at the Energy Resources Institute who serves as one of our experts in that area. If you have a need for policy assistance in

rural electrification or any other clean energy sector, we do encourage you to use this valuable service. Again, this assistance is provided to you free of charge. If you have a question for our experts, please submit it through our simple online form at clearnenergysolutions.org/expert. We also encourage you to share the word about this service to those in your networks and also your organizations.

So now, I would like to go ahead and provide some brief introductions for today's distinguished panelists. The first speaker that we will be hearing from is Lily Odarno. Lily is an associate with the World Resources Institute's Energy Program. She leads WRI's energy access work in East Africa. Following Lily is going to be Estomih Sawe, the executive director of TaTEDO, a Center for Sustainable Energy Services in Tanzania. He has over 25 years' experience in rural renewable energy, including mini grid programs, development combined with experience working with the government of Tanzania Energy Department for more than 15 years, heading the renewable energy section.

Then our third and final speaker today is Maneno Katyega, who is currently senior advisor to TaTEDO on renewable energy mini grids development projects and electrification. Formerly, he was a deputy managing director at Tanzania Electric Supply Company where he was responsible for research, strategic planning, and management of all major projects at TANESCO.

So with those introductions, I would now like to welcome Lily to the webinar.

Lily Odarno

Thanks, Sean. So thank you, Sean and thanks to the audience for joining us this morning for this webinar. This is what World's Resources Institute and the Tanzania Traditional Energy Development Organization has been involved with over the last six months and how we are happy to present the findings of our study today.

Just I will begin with just a brief overview of the study that we have conducted. So generally, there is exploding interest in decentralized solutions for energy access on international level such as the sustainable energy for all. Mini grids have been identified as high impact opportunities. National governments, _____ targets for closing the energy access gaps with mini grids. There is this growing interested in the _____ closing energy access gaps there. The IE projects that in Sub-Saharan Africa, almost half of the rural population is going to gain access to mini grids by 2040, and up to 100,000 and 200,000 mini grids will have to be built to meet those needs. As part of this interest, we realize that there is very little documentation and very little experience with mini grids in Sub-Saharan Africa generally. Unlike we have in Southeast Asia, where there has been a lot of experience with mini grids. There is very little experience with the ____ in Sub Saharan Africa. We were interested in sort of building the knowledge base on mini girds. We realized that most of the information actually available out there is very broad, focused on very general information about mini grids. Focus is on the general financing challenges, the general issues with the development scale of all business models and all of that. So we decided to focus on a more sort of granular approach to understanding mini grids, understanding what the

opportunities and challenges with their implementation is. And understanding from a very specific country level perspective. What is the actual play on the ground, as in once we come in with mini grid implementation the in the typical Sub Saharan African context.

Now, Tanzania has been lauded for successes with creating effective policy environment for mini grids to proliferate, but we also realized that even in that context, there is very little information out there about how mini grids were fairing in practice. So it was necessary to take stock of progress, to understand what has worked and what has not worked to understand what the exact current state of mini grids of in Tanzania is. We also hope that this granular approach to our understanding mini grids and the opportunities and challenges can be scaled across other region as well beyond Tanzania.

So we work with the World Resources Institute. We work closely with the Tanzania Traditional Energy Development Organization to conduct this piece of research. And the aim was to sort of work locally with a partner who is grounded in the realities of the local context to identify research which was relevant and also to identify opportunities for impact.

So our work focused on four key areas that we identified as relevant for understanding the status of mini grid in Tanzania. First of all, our work focused on the challenges and opportunities with developing and operating mini grids. So just looking into fundamental issues of how decisions to go mini grids rather than general grid electrification is done. Understanding the financing challenges that is project level implementers of mini grids of _____ Understanding just some of the very practical issues with building and tariffs that apply to mini grid implementation.

We also look at different mini grid technologies, looking at the factors that influence which technologies are chosen over others and understanding how that plays in the Tanzanian context. Then of course, looking at the policy and regulatory frameworks in Tanzania and looking how these have influenced project level experiences with rolling out mini grids in Tanzania. Then finally, we also examined what is becoming an important issue that is the link between mini grids and development, understanding how the coupling of mini grids efforts with development activities kind of helped develop sustainable _____ markets over the long term. This is an overview of the work that we have done over the last couple of months. With that, I am going to hand over to my colleagues in TaTEDO. I am going to have over to Estomih to take us into the current state of play of mini grids in Tanzania.

Estomih Sawe Thank you, Lily, for the introduction. Sorry, we are having a small problem here. Okay, thank you Lily for the introduction on the presentation. Now I will discuss and I will be presenting the mini grids in Tanzania, the current status.

As the electrification target of Tanzania by the year 2035 is access rate of 75 per cent. Currently, the country has a population of about 49.4 million of whom are 25 per cent they are living in urban areas and 75 per cent are in rural areas. The current access rate is about 24 per cent of whom 43 per cent

are those with access living in urban areas and six per cent are in rural areas. As we can see from the Tanzanian map, which is in front of us, most of the reach, which is shown by black lines and red lines is on the west, north, northeastern part of the country, and a little bit to the south, but most of the southern part of the country and the western part of the country has no reach. We see the green lines are some transmissions. They also note the black points, the mini grids as they are distributed in some parts of the country. So the access rate and the four per cent is really from the grid and also from some of the mini grids, which are shown on the map. Per capital gross _____ product is of 2014 is U.S. dollar, $1,047.00. The electricity consumption per capita is around 100 kWh.

So the history of mini grids in Tanzania, electrification in Tanzania certainly _____ in 1908 during the colonial days when the first of mini grids were developed. In _____ workshops located in Dar es Salaam, Tabora, and Kigoma townships. These mini grids were used to provide services at the railway station, but also extended a few networks to the local people who were located in the Tabora stations. The mini grids were usually developed to power mining, to provide, to support the agro industries, but also some of them were developed also by the faith-based organizations to provide the social services in some parts of the country.

After independence, the government of Tanzania still continued to develop diesel based mini grids for electrification of different isolated townships for industrialization in the country. So before the year 2008, the Tanzania government used to provide regulatory services, but regulatory development, regulatory services by the year 2008, the government came up with Electricity Act which provided, tried to promote light handed approach to regulating small renewable energy projects for small project developers which _____ were sure that they are regulated and also using the Energy and Water Utilities Regulatory Authority came up with Standardized Power Purchase Agreements for main grid and for mini grids, small power producers who weren't ready to sell electricity and vendor as a wholesale or retail to the distribution network operators, the DNO's. By June 2009, also the regulator provided the standardized tariff methodology for mini grids and also for both main grid and also for mini grids owned by the DNO.

With that one, the first generation mini grids all were standardized for ____ tariffs were prepared. They were technology neutral. They were also for the main grid and also for the mini grids. They were, indeed, calculated for the burden costs of the DNO's and they are adjusted during the dry season. They were a little bit higher due to the burden cost of the DNO, but also during the wet season they were lower tariffs. The technology neutral feed in tariffs were also more cost reflective for the hydro and biomass, but were not really very cost reflective for solar and wind. So they are not very supportive for the development of solar and wind based mini grids. Because of that one, the regulatory and the government came up with a second generation of feed in tariff, which were more technology specific and cost reflective and also system size dependent. They were also paid in the dollar _____ the hydro tariffs that are shown there. They were size dependent. Those of the biomass

are basically mini grids also paid in dollars. But in the solar and wind tariffs, we are left with the _____ competitive through competitive bidding. This is project by project.

So the current mini grids status or the current status in the country, what we found out through our study is by early 2016, Tanzania Mainland had up to 109 existing mini grids in 21 regions with the total installed capacity of 157.7 megawatts connecting 183,705 customers. Out of these mini grids, 16 mini grids were connected into the grid and 93 of those were isolated mini grids.

So trends in the development of mini grids after 2008, as small power producers regulations as we can see, the red bars indicates the total number of mini grids, which are in the country. The blue ones are mini grids before 2008 regulatory framework. As can be seen, hybrid systems were developed after 2008 regulatory framework. Solar PV, 13 mini grids have been developed. For biomass or bio fuel based, 25 mini grids are in the country. Five of them were developed before 2008 regulatory framework. So 20 mini grids have been developed after the regulatory framework of 2008. For the hydro, we have a total of 49 mini grids. Forty of them were developed before the 2008 SPP regulatory framework. So nine of them have been developed after the 2008 SPP regulatory framework. For the diesel based in mini grids, we have a total of 19 mini grids. Twelve of them were developed before the 2008 regulatory framework. Seven of them have developed after the 2008 regulatory framework. Although the diesel and natural gas mini grids as we will see it, firstly are not renewable. They also do not benefit from the SPP framework, because they are owned by the DNO.

So mini grids which have signed standardized power purchase agreements since 2008, as we can see, 15 mini grids projects with a total capacity of 53.5 megawatts have signed standardized power purchase agreements. The number includes the ones, which have been commissioned, as well as those that are yet to be commissioned. We can see from the presentation that most of them, they are hydro based, 74 per cent of the mini grids developers have the hydro based. They have signed the SPPA. Eighteen per cent are biomass based and eight per cent are solar based.

So mini grids that are under planning with letter of intent, as you can see a total of 16 mini grids are under planning, with a total capacity of 67.2 megawatts. Out of these, 23.2 megawatts are hydro based. Ten megawatts are biomass based. Twenty-four megawatts are solar PV based mini grids. None of them, we found for the wind and hybrid.

So mini grid ownership trends in Tanzania. There are four types of ownership or four types of operators of mini grids in Tanzania. There are community based mini grids owners or operators. Also private mini grid operators, utility mini grid operators, and also charity mini grid operators. Then so as we can see the hydro-based mini grids are about 60 per cent of them are owned by charity, owned by faith-based organizations. The remaining 40 per cent are distributed as we can see about a little bit more than ten per cent owned by community. We have utility owned mini grids from ten per cent. Also, the private owned mini grids—there are also a few of them. When it comes to

biomass based mini grids, most of them are privately owned. A few are community owned mini grids. Also, when it comes to solar, we have found that most of them are community owned, more than 80 per cent are owned by community. A few were privately owned mini grid. That comes to diesel and natural gas based mini grids, all of them are owned by a utility, a DNO. Also, the hybrid based mini grids are owned by private operators.

The current metering and payment approaches as we can see, we have three types of metering or payment arrangements that we have for the blue one, the blue bars are we have prepayment metering arrangement. Then the red bars indicated the credit metering arrangement. And we have the last one, the load limiter, which is very _____ so we can see from the model, the hydro based mini grids are 34 of them they have credit metering arrangement. Fifteen of them, they have prepayment arrangements. The biomass based mini grids, 21 of them, they have credit based mini grids and also they have four of have prepayment arrangements. Also, for solar, 11, they have load limiters, but two of them have prepayment arrangement. The diesel and the natural gas mini grids, all of them have prepayment metering arrangement. The hybrid based mini grids, two of them have prepayment arrangements, and the one has a credit metering arrangement.

With that, I would like to pass on the presentation to my colleague, Mr. Katyega. Thank you very much for your attention.

Maneno Katyega

Thank you very much Mr. Sawe. Now let's go on the slide whereby we present our findings on financing of mini grids in Tanzania.

Financing of mini grids in Tanzania and grid extension during the 2007/2008 to 2013/2014 involved resources in the tune of US $255 million. The figure does not include funds from faith-based organizations and some of the development partners. Now, if you look into the pie chart, you will find that 52 per cent of the resources was raised from the government budgetary allocation. Next, 18 per cent came from electricity levy followed by 12 per cent, which came from Sida contribution. Followed by seven per cent, which came from Norway government contribution. Then seven per cent came from predestination inspection fee. Lastly, four per cent came from interest on investment. So if you seriously look into the pie chart, you see that 52 per cent and the 18 per cent, all of these show how much the Tanzania government commitment is to financing mini grids and some transmission of the grid. In total, this comes to 70 per cent. So the government of Tanzania is really committed to financing rural electrification and rural renewables in the country.

The government of Tanzania in collaboration with the World Bank slow the so-called Tanzania Energy Development and Access Projects Program came up with the two very motivate ways to assist mini grid development in the rural areas, as well as some transmission. They came up with smart subsidies, which are in the form of matching grants and performance grants. Also as part of the innovation, they came up with credit line facilities. Now when it comes to matching grants up to US $100,000.00 is provided for each project for feasibility studies, business plan development, and environment impact

assessments. A total of $3.1 million has been disbursed for 30 renewable energy projects with a total capacity of 94 megawatts from the year 2010 to 2014. Performance grants in the tune of $500.00 for each electricity connection in the rural areas is provided to the investors. A total of US $5.3 million has been disbursed for seven projects from 2010 to 2014. In addition, a credit line facility in the tune of US $23 million was established for long-term loans for up to 15 years through the local Tanzanian Investment Bank, which is disbursed by seven local commercial banks.

Now, the TEDAP program ended in 2014, but from 2015 to 2019, the World Bank has come up with new financing for the so-called Renewable Energy and Rural Electrification Program. The World Bank support is in the tune of US $200 million for grid extension and US $75 million for mini grid projects. Also, the government of Tanzania in collaboration with the SIDA, DFID have also come up with financing for additional activities. SIDA commitment to Rural Energy Fund is SEK 600 million during 2016 to 2019. The distribution is as follows. SEK 500 million is for grid extension and the balance, SEK 100 million is for mini grids. In turn, DFID commitment is in the tune of GB£ 30 million for green mini grids in the country, which will be supervised by SIDA on behalf of the FID. Now, for the DFID funds, these are to be disbursed during the 2015 to 2019.

Now, let us look on financing sources for completed projects under small power projects framework or the so-called small power projects regulatory framework. We have TANWAT in Njombe, a biomass plant of 2.5 megawatts grid connected. Financing came from ____ developed company, DFID, and the World Bank. TPC from Moshi, a biomass plant of 17.5 megawatts with 9.0 megawatts is exported to the grid. Financing came from DANIDA and World Bank. LUMAMA Mawengi project is 0.3 megawatt hydro. It is off grid. Financing came from Italian government, European Union, Intervita, World Bank via Rural Energy Agency. Mwenga Mufindi hydro plant of 4 megawatts is grid connected. Financing came from ACP-EU, Rural Energy Agency, Rift Valley Energy Company, World Bank via Rural Energy Agency. Ngombeni Mafia Island, biomass of 1.5 megawatts is off grid. Financing came from DFID, World Bank via Rural Energy Agency. Andoya AHECO Mbinga hydro, 1 megawatt, off grid. Financing came from World Bank via Rural Energy Agency. Tulila St. Agness Chipole Songea, hydro plant of 7.5 megawatts, off grid. Financing came from World Bank via Rural Energy Agency. Then we have Yovi hydro Kilosa hydro plant of 0.9 megawatts, grid connected. Financing came from Europe. You have the Maguta power project Kilolo, hydro plant of 2.5 megawatts is grid connected. Financing came from World Bank via Rural Energy Agency. We have Ikondo Njombe hydro plant of 0.4 grid connected, Italian government, European Union and CEFA.

Now, we have some projects, which are under construction, which are all small power projects in _____ framework. Now, the financing is as follows. We have Ninga Njombe, a hydro plant of 4 megawatts, is grid connected, expected soon. The sources of funding is coming from European Union. We have Darakuta Manyara, a hydro plant of 0.24 megawatts, which we expect to

be grid connected on completion. Financing is coming from the World Bank via Rural Energy Agency. We have East Africa Power limited of Tukuyu, a hydro plant of 10 megawatts, which will be grid connected and the sources of financing is coming from the World Bank via Rural Energy Agency. We have Mapembasi Njombe, a hydro project of 10 megawatts. It will be grid connected. Financing is from World Bank via Rural Energy Agency. We have the Nkwilo Sumbawanga hydro plant of 2.9 megawatts to be off grid. Financing is coming from the World Bank via Rural Energy Agency. We have Luswisi Project in Ileje, Mbeya, a hydro plant of 4.7 megawatts. On completion will be grid connected. Financing is coming from World Bank via Rural Energy Agency.

Now, let's look at the experiences on mini grids in relation to rural development because we are building mini grids in the rural areas. So that can foster rural development. What we have found out is that establishing links between mini grids and local development is key to long-term sustainability of the mini grids. Let's look at one example of LUMAMA mini grid project of 300 kilowatts using hydro located in Ludewa District. This project is run as a community owned social enterprise. Initially, when it was started, it was run by three villages, but it has been extended to other five villages. Currently, it a social enterprise for eight villages.

LUMAMA is a success story in the country. Now, the success factors are the following. First factor is development should be linked to productivity. Mini grid development was coupled with the effort to promote productive activities in the local village involving sunflower production, mechanical workshops, poultry farming, and links to financing institutions. The second is funding. We found out that the development of productive activities was funded by an Italian donor, ACRA CCS. Also, cost reflective tariffs were imposed in the projects. Another one is locals have ownership in the social enterprise, thereby implying that whatever benefits accruing from the project, a fair portion remains within the village for development. Management structures is another factor. What we have found out is that well-established local management and accountability structures are in place in the village.

Now when we developed the mini grids, we faced a lot of challenges and barriers. This needed to be resolved so that the mini grid development process can go ahead successfully. Now, from our studies, we have come out with the following experiences. The first barrier was inadequate policy on small power producers or small power projects, especially on the renewables. To date, there is no policy specifically geared to mini grids. However, it is incorporated in the Electricity Act of 2008. Now, this process to resolve this policy on SPP was undertaken during 2003 to 2008. The result is the Electricity Act of 2008.

Another barrier was lack of regulatory framework for small power projects or small SPP's. Now, this was the result through the Electricity Act, the Energy and Water Utilities Regulatory Authority Act, Rural Energy Act, and small power producers regulatory framework of 2008. Now, these processes were undertaken during 2001 to 2008. Now the results are we have standardized

our purchase agreements and standardized our purchase types for operating known as feed in tariffs. These regulatory framework is key to the current successes in proliferating small power projects in the country.

Now, another barrier was lack of SPP tariffs for SPP projects. As I said here, these were resolved by established tariff setting mechanism and during 2008 to 2009. In 2009, we came in with the technology neutral feed in tariffs.

Now, these tariffs had their own challenges. One of the challenges was lack of technology specific feed in tariffs, as my colleague said, the technology neutral feed in tariffs were more geared to mini hydro and biomass projects. So there was some revisions to the tariff setting mechanism during 2009 to 2012. Thereby, we came in with the technology specific feed in tariffs.

However, there were other challenges, which we met because of economies of scale in the technologies involved. Therefore, the feed in tariffs had to be revised through the tariff setting mechanism during 2012 to 2015. Then we came up with technology, which is size specific feed in tariffs.

Now, another barrier was high inflation in the country and Tanzania shillings currency fluctuations. So revision of the tariff setting mechanism was employed during 2012 to 2015 and feed in tariffs in US dollars came in. these were highly acceptable to the investors in small power projects in the rural areas.

Another challenge or barrier was high taxes and duties on renewable equipment. These were resolved by tax exemption for solar and wind equipment. Now, from 2000, taxes and duties have been waived on solar PV and wind equipment. So these have really made things change drastically.

Another barrier was lack of financing for private small power producers. What was done was established smart subsidies. This was done in 2008 to 2014, whereby matching and performance grants for investors in the rural areas were available.

Another one was lack of credit line facilities. This was resolved by established credit and loan guarantee facility via Tanzania Investment Bank, which is disbursed by local commercial banks. This was undertaken during 2008 to 2014. Commercial loans for small power producers, projects, are now available in the country.

Another barrier was inadequate local capacity to develop, operate and maintain small power projects. Now, this was the resolved was by Rural Energy Agency whereby it established a fund for capacity building, which was done during 2010 to 2015. They came up with a tool kit and training of local investors and commercial institutions involved in small power projects financing incentives.

Another barrier, I am going to say, the last, but there are others. Poverty of potential customers in the rural area was a big challenge. As you know, rural population has not the same opportunities as those in the townships. So this

barrier was resolved by connection costs or fees being waived for specific periods for new rural energy projects where the grid extension or mini grids. Regulation was done during 2010 to 2012. The results is that customers pay on value added tax or VAT, which is about 18 per cent of connection fees or connection costs. Actually, this approach has been very much welcome by the rural people. It has changed the connection rates in the country.

Now, when electricity reaches the rural areas whether it is mini grid or grid extension, the excitement is often very high, as you can see in the picture. So, now let's turn this to what are the lessons learned with mini grids in Tanzania. The key lessons, the first one is related to technology. We have found that technology specific feed in tariffs are more attractive to mini grid investors than technology neutral feed in tariffs.

The second is owing to falling prices over time, feed in tariffs for solar and wind projects can best be determined by competitive bidding. Third, the inability of the distribution network, I am talking of the main distribution network operator that is TANESCO to honor its financial obligations affects the viability of grid connected private small power producers, namely Mwenga, TANWAT or AHEPO.

Another lesson was something to do with the efficient operation and management and the reflected cost tariffs. Irrespective of the ownership approach adopted by the mini grid, the efficient operation and management of mini grids coupled with cost reflective tariffs is key to long term sustainability.

Another lesson is that financing of mini grids should be a joint effort of governments, development partners, the private sector, faith based organizations and NGO's.

Now, we have seen what has happened in Tanzania, but what more is needed so as the successes can be accelerated? So from our study, the following can be advised. First, a dynamic small power producers regulatory framework that evolves over time and responds to the needs of all actors including investors, distribution network operators, retailers, and the end use customers is key. The second, you need to have effective monitoring and evaluation of mini grids financing, especially with matching grants so as to make sure that the resources is optimally used. Third, you need to expand innovative metering and revenue collection systems in the country. For example, through use of pay as you go systems, which has been currently practiced by many grids in the country, especially the private sector. This has been very successful.

Now, what we can also come up with the suggestions if we want to bring mini grids to scale. These are our observations, which can be replicated in other parts of Sub-Saharan Africa and other countries interested in mini grids. The first one is something to do with resources. Increasing internal and external resources mobilization for mini grids development is really important. Second is capacity building. You need to undertake large-scale capacity building of mini grid stakeholders in management, business, and

technical aspects. Third, you need to undertake and adopt an integrated approach to mini grid planning that incorporates other development initiatives and promotes community participation. The other one, improving coordination in site selection, feasibility studies, regulatory clearances, and project prioritization for implementation is very, very important. Another one is incentivizing local manufacturing of some of the basic electrification equipment within the country is highly advised. Another and finally, mini grid development should be coordinated with the rural development activities so as to stimulate and sustain demand in the rural areas.

Ladies and gentleman, this has been our experience and lessons we learned. And thank you so much for your attention. I take you back to Lily Odarno. Thanks.

Sean Esterly Great, thank you very much for the presentations. We did receive quite a few questions from the audience, so we will move right along to the question and answer session at this point. Just a reminder to our attendees, if you have any questions of the panelists today, you can submit those through the question pane. Any questions that we might not have time to get to, we can always come back and email those to the panelists following the webinar as well. So I will start. I will go back to the earlier questions that we received. We can start with those and work our way through. Some of these may have been answered throughout the presentation. The first one we received here is they were asking what is the difference between conventional grids and mini grids? Can you explain about the granular approach? Maybe just a little quick overview on what the—we did have another question as well asking what the size of the mini grids, your project was looking at specifically. So maybe a quick overview on the difference between the conventional grid and a mini grid and then what sort of mini grids you were talking about in Tanzania. Is there a certain distinction in size that qualifies that as a mini grid?

Lily Odarno Okay, so.

Sean Esterly Go ahead. Let's start with Lily.

Lily Odarno Yeah, so I just was going to provide the answer to what the granular approach is about. In the introductory comment, I made mention of the fact there is a lot of information out there about mini grids, which is really on a very high level which identifies some of the barriers as this low financing for the sector. This sector is not well understood. We do not understand what policy and regulatory frameworks are going to work for this sector. So those are presented as very high level or very general indications of the challenges with mini grid implementation.

When we talk about the granular approach, we are talking about an approach that brings these experiences to the projects level, which goes to specific communities with mini grids and tries to understand exactly how those challenges are being experienced in a very typical community context because we realized that sometimes the generalizations are useful as general pointers, but do not provide us with information we need to make actual market decisions, to make actual decisions as to whether we want to go with

this technology or the other. It doesn't just give us the knowledge that we need practically about what people experience with mini grid implementation on the ground.

Sean Esterly Great, thank you, Lily. Estomih or Katyega, do you have any insight into what qualifies for a mini grid, what size system would that be?

Maneno Katyega Thank you. When we talk of conventional grid or the mini grid, we are talking about the grid which is connected to large populace and through high transmission voltages starting from _____ to 20 kb and upwards. Now, for mini grids, these are small size grids whereby transmission and distribution voltages, medium voltage in Tanzania it is 33 and 11 Kb. Now, regarding the size I turn the question to my colleague.

Estomih Sawe Okay, thank you very much. In the mini grids, the sizes we are referring to, there are types of mini grid sizes, the ones which benefitting from _____ framework. The size ranges from 100 kilowatts to below 10 megawatts. But also, you can have lower than 100 kilowatts mini grid sizes, which are generated _____ but sale is to customers on retail basis. Thank you.

Sean Esterly Okay, thanks everybody. A couple of questions, a couple of attendees want to know if the report is available to the public or the findings of the work. If there is any information out there that they can access?

Estomih Sawe Well, I think we are still working on the report to finalize, but once it is finalized, I think it will be definitely available to the public.

Sean Esterly What are the most common financing options that a community can take advantage of in Tanzania to cover their required investment to implement a mini grid?

Maneno Katyega The financing options, the first one is if the financier has enough resources, he can go it alone, finance the project, and then sell electricity to the DNO or directly to the villages. However, experience shows that this is very difficult going to the local private investors in the country. They don't have enough resources to do so. So the options are grant financing, which is often available from Rural Energy Agency, development partners, NGO's, etcetera. The second is to take a loan through the Innovative Financing Arrangement in Tanzania, provided the investor has prepared a bankable business plan and submitted to the commercial banks through the Rural Energy Agency. He can obtain financing. The last option is the first option asset to use equity or own resources. Now, those are the financial sources that we have come up into the country. Thank you.

Sean Esterly Great thank you. Move along to the next question now. A couple of people were wondering if you could provide a further explanation of the load limiter metering payment approach.

Estomih Sawe Thank you, a load limiter is a fuse, which is used instead of the meter. The load limiter just allows a certain amount of current to get into the consumer's premises. If the consumer has come up with a load that cannot be supported

by the fuse, electricity goes out. Therefore, he has to reduce the components he is using in the household or in the business. Then electricity comes back. So this type is sometimes called flat rate metering and payment system. This system is inefficient when it comes to looking at demand side management aspects. The consumer has no incentive to reduce his load as long as the load limiter allows the electricity. This is maybe a shortcoming of the load limiter. Thank you.

Sean Esterly Great, thanks again. Moving along now to the next question. It's asking if the ultimate objective for all Tanzanian mini grids is to be connected to the main grid or are all long-term independent commercially viable mini grids also a possible end point?

Maneno Katyega The main objective of mini grids is to provide electricity in those areas where the grid has not reached there and it will take a very long time to reach there. As long as the costs reflective or it is a better option than grid extension, this objective is met. Now, when you have a mini grid, the more time than the demand grows. The capacity is increased. When there comes a time when the demand is large enough, this is connected to the grid. This is the common practice in the country. But you can develop small projects and establish your own mini grid and still sell to the main grid or to the conventional grid. So it's just one option of electrifying the country. Thank you.

Sean Esterly Great, the next question goes back a little bit. It is asking what are the main considerations that the Energy and Water Utilities Regulatory Authority have on calculating the tariffs for mini grid projects?

Maneno Katyega The regulatory authority when it comes to calculating the tariffs for mini grids is come up with tariffs, which are fair to the producers and to the consumers, the distribution network operator or retail customers. That is the basic objective of the tariff setting mechanism _____ So the tariffs, the feed in tariffs are computed based on cost _____ cost of the distribution network operator whether it is grid connected or isolated or mini grid.

That's why during the presentation, Mr. Sawe talked of feed in tariffs for the main grid and feed in tariffs for the mini grids. Now if it is conventional grid, than it is avoided cost in the conventional grid. If it is in the mini grid, it is the avoided cost of the mini grid distribution network operator.

Now, in the case where the small power producer is going to generate electricity, distribute it and send it to directly to the customers, what normally is done is that he provides the cost of service involved to the regulator. The regulator looks at the costs and the tariff, which has been applied. Normally, there is a public hearing whereby the consumers are invited and whoever is investing presents his application. Following the application being reviewed customers, the government, and the regulator, the regulator finally approves the tariffs, which he feels these are fair to the customers, as well as the generator. This is the approach. Thank you.

Sean Esterly Great, excellent. We have a couple questions on the ownership model and building the community capacity. What they are asking is they are asking is

they are wondering more about the local ownership and management, what factors are included in your vision for improved integrated planning and who, if anyone from the communities are involved in the design and governance of the system and how does the ownership type influence the importance placed on community consultation? I will repeat some of that. They are wondering more about the local ownership and management. What factors are included in your vision for improved integrated planning and who, if anyone from the communities are involved in the design and governance of the systems?

Estomih Sawe Okay, thank you very much. As we said earlier, the participation of the local community from the very beginning of the mini grid planning is very crucial for the sustainability of the mini grid services and also for the realizing different benefits from the mini grids development. The involvement of the community starts from involving also the local authority, local government, local village leaders, and also involving different groups in the very beginning to try to identify the needs, the priorities, the linkages between the mini grids development and also the development at the local level.

This could take different forms depending on the type of the mini grid and also the community itself. But they are most important is ensuring that the local community is also well informed on the development of the mini grid, but also well informed about the benefits from the mini grids that they will be developing. Also, they are well informed and well involved on the management of the mini grids.

This can take different forms including maybe information at the local level, of the potential user of services associations. Having them to participate, maybe in the management or having shares from the mini grid itself. Also, training them to be able to operate the mini grids and maintenance, manage the mini grids at the different levels. So I think involvement of the community can take different forms in the community, which is involving the mini grid development.

As we said, we gave an example of the LUMAMA mini grid, which from the very beginning it was tailored to ensure that the community is empowered through proper training of management, proper training of operating the system and maintenance of the system, and also management of the systems businesses arising from the mini grids. They are well trained, well informed, well involved. So they feel they own their part of it. Even the benefits that have been realized from the mini grids, they provide development or benefit the villagers. Thank you.

Maneno Katyega I can add a few things also. During planning, in the case of LUMAMA, villagers provided freelance, whereby they are going to put up a plant and also for the way the lines are going to cross the village, thereby reducing significantly the costs. Also, the villagers have met a number of bylaws which are geared to protecting the water sources whereby if somebody or a village is involved in bush fires or unproductive agricultural systems like cultivating along the river valleys and thereby contributing silt to the mini hydro, now if it comes to a point that they know that a certain villagers is not stop to the bylaws, there are ways to deal with them. During the dry season, when the

flows are very low, the villagers which do not follow the bylaws are normally not given electricity as a lesson. So these are some of the examples of community development in the planning, in the operation and maintenance of the system. Thereby they make sure the sustainability of the mini grid is there. Thank you.

Sean Esterly Thank you both, again. One of the questions notes that you mentioned a light-handed approach that has been introduced in the Electricity Act of 2008. Can you elaborate a bit more on what you mean by light-handed?

Maneno Katyega The Electricity Act talks of the light-handed approach. Now, this has been translated into the small power projects or small producers regulatory mechanism or framework whereby we have standardized power purchase agreement and standardized power purchase tariffs. By having standardized power purchase agreements, the regulator has avoided one thing. If there is an agreement between the small power producer and the distribution network operator, they sign the standardized power purchases agreement and they send it to the regulator.

What the regulator looks at is whether there are no shortcuts done to avoid the regulatory framework. As long as the regulatory framework has been followed, the regulator just allows the project to go ahead.

Now, for the standardized power purchase tariffs it is the same. It is standard. We don't negotiate the tariff. Now, this is what is called light-handed approach. That is instead of each project being negotiated and that would consume a lot of time, the regulator has not allowed that to happen. That's why the regulator has come up with this standardized power purchase agreement and standardized power purchase tariff. This is part of what is involved in the light handed regulatory. Thank you.

Estomih Sawe Let me summarize also, light-handed regulation minimizes the amount of information that is required by the potential development of the mini grid. It also minimizes the number of separate regulatory requirements and the decisions that they are met. As my colleague said, use standardized governments and make the use of _____ that they are used also by different agencies and they also minimize discretion of the argument and the time required for making decisions. Thank you.

Sean Esterly Great, thank you. One of our attendees is noting that they are currently evaluating villages in Tanzania in order to deploy privately owned mini grids. Suitable villages for large mini grids seem to be very rare. Where, in your opinion, are villages in Tanzania suitable for mini grids? Is there, what characteristics do you look for?

Maneno Katyega During the presentation, my colleagues talked of the southern part of the country and the western parts of the country where the national grid has not reached there. There we have large towns and large villages, which can benefit from large mini grids.

Estomih Sawe Also, _____ I think it would depend also on the size of the mini grid that one wants to develop because the cost effectiveness, the loan profile that they would _____ I could also, it's important also to note that there are also villages, but there are also rural growth centers where you find a lot more than 5,000 people, 10,000 people who are different. There are a lot of business activities ongoing. Those have been identified as also a Rural Energy Agency prospectors as potential areas where if the grid is not there, expected to be. Therefore, sometimes those are potential areas for mini grid development in the country. Thank you.

Sean Esterly Thanks and it sounds like a lot of the mini grids in Tanzania are dependent upon public finance. Is this an ongoing requirement or just support to set up? Are there any commercially viable models without public funding for operation, maintenance, and reinvestment?

Maneno Katyega Well, as I said, most of the investors, especially the local investors don't have enough resources to finance the projects themselves. That's why they depend on the government. The other reason is that rural electrification using renewables is very expensive. Also, if all the costs to be tied in the tariffs tend to be very high. Now, to assist the rural areas, the government has come up with an innovative financing arrangement whereby subsidies are provided so as to reduce the costs and thereby make it possible for many rural projects to come up and villages in the rural areas to benefit from electrification so that they can also see their own rural development.

Sean Esterly Great, thank you. Are private owners and operators of isolated mini grids allowed to charge market rate fees to energy users?

Maneno Katyega Can you come again?

Sean Esterly Are private owners and operators of isolated mini grids allowed to charge market rate fees to energy users?

Maneno Katyega Well, for we gave the example of LUMAMA where the tariffs are cost reflective. The market rates and the tariffs that they are prepared by small power producer developers, they have to prepare the tariff and then they submit it to the regulatory authority for approval _____ the tariffs can be definitely determined based on market costs and reflective of your services.

Sean Esterly And we have time for just a couple more questions. How long do you ensure the ownership and what happens when the central grid arrives?

Estomih Sawe Now, for the case of signing the small power purchase agreements, these are from 15, 25 years. Now if the grid comes to the area, there are a number of options. One option is the small power producer can use his plant to sell electricity to the grid DNO. Alternatively, he can remain as a DNO and produce electricity whereby he can be a DNO for that area, which means that when the grid comes, and the load in the villages is bigger than what is producing, you then put in electricity from the grid and retailing it to the electricity end users.

Now, what happens if you decide you are to be selling to electricity to the customers or the retail services and decides to sell electricity to the grid. The standardized power purchase tariff will prevail. The tariff he was charging will have to stop. If he is going to continue generating and selling electricity and receiving electricity from the grid, than standardized power purchased tariffs will not continue, but the regulator will be coming up with tariffs, which the owner of the plant will charge. In the case of Mwenga, they have their own mini hydro, 4 megawatts. They are selling electricity to 18 villages. At the same time, 95 per cent of their generation is sold to the national grid. So he is comfortable and is continuing. So this is one example. So it is quite possible that the grid can come and there are a number of options for the investor to decide. Thank you.

Sean Esterly

All right and thank you again. We are running out of time so we will have to end the question and answer session here. Any questions that were left over that we didn't get a chance to get to, I do apologize, but we can go ahead and email those to the panelists and try to get responses to those as soon as possible for you.

So we do have a quick evaluation for the audience. We will display the first question. This attendee survey will just help us evaluate and improve for our next webinar. So that first question for you is the webinar content provided me with useful information and insight. Please just go ahead and respond directly in the window there. Thank you and the next question, the webinar's presenters were effective. Then the third question, overall the webinar met my expectations. And do you anticipate using the information presented in this webinar directly in your work and/or organization? Then the last question that we have for you, do you anticipate applying the information presented to develop or revise policies or programs in your country of focus?

Great, thank you very much for answering our survey. We do appreciate it. On behalf of the Clean Energy Solutions Center, I would like to once again thank our expert panelists for taking the time to join us today and for answering, giving the presentation, and answering some of our questions. We do appreciate it. Also, to the attendees, we very much value your time. Thank you for joining us.

As a reminder, I would like to invite our attendees to check the Solutions Center website if you would like to view the slides and listen to a recording of today's presentations, as well as any previously held webinars. Additionally, you will find information on other upcoming webinars and other training events. Just a reminder, we are now posting webinar records to the Clean Energy Solutions Center YouTube channel where you will find several of our other webinar recordings, as well as videos on clean energy topics. Please allow about one week for the audio recording to be posted. We also invite you to inform your colleagues and those in your networks about the Solutions Center resources and services including the no cost Ask an Expert policy support that is available. With that, I hope that everyone has a great rest of your day and we hope to see you again at future Clean Energy Solutions Center events. This concludes our webinar.