CLEAN ENERGY SOLUTIONS CENTER
ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

Mini-Grid Quality Assurance Framework

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Panelists	Rose Mutiso, Energy Access Policy Fellow, Office of International Climate Change Policy, U.S. Department of Energy Ian Baring-Gould, Wind and Water Technology Deployment Manager, National Renewable Energy Laboratory
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Sean

Hello everyone, I'm Sean Esterly with the National Renewable Energy Laboratory, and welcome to today's webinar, which is hosted by the Clean Energy Solutions Center in partnership with the U.S. Department of Energy and National Renewable Energy Laboratory. Today's webinar is focused on the Mini-Grid Quality Assurance Framework.

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.

To just go over some of the webinar features, you do have two options for audio. You may either listen through your computer or over your telephone. If you choose to listen through your computer, please select the "mic and speakers" option in the audio pane to help eliminate the possibility of feedback and echo. If you choose to dial in by phone please select the telephone option and a box on the right side will display the telephone number and audio PIN you should use to dial in. Just a reminder to panelists, we ask that you please mute your audio device while you are not presenting. If anyone is having technical difficulties with the webinar, you may contact the GoToWebinar's Help Desk at the number displayed at the bottom of the slide. That number is 888.259.3826.

We encourage anyone from the audience to ask questions or provide feedback at any point during the webinar. We will be taking two opportunities, one during about the middle of the presentation and one at the end to address any questions from the audience. If anyone is having difficulty viewing the materials through the webinar portal, you will find PDF copies of the presentations at cleanenergysolutions.org/training and you may follow along as our speakers present. Also, an audio recording and the presentations will be posted to the Solutions Center training page within about a few and will be adding our 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.

Today's webinar agenda is centered around the presentations from our guest panelists Rose Mutiso and Ian Baring-Gould. These panelists have been kind enough to join us to present the current draft status of the mini-grids Quality Assurance framework, which is designed to address the root challenges of providing quality power to remote consumers through financially viable mini-grids.

Before our speakers begin their presentations, I will provide a short informative overview of the Clean Energy Solutions Center initiative. Then, following the presentations, we will have a Question and Answer session where the panelists will address any questions submitted by the audience, followed by some closing remarks and then a brief survey.

This slide provides a bit of background in terms of how the Solutions Center came to be formed. The Solutions Center is one of 13 initiatives of the Clean Energy Ministerial that was launched in April of 2011 and is 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 on policies relating to energy access, no-cost expert policy assistance, and peer to peer learning and training tools, such as the webinar you are now 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. Second is to share policy best practices, data, and analysis tools specific to clean energy policies and programs. Third is to deliver dynamic services that enable expert assistance, learning, and peer to peer sharing of experiences. Lastly, the Center fosters dialogue on emerging policy issues and innovation around the globe.

Our primary audience is energy policymakers and analysts from governments and technical organizations in all countries, but we also strive to engage with the private sector, NGOs, and also civil society.

This slide highlights one of the marquee features that the Solutions Center provides is the no-cost expert policy assistance known as "Ask-an-Expert." The Ask an Expert program has established a broad team of over 30 experts from around the globe who are available to provide remote policy advice and analysis to all countries at no cost. For example, in the area of Rural Electrification we are very pleased to have Ibrahim H. Rehman, the Director of the Social Transformation Division at The Energy and Resources Institute, serving as one of our experts. 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, the assistance is provided free of charge. To find out if the Ask-an-Expert service can benefit your work please contact me directly at sean.esterly@nrel.gov or at 303-384-7436. We also invite you to spread the word about this service to those in your networks and organizations

Now, I'd like to provide brief introductions for today's panelists.

Our first speaker today is Rose Mutiso, who will be providing an introduction. Rose is an Energy Access Policy Fellow at the Office of International Climate Change Policy at the U.S. Department of Energy.

And then following Rose, our main speaker today is Ian Baring-Gould. Ian is a Wind and Water Technology Deployment Manager at the National Renewable Energy Laboratory.

And now with those introductions I would like to hand the webinar over to Rose.

Rose Thanks Ian. I mean thanks Sean, sorry, and thanks everyone for joining us today for this webinar. I'm just going to deliver some brief introductory remarks really to just set the stage for what will be a great and very interesting kind of deep dive into the framework that will be led by my colleague Ian Baring-Gould. So, let's jump into the next slide.

Thanks. So just to provide some context I will start by invoking this idea of a utility model, which is really the basis for commercial viability in the electricity sector. As many of you know, utilities in developed countries are among the safest of all investments. The business models for these utilities in mature energy markets work because the roles and relationships between these three stakeholders, listed on the slide, are well defined. So, the customer needs a guarantee of service that they can afford and that they are willing to pay for. Power suppliers need to be able to guarantee a rate of return to their investors while covering operational costs and investors need to confident of the risk they are taking. Next slide please.

So, unlike in the developed country utility model where the costs are low and partly to scale, demand is high, willingness and ability is high, and investor risk is low. With rural electrification and what we are calling the mini-grid model in this case this utility model breaks down because of a

variety of challenges and we will just highlight three really important ones that affect these three main stakeholders. One is very high cost of power provisions to remote customers through the lack of sale because volumes are low. Ability to pay is very low and so there is no consistent cash flow from customers and finally the investment risk profile is really not well understood and investors and funders don't really have a good handle on this phase. So a big question is, how do we replicate the successful elements of a mature utility business model in the mini-grid remote electrification setting while still kind of getting around or accounting for these challenges? Next slide please.

So, this brings us to the [inaudible 8:42] framework—what are we trying to do here? At a very top level, and Ian will go more into more of the weeds on this, we are trying to accomplish...what we are trying to do is accomplish at the top level is provide structure and transparency similar or kind of analogous to the successful utility models in mature energy markets while also accounting for the broad range of service levels required to meet the various segments of the off-grid consumer base. We are working with consumers whose needs span the entire energy ladder from very basic energy access up to grid parity. You know the really fundamental underlying goal here is to lay the foundation for successful business models in this case. Can we go to slide five?

So more concretely, this framework—and this will become clearer in later parts of the presentation, have two elements where there are kind of more technical levels of service elements that tries to work in this different kind of consumer segments across the energy ladder and there is also an accountability framework that tries to create transparency in the sector and defines early grade performance and reporting for a goal. All of these things together and the community framework together will be a really important tool for unlocking investment and scale, which are two kinds of critical challenges in the field of how we think that this will help accomplish this at the very base level first. The common framework will enable us to provide a common technical standard for classifying mini-grids. Right now mini-grid projects are bespoke and one off and it's a very fragmented space and you know we are trying to bring all this together using the common framework.

The technical portions of the common framework really allows energy suppliers to optimize system design to match different pairs of end user needs. The reason this can really strengthen revenue flow is because you don't have to provide a bottom level of the pyramid consumer with grid-parity level but then maybe you have an anchor customer who needs more and you can kind of play around with the building blocks of your power system within this framework to meet different consumer needs.

Finally, with the common accountability framework we provide robust performance and market information about mini-grid systems that will expand an understanding and it being a common way to report

performance. Both business and technical information can really allow aggregation and ability to look across numerous mini-grids and divest increasing risk.

Finally, this is a very flexible and adaptable framework. It's relevant to AC and DC mini-grids, renewable fossil-fuel hybrid systems and finally what I've mentioned a couple times is really important is that we capture the entire energy ladder to make sure all the kind of different kind of remote customers are covered. Next slide.

So, finally this work is kind of part of our engagement or our number of international Energy Access for All. For instance, part of India-US promoting energy access through clean energy initiative and we actually had a stakeholder workshop in India in August this year. The outcomes from that were great and Ian is going to present a little bit on that. This work is also part of our engagement on Power Africa: Beyond the Grid Initiative. As part of this work we will be holding another workshop in Tanzania in mid-February on the margins of Energy Access for All forum and we'll be providing you all with more information about that as we finalize the details. Finally, this work is also part of the SE4ALL High Impact Opportunity collaboration on mini-grids. Great, so with that I'd like to hand the reigns over to my colleague, Ian Baring-Gould, who is our technical lead in this work and will walk us through the framework in more detail. Thanks.

Ian Thank you Rose and thank you Sean for the introduction and thank you all for taking the time to hear about this Quality Assurance Framework. As Rose provided the kind of introduction, we all have experience in off-grid power systems and we also see the extreme need for the development of expanded operating power systems to meet the people who don't have access to power as well as to supply more consistent power to the mini-grid systems that are out there. We're very much in this bind in regards to the amount of information and the type of systems that are being deployed, the longevity, the sustainability of those systems. It's something that going back to the village power days with the World Bank fifteen years ago it's a nut that we have not been able to crack. So there are a number of activities that have been increasing. The Quality Assurance Framework is just one of them.

To start off with I want to provide a quick definition of mini-grid. In our lexicon here it includes all type of energy services to isolated power systems. We are not looking at combinations of power systems and we're not really considering what happens when an isolated power system does end up interconnecting, if it ever does, to a main grid. The size range that we're looking at is under this 1 megawatt, though it can be smaller or larger than that. It doesn't really have a size threshold but we are focusing on these small isolated power systems. It is intrinsically different from a micro-grid and there is certainly confusion in regards to the difference between the two but this is a system that will conceptually never be

connected to a larger grid and if it ever is connected then the structure of it changes dramatically so that is a different beast.

As Rose was talking about, as we look at this Quality Assurance Framework we break it down into these two areas. One is kind of a definition, a clear definition, that is available to all in terms of level of service and that looks at quality, availability, and the reliability of power. This is in a grid that is primarily between an energy provider, the utility for the mini-grid, and then there is accountability framework, which is more the infrastructure that helps us ensure that the relationships between the parties—the consumer, the provider, and then the funder or regulator are set in a way that is more consistent with the power sector. It's really clear that the Quality Assurance Framework does not mandate a standard level of service or anything of that nature. It doesn't require anything. It more allows the industry to have more of a truth in advertising so we are using the same kind of lexicon when talking about this and we set up structures to allow the industry to grow. It is going to grow but from being a bunch of single systems that are completely independent to a group of systems that are completely independent into more of a utility model, utility infrastructure.

I like kind of looking at this mental model. Right now we are talking about a Quality Assurance Framework which may or may not turn into a standard at some point in time. Standards can be a little bit confusing and the motivation for a standard can be a little bit confusing so taking into something that is really simple, that don't play into standard space, there are really two important elements about standards, international standards, as well as this framework. The first is this replicability and the standardization of a product or a concept. Here we have a toaster. We all know what a toaster. We all know that a toaster is supposed to provide toast but what the standard allows us to do is to have the person who makes the toaster know that he can develop a toaster that can work as basically as well in one part of the world as in another. So you don't have different toasters for different countries or even different toasters for different cities. If someone wants to go out and buy a toaster, they know basically what they are getting. There is a common understanding of that. What we are trying to do with the Quality Assurance Framework is develop a common understanding of what a mini-grid is so that there is that common understanding. Another thing to think about is that the product is built around the standard so it's not that in our toaster example here, it's not that someone develops a toaster and then goes out and says how do I make this toaster fit within the standard? You actually look at the standard and say the standard for a toaster is it plugs into a wall and it can use this kind of current and you are supposed to put pieces of bread in it and you are supposed to brown them. That is what we expect from a toaster and therefore when you go out and build a toaster that is what you are building. You have different bells and whistles and everything but that is conceptually what you are doing. In regards to the Quality Assurance

Framework that is exactly what we are trying to set in place so that when someone specifies a mini-grid or designs a mini-grid for specific application, there is a common understanding what that really means so we are all speaking the same language. That is the true role for Standards.

It is important to note, as I mentioned, that the Quality Assurance Framework is one part of a bigger system and there are lots of other systems that help address the question of making mini-grids viable. Clearly there are various international and national standards for most of the components that exist in the mini-grid space, be they the wind turbines, or batteries, or PV modules, or light bulbs. Most of those exist and are used in the space. There is the IEC 62257 standard for mini-grid systems and deployment that talks about how you weave mini-grids together and things of that nature a mini-grid also includes, and that is primarily from the distribution system. Mini-grids are also from a power system the IEC 62257. There is also a distribution system that is part of a mini-grid and most nations have national standards as well as the World Bank has a fabulous guideline on the construction of distribution systems. Home wiring is another thing that is included in a mini-grid. There are national standards of that and also a section in the IEC standard. The 622574 is related to power systems that talks about what home wiring would look like for a mini-grid. I don't want to say the last element, but the next element is this Quality Assurance Framework that defines more of the relationships between the parties, the consumers, the providers and then the funders or the regulatory agencies and it provides a framework for those three parties to communicate and that is another element of this. There are certain additional needs that have not been covered that we can talk about in this work—what happens when you connect an isolated system into a national grid, as well as some kind of certification of power system designers and installers. Things of that nature are still to be developed or may never be developed but are certainly not covered in the framework that we are talking about here. Jumping back to the elements, again level of service and the framework, we are going to talk specifically about level of service and then take a little break for questions on the level of service aspects before we jump into the next element of the accountability framework. So when we talk about levels of service we really break it down into these three areas that really drive the level of service that is provided to rural communities: The quality of the power that is provided, and that is very technical in nature and voltage frequency and things of that ilk. We also have a power availability so how much power, or the amount of energy, that is provided to the consumer and that's hours of service, the total power that is available at the home, the energy levels over a period of time, and then the last element is reliability. How reliable is your power system for providing service to the customers? The idea is they develop the framework that articulates this so that there is a defined agreement between the consumer of the power and the provider of the power. The idea of putting in place something that allows us to understand this and to articulate this is that it tackles this willingness to

pay. We are all much more willing to pay for a service that we know what that service is and we have a way to determine we are getting that service. We are all not likely to pay for a service that we think we are getting when we don't get it or we believe we are getting one thing or are supposed to be getting one thing and we feel that we're getting something different. So by trying to clarify this in terms of the terminology, and the levels we will get into, concrete that relationship. So that if someone signs up for a level of service and they know they at the beginning have the ability to pay for that then over time the utility can trust that that will continue, just like it does in mature energy markets in the developing world.

Jumping quickly into each one of these elements, going into power quality, it is really important to kind of look at another mental model. When we talk about grid and mature energy markets a way to look at that is in vehicle context for our mental model. A solid work truck is very akin to grid quality power in a mature energy market. You have plugs on the wall and you have fuses. They protect you from things you are doing. You can basically plug anything into the wall that you want to and the grid quality is there. I don't worry when I plug my cell phone, my computer, my light bulb, my fan into the electric outlet. I know the service is there to provide whatever load I plug in and that's your work truck. That's your kind of heavy-duty vehicle. When we start looking at rural communities, everybody doesn't need a work truck and when we go into rural communities everybody doesn't have a work truck because they can't afford a heavy duty truck in rural communities, nor do they need all the infrastructure that is in place to plug in their electric heater, their toaster, their rice cooker, their whatever they want into that electric service. As we start looking at power quality issues for rural consumers, yes, some of them want the truck and some of them need the truck but a good deal of them don't want the truck and don't need the truck and aren't willing to, nor do they want to, nor do they need to pay for the truck. As we start looking at power quality the top service is clearly the utility truck. It is a mature energy market. It is grid quality power but then we look at lower power levels that are under that that could be more applicable for rural communities if that's what they want.

So, when we start talking about power qualities—quick definition—but what the power companies are worried about in a mature grid or a mini-grid is the loss of unsatisfied customers and then the cost of being able to provide that power. Clearly high quality power costs more money than lower quality power. Then the customers want to make sure that their equipment operates. That is what they care about for whatever they are planning to plug into the grid.

The Quality Assurance Framework tries to break down these three levels of service with a whole bunch of power quality issues. Those are the things you see on the left hand side of your screen: voltage and balance, transients outside of the system insulation design, short term/long term variations, distortions, all of these kind of things that the electrical

engineers and utility people worry a whole lot about but consumers typically don't just so long as their power systems operate the way that they want or their devices operate the way they want them to or expect them to.

So we break this down into these three classifications. The numbers that you see here are based on international standards for the high quality. The high quality we have tagged at basically international standard for mature energy market what would be considered grid parity power and we always want to provide that as an option for mini-grids. Then we have a standard and base levels of service that open up this envelope a little bit more so that we lower the cost of mini-grids and provide the power that people need to supply the loads that they want to supply. We are certainly interested in and understanding what these values are so one of the reasons we are making presentations like this and workshops we are conducting is to meet with experts from the field, who are deploying mini-grids, to really nail down these types of parameters to make sure these fit the need. So as I mentioned, high is grid quality and low we are using for basically power that will not damage loads that you will have in your power system. So those are the range of the brackets we are looking for.

Jumping down in the framework we are looking at AC and DC systems. We have not fleshed out the DC systems to the same degree. A lot of the same issues that you have in AC systems are the same in DC, except that DC is conceptually simpler because you don't have a lot of the issues with frequency, unbalanced loads, harmonics, flicker, all of those types of stuff are not of concerns with DC power systems. We do have to worry about the voltage drop. That's more in regards to voltage and the geographic footprint of the mini-grids for the distribution network. We do have to worry about transients that are similar to AC systems and so the Quality Assurance Framework will have similar specifications for DC as shown for AC systems.

For power availability this is the amount of energy service being provided to a specific customer based on need and a number of factors. It really drives down to parameters to define how much energy a customer is going to need and is able to pay for. Again this drives into this expectation between this relationship that the utility and the customer have. We break it down into these three areas: the power—the maximum and minimum power levels, the energy that is available over a defined time period—month or year typically, and then also the time of day service—so for what hours of the day is power provided to each of the individual customers.

There are several models that kind of look at this. There is one that has been promoted by the World Bank and ESMAP, which is a fabulous structure that really tries to break down these parameters that we have talked about, the peak available power and consumption, duration of supply here, the time of day service, they have the quality—so power quality is also in there, and then evening whether supply is done in the

evening. So the time that energy is supplied. Very good models here at currently residential rates. This is being expanded to look at other consumers, commercial primarily, to break out similar ones. When we are looking at these levels of service we are really building on the tier structure that has been promoted here. One of the issues, however, is that it is really hard to classify power systems in relation to the same tier structure. The tier structure is fabulous at understanding what a specific consumer might need but not necessarily reflect on the power system that is designed to provide that service. That is where the level of service issue that we are talking about comes into play.

The different levels of service that we are talking about, we really followed the tier structure that has been promoted by ESMAP and the World Bank. Looking at available power we break it down into these nine levels and this is based on our discussions with people in the field. To a degree it largely defines what types of devices, energy services, can be used. You could set maximum and minimum levels for specific customers. So a country that is interested in deploying mini-grids can say, within the requirements, everybody has to have level three service or above. They could define a maximum and a minimum but it is really important that the people in the community end up defining what level of service they are based on their willingness to pay. Clearly different rates can be applied to different levels or different groupings of levels of service.

The available energy is similar in nature. Again we followed the tier structure that the World Bank and ESMAP are using to kind of break out the levels of service. Again, you could have a minimum and maximum and again different rates could be applied to these different levels of service. People know what the level of service is if they are being provided. This time of day we have broken it out into basic kind of building blocks. This really falls more along the lines of the types of power systems that are available in the mini-grid space. A level 1—a good example of that would be a renewable only system where if you are based on wind or solar there is really no guarantee of availability. You can have estimates of what the power will be or if people are using too much energy or if the wind doesn't blow for a couple of days the power goes out and you don't have a diesel backup and so you have power when you have it. Level 2 is a system that has more control in regards to the amount of energy that is provided over a time period but it doesn't necessarily have to be full time. A diesel, a very common form of diesel power station. A diesel power-only station that you see in remote areas that provide power for the evening would be a perfect example of a level 2 system because they provide power for a certain part of the day but it isn't 24 hours a day. They have a pretty high confidence that on a particular day you'll get your 16 hours of power of or something like that. The last one is level 3, which is full certainty that you have power again. Grid parity is what we are looking for in level 3.

On top of both of these we have this reliability question. You can have a power system that is providing power to rural communities, but then there is a how reliable is this power system so we delve into that. Again it can be bracketed and understood what level of service can be provided based on reliability. We do break it into two kinds of buckets—unplanned power outages and planned power outages, so that we can get an understanding of both of these parameters. And as is common in the utility space, there is a frequency of interruption. So how often does the interruption happen and then how long is that interruption in both the planned and unplanned? We put basic parameters around both of these. It is really important to kind of break these out and also important to have different levels of service. A good example of providing very high reliable power is the same diesel plant that I am talking about here—very common across the world. In a lot of cases you have one diesel engine and when that diesel engine needs service you shut down the diesel engine and change the oil and everybody goes without power for four hours every other month, or whatever it is, to ensure that your diesel is operating. You certainly have the ability to install a second diesel engine within the community so that during those 4 hours every other month, or however often you will take you diesel down for maintenance, you can guarantee that there is another diesel operating. That comes at a cost—the cost of the second diesel and the interconnection gear and all of that type of stuff, but if that is what the consumers want in that community and they have the ability and willingness to pay for that then it's perfect. Let's do that. In other communities they can go without power for a couple of hours periodically and that is fine and so let's make arrangements to make that happen. Clearly every utility has an amount of planned outages but then depending on the reliability of your system you have unplanned outages. The more unplanned outages you have the lower the quality of power but if everybody understands that you are going to have more unplanned outages because you're relying more on fuel that has to go through a long supply chain, if that's all understood at the beginning, then people are much more willing to accept that than everybody is expecting to have no unplanned outages and they have them and then they get upset and stop paying their electric bill. Being able to define a base for planned outages and unplanned outages again builds up the confidence with the consumer and the utility about what to expect.

So as we look at providing these kinds of levels of service to consumers there are a number of ways to look at it. Currently right now most of it is done on a system standpoint where the power system is designed to provide the customers with a basic level of service and then we grow from that. That is the model we've had in the past. We have the ability to move more toward the customer's standpoint where each customer could specify the type of service and be willing to pay for the type of service that they want. If you are a customer that only has lighting then you don't care about power quality and so you pay for a lower power quality system. Maybe you plan for a higher rate of planned outages and you are fine with that.

The health clinic or the school is willing to pay more for higher quality of power and therefore they get that higher quality of power. Our technology isn't yet to a point where we can really go into a rural community and provide different levels of service to each individual customer so maybe we will get to that in a couple of years, which gets us to this sort of hybrid approach which is the power quality is defined by the system by the highest or near highest level needed by a consumer and the level of service and availability is defined by a customer basis. That is certainly where we are going but we want to make sure the model we are talking about here is able to handle all three of these different approaches.

Quickly, a summary and then we will stop for questions in regards to the levels service. Breaking it down into the three areas: power quality, the availability of the power to different consumers, and then the reliability of that power from a system context.

Do we have any questions Sean or I can move on to a couple of examples?

Sean No you can move on at this point.

Ian So we have a couple of examples that we use to put this in context. I have pulled this up again—the tiers of service that has been proposed as a kind of refresher. As we look at power systems we see some complications in this. Here is looking at the same tiers of service. I have switched axis by looking at power, peak power, consumption, duration, evening supply and quality and then looking at different power systems. The numbers you see in the sheet are tiers of service that would be or could be provided by this power system. As you can see there is a great variety of service here, whether you are a part-time diesel plant, full-time diesel, renewable only, small hybrid, large renewable system. So this is one of the reasons we needed to take a step back to break these out a little bit more so we are not defining a tier. If you are tier two, by definition, you have low power quality. We want to separate those so that if you have a tier two service but you need higher power quality, then you can have that within the structure.

Looking at a couple of examples to hopefully cement it more in context—we have Isla Mechuque, a diesel only system in southern Chile that provides power for this fishing community. It only provides power for a couple of hours a day, primarily in the evenings.

If we look at it from a tier of service perspective it is really all over the board here. There is no metering, there are no light switches, you just connect and use as much energy as you want or can and you pay a flat rate. It only provides service for a couple hours a day in the evenings and because it is a diesel, generally speaking, the power quality is pretty good but it only allows you this kind of tier three because it is only 4 hours a day. So water heating, refrigeration, and things of that nature you can't guarantee the power. In trying to apply the tiers of service, sorry, the

levels of service, we want to break it down so that we can specify a power system that will meet a broader range of levels of service for the different consumers.

Here is a Quality Assurance Framework as we kind of structured it. Clearly this is a project in the making so hopefully we will get more positive feedback from people like all of you on the phone in regards to how to do this. For a diesel only system there is really no minimum power availability because you just plug in because there is no metering and there is no control on energy consumption so you have kind of an 8 out of 9 in regards to power and energy availability because you just do whatever you want. It provides 4 hours of power per day with fairly high confidence level, relatively straightforward planned and unplanned reliability because it is a pretty simple diesel system.

Moving on to a hybrid system—wind/solar. This one is located in far western China. Households have meters and things of that nature. This classifies again relatively high power quality because it is power converter based and therefore has good power quality. They specify a minimum level of service for customers but they don't have to supply very high energy levels, 5 out of 9, and that allows them to design a power system that is smaller because we don't have high-energy needs in this community. It is 24-hour power conceptually, so 100% availability because it has a backup generator and storage. It has kind of standard planned reliability. It shuts down periodically but for planned outages as they do repairs and things of that nature. The unplanned reliability is a little bit high because it is located in a remote mountain pass that in the wintertime has access issues both from a fuel but also from a maintenance standpoint. So the unplanned reliability is more basic. Everyone in the community understands that so they have not put the extra effort in bigger fuel tanks, remote operation and control, multiple redundant systems, so that the unplanned reliability is higher. There isn't an economic advantage of that and the people in the community are willing to accept that.

The last example in Indonesia is a renewable only system, in this case a micro hydro. It provides pretty good 24-hour power but not necessarily guaranteed. Again we break out this system within the kind of Quality Assurance Framework. Power quality is pretty basic because it's just a micro hydro system that feeds into the grid and there is no control on loads or anything of that nature. So basic power quality—pretty good level of availability and energy availability because the hydro is sized quite large for the community. Time of day is reasonably good except the operator has to go down and turn it on and turn it off so it's not necessarily guaranteed at 100%. They have good power for most of the time. Planned and unplanned reliability is pretty standard. They don't have backups or anything of that nature but it's a hydro, a micro hydro system so they are quite robust and don't typically have issues, so pretty good power quality. So just three examples of how this kind of level of service would be applied to different power systems, clearly with the understanding that if

an entity wanted to provide power to a community they could go in and specify these types of parameters and basically everybody would know what type of kind of energy they were being provided. Clearly the energy that would be used to provide this power could vary quite widely and does not kind of define these levels of service in no way prescribes the type of technology or the type of system that could meet those needs.

So the second element is the Accountability Framework. Taking a step back we talk about the levels of service, what energy is provided to customers, and then the Accountability Framework? The Accountability Framework we break down into two basic areas: consumer accountability and utility accountability. From a consumer standpoint it is pretty straightforward. It defines the level of service that someone is buying and then the verification of that service. If I'm level three consumer and I know that and I am getting that and the power system is supposed to provide standard power quality. I know exactly what that is. If I feel that I am not getting that level of service then I have a means to make my grievances known. The utility is primarily is looking from the utility to the funding and/or regulatory organization and that is why this breaks down into this more reporting structure of ensuring that the funding or the regulatory body understands what is happening with the utility bodies and we build up that confidence to bring in funding to that utility area. I will talk about each one of these specifically.

From a customer's standpoint what we really care about is, as I've talked about, a defined level of service. Something like records energy consumption, whether that's a meter, records the ability. It doesn't have to record these but it records the ability to record the hours of service. If I don't believe I am getting the required hours of service I have ability to say to the utility, please come and measure me. You can actually measure that. Also, to check voltage levels at the basic level of power systems is what you need to basically understand what the power quality is for a community. Then the implementation of a kind of periodic and random documented voltage survey so the utility knows by going around and taping into the voltage levels of people's homes whether they are providing the quality on a consistent basis.

The second element—the first one is this sort of verification of level of service, the second element of the Consumer Accountability Framework is this agreement between the consumer and the utility, the power provider, defines what I'm getting and if I don't feel what I pay for an ability to address this with the utility. That last bullet is to protect the utility so that if I have an agreement with a consumer that they are a level three and they go and start plugging in huge motor drives into their outlet and it starts blowing up transformers that the utility is protected from the actions of a customer as well.

All of those things are quite standard in mature energy markets and when we sign our agreement to buy our power we basically sign on to all of

those things. All of those are commonly accepted from a customer perspective in a mature energy market. I think all of us would agree that is not expected when we start talking about the mini-grid space.

The second element that is critically important is the Utility Accountability Framework. Again, we break this up into two areas. The key is to have a methodology for utilities to provide relevant information to regulators and project financiers. This information is really there to document that the utilities are providing the power that they are specified to provide but also to build up the confidence level to have this documentation so that the financiers see mini-grids as a viable business investment. That means that they understand the risk and they understand the return that they can get from investing in this space. That is the critical issue with financiers. So if you are a private or public finance organization you want to be able to understand risk and you are willing to take more risk if the returns are better or if there is a reason to take the higher risk. If you have no idea what that risk profile is then you really can't understand what the returns are and you will not invest in that space because you can't quantify those risks. The whole idea of collecting technical information, as I talk about here—system performance, energy usage, operational issues, is to build up this track record so that both the utility as well as the financiers as well as the regulators understand what's happening within the technical power systems and how it can be improved if it needs to be improved. If everything is running perfectly well then everyone knows it is running perfectly well and the risk profile of the project is really small. Business reporting is exactly the same way so collection rates, electrification rates, customer characteristics, service calls. All of these things that we have in the utility sector in mature energy markets build confidence in the power sector. You can go to your utility today and you can ask them what their revenue stream is going to be in six months and they will be very clear—they might not tell you but if you could get them to tell you, exactly what that revenue stream is going to be in six months. Therefore they can get not only bonds or investors to help them expand their network, get more customers, put in more mini-grids, but they can also get people to come and invest in them as a company to build new technology or to build new widgets or things of that nature because everybody understand the risk-return ratio for a well operated business. In some cases in the mini-grid space some companies do this really well and a lot of case this does not exist at all. So by defining this framework we put in place a process to start collecting that information, not only from a single power system but if we have a reporting template, which is the second element, we get this from multiple power systems. It is one thing to know the risk profile of a single mini-grid in Tanzania. It is another thing to know we have 100 mini-grids in Tanzania and this is the risk profile for all 100 or if we have 10,000 mini-grids in Africa this is the risk profile of 10,000 mini-grids. We only get that if the reporting template, the type of information, and the way the information is provided is the same. If I have 100 mini-grids all providing different information at different

produce, with different people, different formats that information is basically useless. The fact that they are all collecting that information is great, and maybe from the utility perspective that specific mini-grid they have a great understanding of their energy needs are going to be, their energy and revenue needs are going to be in 6 months, but from the Ministry of Energy in Tanzania or investor standpoint that does not help them because they can't say we have 100 mini-grids in Tanzania and one is going to fail. We know that but the other 99 are going to be fine so from a risk profile, that is very low risk profile, as opposed to we have 100 mini-grids and we have no idea what each one is doing. We have no idea if each one is going to fail tomorrow or is going to need to be expanded tomorrow and therefore we have no idea and the risk profile is extreme. This common reporting template is there to help build the pool of understanding and lower the risk profile for mini-grids. We do that by having reporting that is all similar in nature.

We go into some details in terms of the technical reporting that we are talking about. It is all pretty straight forward energy usage, energy sales, plant reliability, renewable energy contribution—so how much fuel you are using, system efficiencies, operation maintenance—all pretty straight forward.

From the business-reporting standpoint, again, all information to all of us is very basic and a utility in a mature market has all of these numbers at the top of their head. I would hazard that in almost every case, not every case—there are some mini-grid operators that have all this information and can hand it to you, but these numbers are not common across the industry and certainly aren't common among many mini-grid operators. Some are fabulous and some have none of this information, so this kind of basic information. Then we talk about the reporting template kind of a structure of this information to be used. As I talked about, eventually will result in the assessment of the utility system, of the individual mini-grid, trending of service and energy of that mini-grid over time, the ability to do risk assessment of investment and develop appropriate mitigation strategies for risk for a specific mini-grid, but also the ability to look across investments—meaning across multiple mini-grids of different technologies in different parts of the world all using different framework so that we can understand what the risk profile is so we can bring in private investors who will be the ones funding the rapid development in the mini-grid space.

Just a quick summary before we move to close up again. Two main elements of the Accountability Framework: Consumer accountability—that agreement between the customer and the utility so that everybody understands what that is and it increases confidence in that arrangement that again builds willingness and ability to pay for that service that they are being provided. Then second, the Utility Accountability that helps to define this relationship between the power provider and the regulatory agency and moves this industry from a whole series of one-off small

projects into a large pool of mini-utilities that again bring confidence and reduced risk to the investment infrastructure.

Quickly, in closing, we have levels of service and accountability that we already talked about. Both of those are critical to understanding levels of service, the building blocks for power systems and energy usage and then the accountability framework to put the pieces together. So, in two slides a quick overview how we see this being applied. Again, this is very much a work in progress and we are always looking for feedback in this but we break it up into these four areas: The funders and the governments. In some cases these entities are the same and in some cases they aren't. Then we have the developers/suppliers and the utilities in purple and then the customers in blue. Each one of these really has to look at how you would apply this framework a little bit differently. The funders and the governments integrate the level of service concepts into their community and initial assessments. They ask people to go into a community that is looking to get electric service and be able to understand what energy, what levels of service are going to be required, form of power quality, how many level three users, how many level four, how many level five, what is the potential for growth rate from level three to level five. All of those things can be defined in a clear and straightforward process that allows us to develop energy needs profile estimates for the community that allows us to find a power system and then implement that. Certainly from the funders' perspective tracking each individual's system load to performance so that you can keep track of whether the power is getting better or worse and be able to come in as needed and then certainly be able to collect this long-term financial information. Government is pretty much similar. Most of the same bullets but in this case they can specify minimum levels of service in terms of compliance to power quality issues. The developers and suppliers use this to define the supply of their power system so they know how many users they have, what kind of power quality they need. It helps them to find willingness to pay and identify rate structures that will cover costs of the operation of their power system—the deployment and operation of their power system as needed, collect data to demonstrate operation, service levels and payment of the system, and then use the concept of level of service concepts to consider system expansion needs and things of that nature. So, it's kind of a proactive approach to collecting this data so they know how the system is going to grow.

From a customer standpoint—know how to determine their levels of service that meets the need they are willing to pay for and also allows them to alert regulators or power providers of any concerns that they have.

The next step of the benefits of this I have articulated them throughout the presentation but just to sum them up more succinctly from a funder perspective—easier to define performance requirements that meet the needs of different customers so that can be specified as you start to look at communities. It allows a more standardized process to identify project revenues by identifying the different levels of service and then by putting

in payment schemes based on the levels of service that are needed within the community. Standardize long term tracking so that you can understand whether the system...how sustainable the systems that you are putting in are going from initial deployment to multi-years after that. Putting in this mini-grid risk profile to expand or understand what your investment returns are and then also this last one as we are collecting data. Improve data on rural energy usage and needs so right now there is in truth very little data that is hard-core, commonly available in regards to how energy need changes in communities as they become accustom to electric service and lots of other data questions that will help this industry grow over the long term.

From a government perspective the benefits of a framework of this nature are it is easier to define performance requirements that meet the needs of different customers, defined project development process, you have the levels of service surveys in the community to find the level of power system. It ends up being a pretty straightforward approach as compared to the much more ad hoc process that exists now. Again, standardized long-term tracking of projects resulting in improved sustainability and then improved data collection that I talked about.

From the developers, suppliers, and the mini-utilities again a standard approach to project development process so you know you can go into a community or if you get data on a community that says we have this many tier threes, sorry, this many level threes and level fours and level 5s and you need a base pair quality and they want, based on the surveys, power for 16 hours with 95% reliability and these reliability numbers. You as a developer you can actually start designing your power system based on that information, as compared to what happens now, which is every developer has to go in and do their own energy assessment within the community to be able to design their power system. Hopefully it will reduce the amount of time people will have to spend in each community to do this development. Uniformity of mini-grid technology options so that you know that if you have a power concept that fits within this framework and this framework is being applied in Tanzania and then you find out it's being applied in India. You know that if your technology conforms and can fit within the structure, you know you can conform in India as well as Tanzania. You don't have to redesign, redefine, redevelop your power system for these completely different markets because the entities that are looking at mini-grids in those few spaces are using different power quality requirements, different energy needs, different reliability issues. Everybody is coming at this with a different approach then clearly there is no uniformity and a power provider has to develop basically a different power system to meet the basic needs of each RFP that comes out.

You have independent data streams to justify funding, not only for projects but also for your own internal investment to do technology develop. If you can demonstrate that you have a bunch of mini-grids out there that are operating in this fashion, that have high power quality and

are meeting the needs of the customers and you have a designated rate of return then clearly you can go to more funders to put in more mini-grids but you can also go to more investors that are willing to provide you funding to build a better mouse trap, to do a lower cost power system that allows you to compete better. Then, of course, reduced risk through standard data processing and risk collection. So, in a lot of cases mini-grid operators have gotten in a lot of trouble going into a community and developing a system that after three years does not work because of different needs within the community. The more information we have the better data we have and the lower the risk even the mini-grid operators have in being able to provide a sustainable power system.

Clearly the customers overall higher quality of energy services because there is a structure around this, recourse if service is not meeting their needs and then I think the last one, even though it isn't specific to a customer, clearly mini-grids—everybody says—mini-grids will play a major role in the services going into the future. If we can get a framework that addresses risk, addresses sustainability in a concise fashion, clearly we'll be able to deploy more mini-grids for less money and therefore provide more energy services to more people who need it. So we have more customers out there with energy services.

Lastly, just to kind of cover the next steps and Rose covered this already. Clearly we brought in a lot of experts and are working with a great team in the development of this Mini-grid Quality Assurance Framework but the first step in anything of this nature is really piloting it and doing a demonstration with an organization or organizations that are deploying mini-grids out into the real world so a desk top study doesn't do a whole lot. A framework of this nature that good minds put together but is not actually used in the field is not really useful. So the first step in this process is to identify organizations that are working to implement mini-grids and then work with them to iron out the bugs that we know that are in this framework in the actual piloting of mini-grids within communities. That is something that we are looking for, partners, that are interested in working with us as we roll this out and the hope is that we will start that pilot demonstration project, pilot/demonstration project, over the spring. It's not from our contacts from putting the hardware in the ground pilots, it's the using the structure to iron out the issues in regards to the framework.

We are seeking incorporation of this QA Framework into the international standard so the IEC technical standard 62257 that I mentioned in the beginning of the presentation—recommendations for small renewable energy and hybrid systems for rural electrification. This was originally posed as an element to that but was never completed. There is a grid team that is working on updating the standard 62257 so it is an opportunity to incorporate this framework into this standard. That however is a relatively long process, as it should be, to make sure we are catching everything that needs to be caught as we start putting this in place. We are looking to

move forward on that and then lastly, really wanting to get feedback from anybody and everybody to understand how this will be deployable and then get the adoption of the government and donor community to actually adopt this structure and adopt it into the projects that they are doing. As I said, a framework or standard that exists but nobody uses isn't overly helpful. So the last step in the implementation is working with governments and funding organizations, initially donor but then hopefully private, to be able to take this model and deploy it and then deploying it widely.

It would be good to note again, as Rose mentioned, that we are seeking feedback. We do have this workshop planned in Tanzania in February and would encourage people who...would certainly be interested in anybody who is planning on attending that event that would like to come and talk to us in person as part of that workshop please let us know. We'd love to have you and then clearly we're seeking feedback. We have our email addresses up here, both mine and Rose, so seeking feedback on that to ensure that what is put in place doesn't restrict anybody. A good standard provides a framework but doesn't restrict the market in any way. So we are hopefully doing that. The only way that we can be sure that that is successful is by working with people that are deploying this model, new technologies, new approaches to make sure we are not artificially restricting any type of deployment of mini-grids going forward but are actually providing helpful structure around the deployment of the technologies that help move market forwards and provide the electrification needs to so many of the people around the world that need it. With that I think we will open it up to questions.

Sean Thank you very much Ian for the presentation and also Rose for the introduction to that. We did receive a number of questions from the audience so I will start with those. A very brief one Ian, some would like to know if you know where to find the World Bank standard for distribution systems.

Ian That is a great question. Probably the easiest thing is to email me and I will email it to you. I am sure it is available somewhere on the World Bank website but I don't know exactly where one would find that but I have the PDF of that and I would be happy to share it.

Sean Great, we can follow up with them after the webinar then. Moving off to the next question then. Is this framework designed to measure quality of power rather than the quality of mini-grid in components of its composition? Is that correct and if so, to what extent does the quality of the mini-grid in its installation impact power supply?

Ian A great question. So the framework is really structured around the provision of...I don't even want to call it a requirement but, the quality of the power that the mini-grid, that the technology within the mini-grid produces and how people want to develop that technology, put in place that technology, what technology they want to use to result in a power quality that is defined here is completely up to them. There are hundreds of ways to do it so with this framework we don't want to try and specify in any regard what type of technology people can use. This is really focused on the resulting power quality of the system as, basically as it's specified. What was the second part? How would you do that?

Sean The second part was, if so, to what extent does the quality of the mini-grid installation impact power supply.

Ian Greatly, and so the quality of the technology impacts the resulting both the technology choice and the technology that is used greatly impact power quality. As we've seen in solar home systems the great technology that isn't deployed very well without grounding and things of that nature. You can get great technology that normally would provide very high power but ends up providing no power quality because it's not installed right. So the framework really tries to go after the ladder in the sense of you develop the technology, you put it in, and do you meet the requirements in quality, not only the day you turn it on but five years later.

Rose I'd just like to add that standards exist for a lot of the components and Ian you can elaborate a lot on this, the difference between standards around confidence and kind of the integrating the system or the project—creating framework around the project.

Ian Yeah, so almost every component has a standard. Whether that standard is followed or whether that standard is required in deployment of the technology is a completely different question. From an implementer's standpoint, the true crux of the question is what happens when you patch multiple technologies together? So a battery, the power that comes out of a battery has pretty high power quality but you can't really use that so you add the power converters on the back side of that and out of the batteries and power converters work together to provide the power quality that is kind of specified. That's the secret sauce that all the developers have to work to understand and implement.

Sean Great, thank you both and next question is slightly related. The monitoring framework to assess performance specified or will it be? They use examples of a voltage drop measurement units.

Ian The answer is...the basic answer is no. Certainly on the smaller power systems where the implementation of advanced monitoring would increase the cost of those exponentially and we've really tried to walk the balance of the level of power quality and the level of power quality measurement that would be required by the consumer. So in very basic power quality really all your worried about is voltage levels and voltage drop brownouts and things of that nature and so relatively simple measuring and monitoring and documentation of that. Clearly if we want, not want, but when we get that to the higher power quality levels, and especially in larger power systems, then the use of different technology makes more sense—kind of more advanced technology makes more sense. We're not trying to define in any stretch how you measure or what you use to measure that power quality. We're trying to stay away from that because we feel that as soon as you start doing that stuff you start to put handcuffs on people. We don't want to restrict kind of that development. We'll see if we can do that but that's the goal.

Sean Great, thanks again Ian. Another question and this says in Nicaragua they are seeing micro-grids being operated on very heavy subsidy. They are wondering which governments that you have worked with Ian are being progressive on quality assurance and that are taking willingness to pay into account in building micro-grids that are well tailored to the user desired service levels?

Ian God, that's a hard question because it varies a great deal by country and by time. So China had a very developed program for rural electrification that was very robust and did a lot of great work. I don't want to say anything disparaging and part of the problem is that people can do a great job up front but the real test is over time. So 10 years later are they doing a fabulous job monitoring and how many of the power systems are operating 10 years after the initial ones were deployed. I don't think I know of any country that is doing a fabulous job of this kind of long-term operation and maintenance, infrastructure, and knowledge with these power systems. Certainly the funding agencies, the World Bank, and US Agency for International Develop, and a lot of the Europeans are much more sophisticated than they were 10 years ago in regards to the type of structure that is in place around these systems. It isn't country dependent but funding organization dependent—the kind of level of expertise that is brought to bear in not only the initial deployment but in the long term deployment or the long-term sustainability of the resulting systems.

Rose I'd just like to add that we can continue this conversation online but more broadly one of the goals, the end goals, for us for this framework is to work with governments and funding agencies to elevate this idea of QA and have them adopt, you know, this idea...these ideas as say mechanisms for funding projects. Potentially for some countries it could be a regulatory aspect. This is not, you know, the main goal of our framework but this is a huge gap in the field and that's what we're doing this for, to get these concepts out there, to get them adopted.

Ian And I guess, Sean, to the last point, the framework is pretty independent of funding source. I am a firm believer that power systems in rural areas are expensive and to assume that a consumer will be able to cover the full burden of that is not overly realistic. Clearly governments pour billions of dollars a year into rural electrification, whether it's grid extension or things of that nature. The flip side of that, as I've mentioned, if we are going to address the billions of people who don't have electric service it can't just be a public sector funded thing. So through this framework we are hopefully marrying the private and the public sector funding to be able to target this issue and in some instances it will be more public and in some instances it will be more private. The framework should operate completely independently of those funding streams and we spend a lot of time making sure that we don't restrict—that this only is applicable for the private sector or this only is applicable for the public sector, because as we go forward it's going to require both.

Sean Thanks again guys and moving on now to the next question. It asks if there is any risk that the framework might create that a government entity may specify a level of service that customers in a region are unwilling to or unable to pay or that the government may change the level of service required after an investment in a mini-grid system has been made?

Ian Governments will always do what governments will do so the answer to that is clearly yes. Hopefully if a government or a funding agency is deploying this, certainly within the concept of the framework, they shouldn't be doing that. They should be going into the community and understanding what level of service is needed. A government could go in, like we see in Alaska, for example, we saw in China, where the government basically said we will mandate a level two power. Everybody gets 100 watts and we will subsidize people who receive or use less than 500 kWh per month or whatever that is. We will subsidize those people. We won't subsidize the rest. We certainly see...I think the framework allows governments to come in and entities, whether government or not, and do that kind of stuff. Again, the framework isn't supposed to tie anybody's hands. It's supposed to put the structure around so that everybody can articulate in the same way or can use the same words to articulate and the policy that is put in place to do one thing or another thing we have no control over and shouldn't have control over.

Sean In this next question you've definitely touched on a little bit but I'd like to ask it anyway. It asks—smaller systems are currently unregulated in many countries. Does this framework imply a move towards greater regulation?

Ian I don't think so. Again it puts a framework around it. Regulation is a government decision and so the government, whatever entity that is, can determine whether they want to regulate it or not. Hopefully, the framework would be applied in those systems whether they are regulated or not. If they are unregulated to a degree it doesn't matter. There's not an oversight but the information that comes out of this, that system, if they are using the framework as well as the kind of understanding of the relationships between the utility, the provider, and whoever is providing funding for that unregulated power system means that the system is going to be more sustainable over the long term. Whether there is big brother watching it or not, to a degree, is irrespective of whether the framework has benefit when applied to small systems or not.

Rose Yeah, and I will just add on that. So in the final slide that Ian discussed, the different kind of benefits of this framework and how it's applied to different sectors, so it all works to build the systems effectively, to monitor their projects and to even sustainably plan even for it. It's a tool for funders, some of whom are public sector funders; some are private sector funders, to understand the sector better. So we think that there is some utility for quote unquote regulation but that is a very small piece of the, you know, why this framework is helpful, you know. And we definitely do think that like that small systems should not be regulated, you know, the same level as kind of grid parity or bigger systems. Things should be light handed but this can be a mechanism to just ensure basic safety. Again, that's one very small slice of the whole framework and how it can be applied and how it's useful.

Sean Thank you Rose and Ian. And moving on to the next question it asks, will the framework address AC voltage levels for mini-grids, for example, 12 volt or 24 HVDC and their associated usability using standard appliances? So, for example, so that a customer knows what they can or cannot do with each mini-grid.

Ian To a degree yes. It will include DC and it will again put power quality brackets around the variability in voltage so that people can be sure that if they have mini-grid that is providing 24 volt DC and they plug their DC appliance into it, it won't burn out their DC appliance or short the wiring or things of that nature. So, we will have that. It won't get to the point of trying to articulate or work with the different component suppliers to make sure that there are components to work on the mini-grid. The idea is much more looking at it on DC, as we are on AC to understand what are the bounds that we the community need to worry about, going outside of, to provide safe and reliable, in this case, DC power.

Sean Thanks Ian. We do have one attendee that asks to try out the Quality Assurance Structure on a solar mini-grid that they are operating in Bangladesh since 2010. So perhaps we can follow up with them offline?

Ian Great, we'd be happy to.

Sean Great. And another question that we have—the development of sustainable business models has been a key focus in mini-grid efforts recently. How does this support that effort?

Ian Business models is a critical element to this and to supplying power to remote communities and as we look at different business models one of the things we need to be really careful about is that a framework of this nature doesn't infringe or stop anybody from developing a new business model. But the hope is that the provision of this information, the collection of the data, the agreements that are in place, improve and support and document the benefits of any business model that someone could or would dream up to provide power. So, the hope is and with the help of people like the people on the phone, the hope is that the framework supports any business model that anybody could come up with by again using similar terminology in regard to energy needs and power quality, and levels of service, the data collection, and making the data available to document whether the business is functioning or not functioning.

Sean Great, and another question came in. When will the Quality Assurance Framework be publicly available and is there a window for comments?

Ian So the window for comments is now and in all reality it will be the window...a document of this nature, the window of comments is never closed. It is a living document, even when it is within a standard. Standards are in all truth living documents. The hope is to have a draft version of the framework in the kind of February/March timeframe. We have a working draft that we keep using that mainly provides all of the technical details that we talked about here. That is something that we could share and want feedback now on so would be happy to share that with anybody and then receive feedback on that. Clearly feedback in regards to the larger concept and things that we want to make sure are included, we're more than happy to get those—either Rose or myself. Then we will share them with the team to talk about that. We'll start off with an email and then get on the phone if that makes sense. So a draft document in this sort of February/March timeframe and then we dive into the piloting and almost guaranteed, is guaranteed, it will be changed based on that experience. So the plan is after the pilot to release two documents. One would be an updated framework and the second would be the learning experience based on the pilot system. So you want to keep the technical document, this is the framework, pretty clean but there is going to be a lot of learning that goes on through the pilot process so that would be in the form of a different document. So that's the current plan at this point. That other document would depend on how long the pilot takes but we are probably talking about this time next year or something in that time frame.

Rose We definitely welcome feedback at any time. We are responsive. Shoot us an email. We've been setting up a lot of calls with different stakeholders who have reached out to us. So there is that kind of informal channel to discuss both technical and specific or broad aspects of the framework. We have one more structured opportunity for feedback, which in addition to the India workshop we had, this webinar series and then in February we are having a workshop, a technical workshop, in Tanzania. This will be a very hands-on session. It will be kind of a heavier focus on the more technical side of the framework but it will be a small group but we definitely welcome...if you are interested in participating in this please let us know. We'd love to see how we can get as many people giving us feedback. Again, there are just...as Ian said, the feedback window never closes. We welcome emails and calls at any time and we are trying to make this process as collaborative as possible.

Sean Great, thank you both. That is the last question I received at this point. Before we move on to the survey for the audience, if you have any comments for attendees please go ahead. Great, we'll move on to the survey then.

For the attendees today we do have a brief survey for you to just help us evaluate our webinar and improve going forward. So Heather, if you could just display that first question. The first question is, the webinar content provided me with useful information and insight. And the next question. The webinar's presenters were effective. The final question is, overall the webinar met my expectations.

Great, thank you for answering our survey and on behalf of the Clean Energy Solutions Center I would just like to again thank the panelists for their presentation today and for our attendees for participating in today's webinar. We do very much appreciate your time. I invite the attendees to check the Solutions Center website if you'd like to view the slides and listen to a recording of today's presentation as well as any previously held webinars. Additionally, you will find information about upcoming events and other training events and we are also now posting webinar recordings to the Clean Energy Solutions Center YouTube channel. Please allow for about one week for the audio recording to be posted. It will be available after that. We also invite you to inform your colleagues and those in your networks about Solutions Center resources and services, including no-cost policy support. With that, I hope 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.