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Grid Interconnection of Mini-Grids

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Webinar Panelists

Chris Greacen	Palang Thai
Dipti Vaghela	Hydro Empowerment Network (HPNET)
Sam Slaughter	PowerGen Renewable Energy

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Katie — Hello, everyone. I'm Katie Contos, and welcome to today's webinar, which is hosted by the Clean Energy Solutions Center in partnership with the United Nations Foundation Energy Access Practitioner Network. Today's webinar is focused on the Grid Interconnection of Mini-Grids.

Before we begin, I'll quickly go over some of the webinar features. For audio, you have two options. You may either listen through your phone or over your computer. If you choose to listen through your computer, please select the "mic and speakers" option in the audio pane. Doing so will 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. If anyone is having any technical difficulties with the webinar, [break in audio] GoToWebinars Help Desk at (888) 259-3826 for assistance.

If you'd like to ask some questions, we ask that you use the question pane where you may type it in. Also, the audio recording presentations will be posted to the Solutions Center training page within a few days of the broadcast and will be added to the Solutions Center YouTube channel where you'll find other informative webinars as well as video interviews with thought leaders on Clean Energy Policy topics.

Finally, one important note to mention before we begin our presentation 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 practice resources reviewed and selected by technical experts.

Today's webinar agenda is centered around presentations from our guest panelists, Chris Greacen, Sam Slaughter and Dipti Vaghela, who have joined us to discuss the various country-specific case studies from Asia to Africa and the potential requirements needed to achieve a relatively seamless interconnection of mini-grids with the main grid. Before we jump into the presentations, I'll provide a quick overview of the Clean Energy Solutions Center, and Ruchi Soni from the United Nations Foundation will provide a quick overview of the Energy Access Practitioner Network. Then following the panelists' presentation, we'll have a question and answer session where the panelists will address questions submitted by the audience. At the end of the webinar, you'll be automatically prompted to fill out a brief survey as well, so thank you in advance for taking the time to respond.

The Solutions Center was launched in 2011 under the Clean Energy Ministerial. The Clean Energy Ministerial is a high-level global forum to promote policies and programs that advance clean energy technology, to share lessons learned and best practices, and to encourage the transition to a global clean energy economy. Twenty-four countries in the European Commission are members, contributing 90 percent of clean energy investment and responsibility for 75 percent of global greenhouse gas emissions.

This webinar is provided by the Clean Energy Solutions Center, which focuses on helping government policymakers design and adopt policies and programs that will support the deployment of clean energy technologies. This is accomplished through the support and in-classing and implementing policies related to energy access, no-cost expert policy assistance and peer-to-peer learning and training tools such as this webinar. The Clean Energy Solutions Center is co-sponsored by the government of Australia, Sweden and United States with in-kind support from the government of Chile.

The Solutions Center provides several clean energy programs and services, including a team of over 60 global experts that can provide remote and in-person technical assistance to government and government-supported institutions, no-cost virtual webinar trainings on a variety of clean energy topics, partner building with development agencies and regional and global organizations to deliver support, and an online library containing over 5,500 clean energy policy-related publications, tools, videos and other resources. Our primary audience is made up of energy policymakers and analysts from governments and technical organizations in all countries, but we also strive to engage with private sector NGOs and civil society.

The Solutions Center is an international initiative that works with more than 35 international partners across a suite of different programs. Several of the partners are listed above and include resource organizations like IRENA, NIEA and programs like SEforALL, the regional focus entities such as ECOWAS Center for Renewable Energy and Energy Efficiency. A marquee feature the Solutions Center provides is a no-cost expert policy assistance known as Ask an Expert. The Ask an Expert service matches policymakers with more than 60 global experts selected as authoritative leaders on specific

clean energy finance and policy topics. For example, in the area of grid integration, we are very pleased to have Steve Lucas, head of the energy department and Factor CO2 serving as one of our experts. If you have a need for policy assistance and grid integration or any other clean energy sector, we encourage you to use this valuable service. Again, this is assistance provide free of charge. If you have a question for our experts, please submit it through our simple online format, cleanenergysolutions.org/expert. We also invite you to spread the word about this service those in your networks and organizations.

Now today's webinar is co-moderated by Ruchi Soni, who's a Manager of Energy Access at the UN Foundation, where she oversees Energy Access Practitioner Network and the Foundation's involvement in many grid partnerships. And now I'd like to provide a brief introduction for today's panelists. First up is Chris Greacen, who's a consultant with World Bank ESMAP Global Facility in Mini-Grids, where he works on policies and hand-on implementation of renewable energy projects from village to the national level. He's helping the government of Myanmar develop and implement the off-grid component of its national electrification program and develop a regulatory framework for mini-grids and small power production.

Following Chris, we'll hear from Sam Slaughter, who is the cofounder and CEO of PowerGen Renewable Energy., a micro-grid builder, developer and operator based in Kenya and Tanzania. Over the past seven years, PowerGen has installed several hundred renewable power systems through seven East African countries, including over 50 micro-grids.

And our final speaker today is Dipti Vaghela, who is currently facilitating and managing the Hydro Empowerment Network of South and Southeast Asia. While she freelances to advance the end scale Myanmar's local manufacturer-developers of micro and mini hydro and advanced biomass. And with those brief introductions, I'd like to welcome Ruchi to the webinar. Ruchi.

Ruchi

So, good morning, good afternoon and good evening, everyone, depending on where you are. My name is Ruchi Soni, and I'm the Manager of Energy Access at UN Foundation. We are very pleased to be co-hosting this very interesting discussion with three brilliant panelists on the topic of grind interconnection of mini-grids. If the registration numbers are any indication of the [break in audio] of interest in this webinar, we've had tremendous response, close to over 450 people registered, so many thanks to those who've joined us.

Let me start with a little background on Energy Access Practitioner Network, or EAPN as we call it, which is a United Nations Foundation initiative. Katie, can you move to the next slide, please? This slide basically sums up our Energy Access Practitioner Network, which is a global platform that connects practitioners to each other and to resources. It was established seven years ago in 2011 as a contribution to Sustainable Energy for All. The Network's overarching aim is to support the development of market-led decentralized energy access solutions and businesses. We carry out this mission in three main ways: by helping identify the sector, by accelerating the learning and,

number three, by elevating the distributed energy access sector within the international development agenda.

We have a number of ways on how we accomplish this mission. It is through creating market intelligence through surveys and other research. It's by convening the sector through webinars like this one and events so that stakeholders are able to get together and share knowledge. And lastly by communicating news and sector highlights through newsletters, social media and our web site. We started off with about 20 members in our network, but we've now grown to close to 2,500 members representing 1,400 organizations active in over 170 countries. These organizations span the ecosystem of all types of organizations that exist in the sector, including SMEs, NGOs, development partners, CSOs and many more.

I also want to use this opportunity to go over another initiative on mini-grids called the Mini-Grids Partnership. Katie, can you move to the next slide, please? Mini-Grids Partnership is essentially an umbrella group that bridges discrete but related stakeholders and initiatives, especially those of industry, government and investors or financiers together. The Mini-Grids Partnership, or MGP, was built with the premise that currently no single global initiative exists to provide the coordinated support needed to scale up clean energy mini-grids. This partnership is led by a steering committee comprised of 15 leading organizations and institutions engaged in supporting mini-grids globally, logos of which you can see on the bottom of the screen. UN Foundation serves as the secretariat along with the Alliance for Rural Electrification. Can you move to the next slide, Katie?

Something I should stress is that the goal of this partnership is to create a mature and thriving clean energy mini-grids market while also reducing the existing fragmentation of the sector. Next slide please. Lastly, before handing it over to Chris, we encourage you all to contribute to this conversation on social media. We're using the hashtag PNwebinar, where PN stands for Practitioner Network. And I also strongly encourage you to follow our Twitter handle @energyaccessPN. Thank you again, everyone. We are very excited to get started on this topic. I'm now going to hand it over to Chris Greacen, who will set the scene and provide a background on the topic. Thank you.

Katie Hi, Chris. This is Katie. Your mic still might be on mute. You need to take that off.

Chris Thank you. Now people can maybe hear me. Great. Most mini-grids start off as small isolated systems, and over time, the national grid extends and reaches many villages that were previously supplied by isolated mini-grids. And this raises the question what should happen to the mini-grid when the national grid arrives? As somebody who's worked a lot on regulatory frameworks and program designs to support mini-grids, I hear this a lot. The risk of mini-grid arrival is a theme over and over again that especially developers bring up, and they're concerned about this because the arrival of a subsidized national grid will take away their customers and leave them unable to meet their debt payments. This concern is really well warranted in my

experience because when I've observed mini-grid projects that have been abandoned, the primary reason seems to be that the grid arrived, the national grid arrived. So, if you're a policymaker or work with a regulatory authority or if you're a rural electricity customer or aspiring rural electricity consumer, this is an issue of interest because lowering barriers to mini-grid investment means that more rural citizens can get high-quality electricity more quickly with less investment of scarce public funds. Mini-grids can be built in considerably less time than it takes to extend the national grid, and if done right, there can be a smooth transition from mini-grids to the national grid when it arrives.

I'm going to try to help provide a foundation for this discussion by giving an overview of several different interconnection options that we've observed in practice. And none of these is a magic bullet, but if well implemented, can offer some relief, reduce wasted investment and help balance the interests of mini-grid developers, utilities and consumers, especially if mini-grid developers take these into consideration at early stages of mini-grid planning.

So, we've observed six different possibilities for mini-grids when the main grid arrives. One is conversion to become a Small Power Distributor, or SPD. Another is conversion to be a Small Power Producer, or SPP—and I'll get into these in more detail in a moment. A combination of the two, SPD and SPP. Continuing to operate as separate systems in the same village. Buyout of assets by the national utility. And last and least desirable, abandoning the assets.

Before the arrival of the main grid, we have separate systems. There's the main grid powered by centralized power plants and an isolated mini-grid with its own power source supplying customers over a localized distribution system. And when the main grid expands into the proximity of the mini-grid, one option is to become a Small Power Distributor, or SPD, in which the mini-grid abandons its generation assets but it stays in the distribution business, keeping its retail customers and selling electricity that it purchases in bulk from the national grid. Cambodia is the biggest example that we've seen of this. In Cambodia, as the main grid expanded and reached mini-grid areas, 250 mini-grids became SPDs. They abandoned their generally diesel generators and purchased electricity for lower cost than they could generate themselves from the national utility for resale to their old customers. The SPD model works particularly well for diesel mini-grids because generation costs are high but the diesel generators themselves aren't worth very much, so abandoning them is not that big a deal.

The Electricity Authority of Cambodia, the country's regulator, played a key role by putting in place a comprehensive program to support conversion from isolated mini-grids to be SPDs. It did two things. First it required licenses, and to acquire a license, mini-grids had to invest in upgrading the quality of their distribution networks and extend networks throughout service territories that EAC had assigned to them. Grants and loans from a rural electricity fund made the process easier, and retail tariffs for these distribution franchisees are standardized. The difference between this tariff and a project-specific cost-

reflective tariff that was calculated by the EAC were paid out of a rural electrification fund that was capitalized by the main utility. SPDs are also found in Nepal, Bangladesh and in Burkina Faso.

A second option is becoming a Small Power Producer, or SPP, in which the mini-grid abandons the distribution network but keeps its generation and sells electricity to the national grid at wholesale. This works particularly well for small hydropower which has zero fuel costs and can generate 24-7. In Sri Lanka, over 250 micro hydro mini-grids were built with the support of the government of Sri Lanka, the GEF and the World Bank, and with the arrival of the main grid, more than 100 have been abandoned, but three projects successfully converted to become SPPs. Fifteen more are possibilities, and a number of these are in the pipeline. These SPPs now only sell electricity to the national grid, and the national grid exclusively services households in the villages.

Another option is a combination SPP and SPD. Keeping their generation and their distribution networks, they generate electricity, distribute to local customers and sell excess to the national grid. And if they don't have enough electricity, they can purchase it from the national grid. In Indonesia, of 200 community-owned mini-grids where the national grid has arrived, again, most were abandoned, but nine have become combination SPP and SPDs, selling all or some of their electricity to the national grid.

A fairly common model that we see might be termed coexistence in which the mini-grid continues to operate its lines and its power plant even after the main grid arrives, and the electrical systems operate side-by-side but never electrically connect. In Indonesia, there's 40 to 50 village mini-grids that coexist, selling electricity but remaining isolated. And in Uttar Pradesh in India, mini-grids that coexist with the national utility are fairly common because the gridlines that extend to rural villages are pretty extensive, but the electricity supply in India is quite erratic. And in some cases, developers are even building mini-grids in already-electrified villages.

Regulations that are now in the books in Tanzania and Nigeria and under development in Sierra Leone and Rwanda provide for mini-grids to be compensated when the main grid arrives. In Tanzania, it's only the depreciated distribution assets that are built to sufficient standards that are eligible for compensation. In Nigeria, it's more comprehensive. Depreciated generation and distribution assets plus a year's worth of revenues. I should note that this is all fairly early. While these are on the books in the emerging regulations, as far as I know, compensation has not yet actually happened where a utility has actually paid for the assets of a mini-grid.

And then unfortunately the most common case that we're seeing is of the assets being abandoned. Some solar mini-grid developers are guarding against this by building their equipment into shipping containers that can be easily picked up and brought to another more remote village when the main grid arrives.

So, let me finish up with some lessons. One is that viable examples of formerly isolated mini-grids connecting to the main grid do exist, particularly hydropower remains—micro hydropower mini-grids can remain financially viable selling wholesale to the utility, with examples that I mentioned in Sri Lanka and Indonesia. And mini-grids that have built utility-grade distribution networks have been transitioning in some cases to become small power distributors in Cambodia, but they're pretty rare. Most mini-grids have been abandoned when the national utility arrives. One other observation [break in audio] that the cost of interconnection depends a lot on the business model. So, connecting as an SPP, connecting your generator to the national grid costs more because you need to have equipment that can synchronize that generation with the national grid compared to connecting as an SPD where you're just connecting the distribution lines.

My last slide is just a note for a couple of publications, three publications that cover these issues in depth. All of these are free and I've worked on all of them. The first is a technical guide for grid interconnection of generation under 200 kilowatts that was published by the US Lawrence Berkeley National Labs. The second is the World Bank book From the Bottom Up, that was—is available in English and French and was published by the World Bank and connected with the ESMAPP global facility on mini-grids. And then third is a small book co-written by Bernard Tenenbaum and my fellow panelist on this webinar, Dipti Vaghela, that focuses explicitly on the experience of developing countries that have been pioneers in integrating mini-grids with the expanding national grid. And I've provided URLs to upload those, and hopefully they will be of use to you.

So, with this, I'm gonna turn it back over to the conference organizers. Thank you very much.

Katie Thanks so much. [Break in audio] wonderful [break in audio]. You might still be on mute. Oh, perfect.

Sam Hi, everybody. It's quite intimidating to be sandwiched between Dipti and Chris, who literally wrote the book on this, but I'll do the best I can. The context that I'm coming from with PowerGen is as an Africa-focused mini-grid developer. As Chris' presentation very clearly pointed out, most the successes in this area so far have taken place in Southeast Asia, so there's still a lot of progress to be made in Africa, and we're very early on. Some quick background on PowerGen, we've been around for about seven or eight years, and we build mini-grids in East Africa, but are becoming more familiar with the climate for mini-grid development in other regions of Africa as well.

I'd like to start off with some conceptual ideas around why this is even an important conversation and why interconnected mini-grids are really important driver of the future grid we all want to build in Africa and developing markets in general. We hear these terms a lot, but the future grid seems to be evolving quite quickly. We're moving from modern directional to multidirectional network, from centralized to decentralized, from analog to digital, from carbon to decarbonized, and it's becoming much more consumer-centric. You hear people talk about the three Ds sometimes. Those

three Ds in the middle—decentralized, digital, decarbonized—and these are driven largely by some of these technologies you see on the bottom. And again, these are things that are—we're constantly inundated with in the news, so I'm sure are not coming as a surprise to anyone.

The key for us in Africa is to make sure that we build this future grid now as we solve the energy access problem. We don't want to connect everyone to a power grid—the power grid of 1980. We wanna build the grid of 2050, and it looks more and more like mini-grids, micro-grids are the future building block of this utility. Here on Slide 5, you see just a small smattering. It takes about ten minutes to find a plethora of headlines that refer to this fact, and it's very likely—and the term mini-grid can mean a lotta things, but it seems quite likely that the future grid will be a network of interconnected mini-grids that are sharing power with each other and the embed storage consumption generation nodes within them.

So, how can we apply this concept to Africa? Well, in Africa, we essentially have a situation where main grids in many countries don't extend beyond core areas, and we have peripheral communities that don't have energy access yet. By building autonomous micro-grids in those unaddressed areas or grid-connected micro-grids in those areas with the future smart grid components like smart metering, embedded storage and embedded clean generation, we essentially can start building the grid of the future in Africa from the grid edge inwards. If we do this right, we can converge on where the global grid is going and not where it is now, and this needs to be our objective here. If we don't achieve the grid of the future in Africa now as we connect the 0.5 billion people who don't even have power, what we'll have to do is spend billions more in the decades ahead retrofitting everything once we've completed the job. So, it's very important that we focus on convergence.

Slide 9 is a little bit chaotic. I apologize for this, but this gives the basic overview of how a modern smart mini-grid looks. We have smart metering embedded. We have generally solar-based generation, often with storage and diesel backups, cloud-based energy monitoring and customer management. And importantly, on the bottom here, seeing the ability for this grid to interconnect seamlessly with the main grid.

So, what are the big challenges to overcome? Essentially there are three categories: technical, legal and commercial. In general, technical is not a big issue as long as grids are being built that are AC and are up to grid standards, which increasingly is the way that mini-grid developers in Africa are approaching this. And I'm speaking also somewhat on behalf of the African Mini-Grid Developer Association and for sure within the—within AMDA, it's a very important tenet of ours that grids must be technically grid-integrable. And so, there aren't huge issues here with grid integration from a technical standpoint, but legally and commercially there's still a lot of questions.

From a legal standpoint, there's not yet clear guidelines for if there's even a right to operate an SPD like Chris referred to. Sometimes countries can make it relatively straightforward to build an off-grid mini-grid but then the frameworks for what happens when the grid comes, can you still sell power,

are murky. The legal right to set tariffs at a level that's cost-reflective is often unclear or nonexistent. The protection from being built over by the main grid is often nonexistent, and it's often not clear whether there is a right to buy and sell power from the main grid. So, these are all issues that must be resolved from a legal standpoint, and people like Chris have been doing a great job in the countries he mentioned, Tanzania, Nigeria and others, starting to make progress in various African countries to set the good precedents around these legal frameworks.

Commercially there are similar challenges. The buying and selling prices to the main grid are important, and I'm saying all this with the sort of premise—on the premise that most mini-grid developers, at least those in AMDA, would prefer to be an SPD plus SPP or an SPD. Continuing to operate the distribution network tends to be a high priority for African mini-grid developers. IPPs have a different approach, and IPPs obviously prefer to be the power provider, but in general, people who are building mini-grids in Africa are members of AMDA are more focused on distribution element and wanna make sure they retain that. So, the buying price from the main grid is quite important. The selling price is also important. And if there is going to be an insistence on asset purchase for the public utility, then a fair price setting that is important. As Chris mentioned, in Tanzania now, that price is set at the depreciated value of the assets, which isn't a particularly exciting proposition for a developer.

But the most important element of all this and I think that underpins all the issues here is subsidy parity. There—were currently in a regime where the main grid receives billions of dollars in subsidies from donors and private utilities in Africa receive very little. As long as this remains the case, it'll be very hard for private utilities, whether autonomous or grid-connected, to offer pricing competitive with the main grid. And this means as the grid gets closer and closer, inevitably the tension between some people on private grids are paying a higher price than people on public grids becomes more and more untenable, and eventually the politics of the situation will result in a big problem. So, we can talk a lot about details around policy and commercial agreements, but really if we don't fix the subsidy parity issue, we're gonna have a fundamental problem.

So, how do we level the playing field with subsidies? At least—and this is, again, taking an Africa-centric perspective, but in Africa, it starts with creating effective results-based financing from direct-to-market donors. So, there are donors out there who are willing to support private utilities throughout the continent, and in general, there's been a move toward this RBF, or results-based financing structure as an effective means to achieve this. So, far, these programs have started to make progress, but we need to do a lot more work to ensure that they're maximumly effective. If we can get these programs to be effective, we'll start to gain traction as a sector. We'll start to show that private utilities are really effective way to solve the energy access problem while building the grid of the future in the grid [inaudible] and we can start proving this to governments and their bilateral supporters. Once we can get governments and bilateral donors onboard, we can start

being a part of the subsidy stream that flows through national governments and into the utility sector, and we call this institutionalization of the RBF subsidy. This is when we aren't, as a private sector, asking for direct subsidies from donors, but rather we are in the bloodstream of subsidies that flow through national governments and treasuries and ministries, and instead of them plowing all of their money into their public utility, they also allocate some to private utilities.

And finally, once all this is solved, there's still this problem of an op-ex subsidy, which is that in almost every African country, there is a utility that owns the best and biggest urban load centers, and in general, all utilities cross-subsidize their rural consumers with surplus profits from their urban consumers, and to really solve this problem and allow for a socially equal tariff amongst rural and urban consumers, we must find a way to spread urban tariff surpluses to the rural poor in order to buy down their tariffs long-term. So, there's a lot that needs to be done in order to get this playing field level.

To wrap up, private mini-grids, grid-connected and otherwise, are an excellent tool to solve the challenge of energy access while building a future grid. Compared to the main grid, we have typically three advantages: (1) we can deploy our infrastructure for cheaper; (2) we offer a higher level of service, more reliability, and we also take efforts to try to stimulate demand and grow local communities economically using their power; and lastly we serve as a vector for bringing future technologies into the African grid so that we can ensure that we build the grid of 2050 and not the grid of the past as we solve this problem. And that's it. Thank you very much.

Katie Wonderful. Thank you so much. Our next presenter today is Dipti.

Dipti Hi, everyone. Many thanks to the organizers for highlighting this important topic and thank you to Chris and Sam for giving an excellent background and significance of the topic. I wanted to focus on the role of knowledge exchange in advancing some of the issues that Chris and Sam spoke about.

So, I coordinate a practitioners' network for small-scale hydropower in South and Southeast Asia called the Hydro Empowerment Network, also known as HPNET. And I'm trying to change my slide. Okay, here we go. Yeah, I'm just going to give you briefly our evolved approach to knowledge exchange and how we've utilized it for this topic on grid interconnection and what we have planned in the coming year.

So, we are a multi-stakeholder network. While we focus on the needs of local practitioners, we use the network platform to build a coalition of various stakeholders working on topics that are important for local practitioners, and this is now across fourteen countries in South and Southeast Asia. And we have a framework where we have thematic working groups that are applied within country context. So, one of our earliest working group has been the Grid Interconnection Group. And we use a four-step approach to knowledge exchange. First we end up collating all the information that's available. Especially for our sector, various things are not online, are not in one place, so we work with our members to bring this to one place on our online library.

Then we also fill in the gaps of what is missing from the ground, and we use information collected to design in-person gatherings, more often practice to policy exchanges and trainings and field visits. And then we do post-event advocacy for these certain thematic solutions.

So, in fact, our work on grid interconnection has led to this approach. And so, in 2015, we started out, many thanks to inspiration from Chris and others who had really highlighted this as a topic for sustainability of small-scale hydropower. We ended up collating knowledge from our members in the region, and there weren't, at that time, lists of which projects were interconnected, et cetera. And there were also not one place where we could know who were the experts in this field, who had made it happen in countries like Indonesia and Sri Lanka. So, we were able to identify the diverse stakeholders and decision makers. Finally, we also looked at what challenges and opportunities were there. So, we, for instance, realized that there was very little awareness of what were the cost benefits. Some country contacts thought that the technology was just unattainable. And then there are also opportunities where we see the main grid has reliability issues and what Sam described as there's a clear benefit for interconnecting mini-grids. These are opportunities but are not made aware among local decision makers.

So, in 2016, using the baseline information that we collected, we organized an exchange in Sri Lanka where projects have been interconnected at the local [inaudible] level. We had—this was a five-day event where we had various discussions, panels of the people from eight countries that are working on this, including utility actors, government developers, and then we visited sites on the ground. A lot of momentum came out of this, and we followed up with some advocacy work.

There was a webinar last year, various discussions and other advocacy knowledge products, but what has really been an example of the possibility to make this happen has been in Nepal, where the right persons were brought to the Sri Lanka event, the right top-level decision makers, and because they were able to see projects in person and also have time at length those four or five days to hash out what had been stalled—in Nepal, there was a policy that had been developed but it wasn't operationalized, the language was ambiguous. So, after these set of four or five stakeholders attended the Sri Lanka Multi-country Exchange, they went back to Nepal, and within a few months, organized their own exchange, and they had this resolve to really make it happen. So, they went through the follow-through of addressing the utilities' concern about safety and other technical requirements and documented this and finally made a great code and a policy happen. And since last year, they've been on a roll interconnecting project after project. So, the first one was done in late-2017, and since then, two others have been done, four more are in the very near-term pipeline. They've also been doing project-to-project interconnection as an intermediary to then connecting the cluster to the main grid. So, it's been an eye-opening example of what can happen when you bring the right decision makers into the room and work through everyone's perspective.

And so, what are our next steps? So, I mentioned we did this exchange in Sri Lanka where three or four stakeholders from all of these countries could see work on the ground and Nepalese went back, held their own event, and what we really want to do now, we see that just as Nepal had this in-country momentum built, we need to do the same in the various other countries that have expressed a need for this, and it needs to start, again, with a baseline of what are the pros and cons of specific projects being interconnected, who are the key decision makers, who are the allies on the fence that could then serve to reach the top level decision makers, what are the technology gaps, and what kind of planning tools, especially local level GIS-based tools can be used to show exactly what Sam was saying, why mini-grids are important to make the main grid more reliable.

So, yeah, I will be sharing some links to the resources, and I'd like to think our Nepali and Sri Lankan friends for some information. You can find out more about our network here. Thank you.

Katie Wonderful. Thank you so much. We will now be going back to Ruchi where she'll be moderating a Q&A discussion with our panelists.

Ruchi Thank you, Katie, and thank you everyone for your great presentation. I'm going to use my moderator privileges and pose the first set of questions to all the panelists. Chris, I know you mentioned that there is no magic bullet here, but I was wondering if you, Sam and Dipti can speak to what could both the mini-grid developers as well as utilities due to lower the risks of accompanying the arrival of a national grid? Chris, would you like to take this one?

Chris Sure. I'll take a stab at it and then Sam and Dipti can add more if they have ideas. Well, I think Sam touched on a point. Developers can work towards this end by thinking about ultimately grid connection in the process of developing their mini-grids from the beginning. So, technical designs that have distribution networks that are grid-ready, that are built to standards that a utility will be happy to allow to interconnect as a distribution system if the developer's looking at SPD as a possible kind of post-arrival model or choosing equipment especially on the small hydro side that has the ability to interconnect in a more—it doesn't take a whole lot of incremental investment in [inaudible].

I think Sam also mentioned that developers and others can really push to have regulatory and policy frameworks in place that support this. As Sam mentioned, the technical issues are not really paramount. It's more policy and regulatory challenges, and advocates that are private developers, advocates that are NGOs and citizens groups that are trying to improve energy access can all work to help spread stories of successes and best practices in regulation and policy and help solve some of the issues that Sam nicely laid out, the lack of regulatory framework and the need for subsidy parity so that the kinds of subsidies that national grids receive in doing rural electrification also apply to mini-grids. Any other thoughts, Dipti and Sam?

Sam I might add that I think the developer community can do a better job of framing ourselves as allies with the government and the Ministries of Energy to helping solve this problem and not as adversaries somehow coming in and, by our existence, implying that somehow they aren't doing their jobs. They are doing their jobs. We need to give them another tool in their toolkit to solve their problems. I think right now most Ministries think that their only real tool for solving electrification is their public utility, usually their monopoly utility. I think that we can do a better job as developers in showing them, yes, that's a very good tool that you have. Usually they have more scale, they often have sovereign backing, but there's also advantages to bringing private utilities into the mix. And how do we position ourselves to be on their side with the same goals of them and become one more tool they have in their master planning for electrifying their countries? Right now, there's a very discordant approach where the private sector's running around trying to prove that we can be effective but often not with sufficient integration with the government's own plans, and it creates an atmosphere where it's hard to—I mean, we're not connected on a planning and philosophical level, so obviously the physical interconnection of main grids is consistent with that and is challenging to achieve at this point.

Chris That seems like a really good point. I also just touched on my experiences with utility culture is that utilities often have an expectation that they will own assets and that power flows from them to customers and money flows from customers to them, and framing this as not a competition but an opportunity to work together to meet the common goals of energy access is really crucial and challenging, frankly. You know, there are some cultural gaps to overcome.

Dipti Yeah, and just to add, I think there are three factors that government and utilities look at: cost, time and reliability. And then among the social community sector, there's also the empowerment of a community-owned utility selling electricity, clean energy and generating income from that is also very powerful. So, one key thing that developers can do is to work with advocacy groups to find ways, as Chris just said, to convince these decision makers. And we've seen that one key way is to find their equivalent. So, the Nepali utility actors were convinced because they heard the Sri Lankan utility head saying this is a good thing. And if we were to have Myanmar and Malaysia utility actors, government actors here, the Nepalis saying, you know, this actually is good for our grid, it's—that conversation is easier among their own versus having others tell them, based on our experience.

Ruchi Thank you all. I think I completely agree on sort of reframing this conversation on making sure that the developer community's seen as an ally, as Sam and Chris were saying. I think I'll pause here and, given the interest in the webinar, sort of hand it over to Katie to field the questions with the audience.

Katie Wonderful. Thank you so much for that interesting discussion. We've had a lot of great questions from the audience today. Just a reminder, you can submit your questions at any time during this question and answer session,

and if we're not able to get to your question today or all the questions, we'll connect the questions with our panelists afterwards and they can reach out for those that we didn't get completed. Our first question, and I'm gonna address an individual, but if anyone in the panel would like to jump in after that person addresses it, please feel free. This is an open discussion. Our first question is for Chris today. Chris, our attendee wants to know is there information available about projects having used each option when the national grid arrived, especially those combining SPD and SPP? And is there any recommendation or comparative analysis about the best option?

Chris Thanks. That's a great question. The book that was shown on my last slide, the mini-grids and the arrival of the main grid, would be—is the one publication that I'm aware of that provides some comparative analysis of projects that have actually happened in countries that have been pioneers in this regard. The book is actually—the link that I provided on my last slide, and it's tiny.cc/gridarrival, right now actually points to a version of the book that's about a year old, and it's under significant revision and right now know kind of grinding through the gears of the World Bank's publication bureaucracy. And when it comes out in a month or so, the same link will point to the new version of the book, which is considerably expanded and quite a lot better. So, that's all I have. Any others?

Katie Thank you, Chris. Okay, we'll go on to the next question if no one else wants to add to that. We'll start with Sam for this next question, but again, Chris and Dipti, feel free to jump in. Sam, this attendee is—work for an international donor, and besides the increased availability of the RFB—or I'm sorry, RBF, what do you all want to see donors do more of to support mini-grids in the question of interconnection? What do you want to see these donors do less of?

Sam Thank you. That's a very good question. I think this might be an area where less might be more. We have right now, as was alluded to by Dipti in the work she's done in Southeast Asia, an issue of quite a bit of fragmentation, and we need to figure out how to bring some harmonization and consistency. The challenge for developers right now in Africa is that every country we go to is vastly different, not just in terms of regulation, which is understandable, but also in terms of financial support. Donors will launch a unique program in seemingly every country they go into, which means developers need to be prepared to react to totally bespoke situations in any market that they want to look at, and the structuring can be quite different. Our agenda as AMDA would be to try to harmonize some of this approach, preferably to the extent that we can, with a Pan-African approach, and instead of having 10 or 20 or 30 different donors doing different things with different structures and different consultants advising them, have a broad-based, pull-based subsidy which we typically refer to as the RBF, and by pull what I mean is truly make it results-based.

What enabled solar to succeed so wildly the last 15 years in developed markets like Europe and the US was very clean and simple—relatively simple pull-based subsidies. In the US, the Investment Tax Credit and in Europe,

Feed-In Tariffs. You didn't see the government of Germany going out and trying to design a solar home—a solar system for every home and factory in Germany and then tender those out on some sort of auction. No, you saw them put forward a broad-based policy around tariffs and see the market react to it. We need something similar in energy access and private utilities in Africa. We need donors to come together and create a simple, broad and deep subsidy pool to enable results-based financing as developers bring impact, and we need to move away from these very overdesigned, very bespoke and very specific programs that only address one or two countries at a time. Those kind of programs can be useful for piloting, but we will never achieve scale with that level of precision and uniqueness being aspired to by such a fragmented universe of donors.

Chris Maybe I'll just add a big to what Sam said and kind of touch on something that Dipti had said too. One idea would be work to have regulatory frameworks or understanding about mini-grid regulatory issues. The kind of Pan-African arrangement where instead of different regulatory frameworks in each different country, if there's some possibility for donors to harness their ability to reach out to regulators across a number of countries to try to kind of coordinate some kind of agreed regional approach to regulatory frameworks that would facilitate mini-grids so that developers don't have to have customized solutions to customized situations.

Another that Dipti alluded to was that a lot—in a lot of cases, utilities—getting utilities onboard is essential because ultimately we're connecting with the main grid, and utilities control this and have a variety of ways in which they can, even if the regulations are in place, they can slow things down to a crawl. And getting utilities onboard through south—south utility exchanges where the appropriate mid-level utility people that have expressed an interest in this topic have the opportunity to meet with counterparts in countries that have already pioneered these grid interconnection arrangements and are satisfied and enthusiastic about how they can help the utility and the country meet its energy access goals can be quite useful. And as Dipti mentioned, utility people talking to utility people, engineers talking to engineers is often much more effective than consultants and NGOs trying to talk to the utility people just because they believe utility people much more.

Katie Please, go ahead, Dipti. I'm sorry.

Dipti Very quickly, yeah, those were all on my list. In addition, it would be really helpful to have donors focus on demonstrating pilot projects based on hindsight lessons, so what went wrong in some of the cases in Indonesia, what went right and also finding those low-hanging fruit projects. So, not doing a pilot out of midair, but really coming up with a sure-to-be-successful pilot and make that happen along with setting the local financing mechanism. So, for at least small-scale hydro, subsidy is not required, but up front financing is required. Thank you.

Katie Thank you very much for that answer from all our panelists. And that leads us really well into our next question. And, Dipti, I'll address this to you first, but again, Chris and Sam, feel free to jump in. What would you all say were the

main technical challenges and are the main barriers technically or policy-wise as you work on your projects?

Dipti Yeah, we in fact, just in the last several days, have been having within the Network dialog on some technical challenges going on in Nepal. What happens when the village load disconnects, et cetera? You're welcome to join HPNET. There's no membership cost, et cetera, and participate in that dialog, but as Sam says, the technology for the most part is figured out, but the technology suppliers are not communicating with each other at the moment. These tend to be people who aren't online but have built these synchronizing equipment, so it'd be useful to get them into [inaudible].

Katie Great. Thank you so much. Our next question is—and why don't we start with Chris on this one—how do you start subsidizing when there's a strong private grid operators network who wouldn't like to lose their market share?

Chris That's tough. I mean, I think Sam mentioned donors providing results-based financing, for example lowering the cap-ex cost through a per customer connection subsidy. So, for example, every customer that a mini-grid connects gets several hundred dollars. That kind of subsidy can work out well, but that's addressing the cap-ex side of things. The—in Cambodia, the—there is an op-ex subsidy where, in a sense, utility revenues that are really healthy from serving urban areas, in Phnom Penh, for example, are distributed to these mini-grid developers through a mechanism that looks at the actual cost of each mini-grid and provides the gap between what the mini grid's actual cost is for serving each customer versus what a standardized tariff that each customer pays. So, that's one mechanism that's been used in Cambodia. I have to say it requires a fair amount of regulatory oversight. There's detailed spreadsheets on literally hundreds of mini-grids and they're doing lots of detailed calculations. I think it's kind of still an open question on how to best do subsidies, and I'm not really a subsidy expert. Any thoughts, Sam? You've probably thought about this a lot.

Sam I've taken the question to be about how do we inject subsidies into a market where the public utilities are feeling threatened about losing market share. Sorry if I may have misheard that.

Chris You probably heard it better than I did.

Sam I'll try to answer that. So, I think the first thing to note is that the private utilities are not asking for new subsidies. We're asking for a share of subsidies that are already pouring into African utilities. There are plenty of examples of hundreds of millions if billions of dollars going into individual public utilities in various countries to support their grid extension. They're getting cost per connection in the $2,000 to $3,000 or even $5,000 range. In general, AMDA members, private developers in Africa have demonstrated cost per connection of less than $1,000, and that's including generation and a fully-integrated power provision and with a grid that's ready to integrate with the main grid. So, just on a real cost basis, we are cheaper. We require less subsidy.

So, the question isn't how do we get subsidies just for private utilities. It's how do we just spread the subsidy that currently is being injected only into public utilities to private as well, and the question asker is right in that the public utilities may have an issue with this because it's essentially taking a revenue stream away from them, taking subsidy stream away from them, but also really it's the governments and the Ministries who decide this, and this is why we need to prove to the governments and the Ministries that it is a better outcome for their people and there's more chance of getting reelected if you do the most efficacious thing, which could be allowing some of the subsidy money that's coming into them from bilateral donors to go to private grids along with public. The public grids might not love it, but the politicians will benefit from it, and ultimately in general, the public utilities report to politicians.

There is another element of it though as well which is gonna soften the blow for the public utility, and that is in most countries, apart from least-developed countries, places like DRC, South Sudan, Somalia, the public utility already has its hands on the best load centers in the country. What we're fighting over here are—is access to rural distribution networks, which are typically pretty unprofitable. So, these aren't the crown jewel of public utilities collections here. They aren't gonna be making a lotta money off of these areas anyway, so I think once they get over the emotional barrier of maybe no longer being the sole monopolistic utility, I think that pretty quickly they'll realize that it's not actually in their interest to fight that hard for rural grids that aren't super profitable anyway. So, I think a combination of those factors are what will enable this to happen despite some initial resistance from public utilities.

Chris Sam, I have a question for you that's related to this, and that is, so the issue of subsidy money going to a private mini-grid developer company is, you know, the perception is we're using this public money and it's going into the private hands. Do you have any thoughts about ways that the public interest can be somehow guaranteed so it's not looking like private companies are walking off with public money somehow?

Sam Yeah, that's a good question, and it's worth noting that in many of these countries, the "public utilities" have been largely privatized anyway, so there are private investors who are benefitting from these public utilities. Kenya Power, for instance, is floated on the stock market, et cetera. That said, I think the more robust answer to your question is, in general, developers in Africa that we associate with are not fixated on owning the underlying power lines. What we are interested in is being the power provision on top of those power lines and serving customers better and having the operating control to do things like integrate solar, integrate storage, use our own metering systems and billing systems, et cetera. If the public utility or the public—if the government wants to own the underlying power lines, we don't have an objection to that. That's fine with us. And in fact, one of the things that we're moving towards is trying to sell off our underlying assets to off-balance-sheet vehicles so that we can focus on being lean and operating the grids rather than having these assets on our balance sheet. So, that's not an issue for us.

The way that one implements that, though, is quite important. One way that we've seen this being attempted is where the public—where the government comes and builds distribution networks and then invites private companies to come and bid to provide the generation and the retail services on top of that. We are not a really big fan of that approach. The problem is it puts the government right in the middle of your energy access plan again. Sort of the whole point of getting private utilities going in Africa is to unleash the speed, the velocity of the private sector in solving this problem. If you put the public sector right back in the middle of that, you're kinda just right back where you started. You're still gonna—you're only gonna move as fast as your slowest actor, so we're not in favor of anything that requires the private sector to wait for the public sector to build assets, but we would be fine if it was a situation where, after building assets, the private sector can sell those assets back to the public grid at some predetermined cost as long as we maintain the ability to operate because we think we can operate them and serve our customers better than the public utility in some cases. So, hopefully that clarifies.

Katie Great. Thank you so much, Chris and Sam, for that awesome discussion. Our next question is for Dipti. Dipti—and Chris and Sam feel free to jump in as well—what are the main technologies used in mini-grids and are they mainly from renewable energy resources or through diesel generators?

Dipti Yes, so they—yeah, they can be solar, hydro, biomass, wind, all of the renewables as well as diesel generators. We did a webinar, which the link I'll include in my slides, that compared each of these cost-wise and other aspects such as local manufacturing, jobs, et cetera. So, yeah, all of these can be used for mini-grids, and it's very good that this question is asked because most often in today's context, mini-grids are synonymous to solar PV, when actually there are other options that might be more economically viable for some places. Thank you.

Chris I'll just add onto that a little bit. I would guess—I don't think anybody has complete data on this, or if they do, I'd be curious to see it, you know, how many mini-grids of different types actually exist on Planet Earth. There was a survey done in Myanmar, for example, by the Myanmar government a few years back, and they concluded that there are about 13,000 diesel mini-grids in the country, about 2,400 hydropower mini-grids, 1,200 biomass mini-grids, and 100 or so solar mini-grids. So, while you hear a lot about solar, and the price of solar panels recently coming down makes them really competitive vis-à-vis diesel, I think diesel's probably the mini-grid technology that's mostly out there but not the one that's generally being built, or especially not the one that's being built under programs that are supported by international donors and really have kind of a clean energy focus.

Katie Great, thank you. And this perfectly leads us into our next question. Our attendee is from Haiti, where they work for a solar provider, and they're curious about what technology can they incorporate into their installations to make them mini-grid ready. Does someone wanna start on that one? Chris, do you wanna start on that one?

Chris So, this is particular for a solar mini-grid. Well, again, it kind of comes down to the future business model in mind, but if, as Sam was mentioning, SPD ultimately holding onto the distribution business is really the one that makes a lotta sense, and I think it's the one that often makes sense for solar mini-grids. Then building distribution networks that a utility would be comfortable connecting, that the Haiti utility would be comfortable connecting up with ultimately makes a lot of sense. I would imagine in Haiti it's a situation too where the power might be intermittent sometimes, so you can—I can imagine that the model might be developing a mini-grid that gets electricity from the national grid when it is available and cheaper than the solar can be providing but where the solar and storage provides backup when the main grid is not available. And when there's excess solar electricity, that the solar injects electricity into the national grid. Fortunately, when it comes to solar, many of the inverters that are part of solar grids inherently can connect to utility gridlines, so equipment by Outback and SMA and Schneider and so forth generally has a synchronization functionality. Sam, this is your expertise.

Sam I'll try to build on. This may be a slight tangent, but I think—Chris, I think you said sort of triggered this. I think one thing we haven't discussed I don't think quite directly yet is we've talked a lot about the main grid coming to a mini-grid, interconnecting with it, but I think there's actually a really—if you extend this idea further, there's a great opportunity to build mini-grids which are grid connected from the beginning, and this is why a few times I've used the term private utility rather than mini-grid company because really what this is about is getting private utility actors moving in the sector, whether it's building an autonomous mini-grid or a grid-connected mini-grid is less important. So, if you take a country like Kenya, for example, most of the people who don't have a connection to the grid are very close to power lines. So, what isn't—what we don't need to do is build totally autonomous solar and battery bank mini-grids. What we—hydro would be great, but hydro is harder to find sometimes co-located with the need. What we could be doing in those context is building a distribution network, maybe adding a bit of storage to help reliability and then interconnecting with the main grid right from the beginning and buying power from them and being SPD right from the beginning. And so, I think it would be useful for our sector to be a little careful about how narrow minded we are about the term mini-grid and start thinking more generally that we can be SPDs right from the beginning of development and you don't need to become SPDs by the grid coming to us and that we could solve a lot of problems by doing this. Obviously we run into all the same policy and financial challenges that we have when the grid comes to a mini-grid in the first place as well.

Chris I think that's a really good point, Sam, and your company is really kind of pioneering this. But it's also somewhat of a new model. I mean, when we talk about mini-grids in OECD countries, this idea of kind of grid connected from the beginning and providing reliability services is really core to the definition, but when we're talking about in developing countries, it's tended to be more about energy access for rural areas, but I think as Sam mentions, there's a lot of these kind of peri-urban areas where there's—or even somewhat rural areas where the grid is there but it's unreliable or it's nearby, and working on

business models that address that interface makes a lot of sense. Sorry, Dipti, to interrupt you there.

Dipti Oh no. I just wanted to let Sam know that in Indonesia, the hydro sector is predominantly that. There are over 400 hydro mini-grids that were grid connected from the start, and there's some good lessons to learn from that monopoly utility there and the government and could be useful.

Sam That would be great to look at. And so, a lot of the context in Africa is relatively smaller grids where maybe 100 or 200 connections where you can't concurrently develop a megawatt scale IPP that can put a useful amount of energy back into the grid and create a useful revenue stream. And so, it really becomes a very just one-way distribution-heavy business model. And we've been trying to push this in some East African countries, and if you think about it from a utility perspective, it's not a terrible deal for them. The pitch to the utility is we're gonna help you sell more power from your existing network, so you're gonna generate more revenue, zero additional cap-ex from you and pretty much zero additional op-ex 'cause we're gonna run the grid. We're just helping you sell more power on the grid you already own. That's a pretty good deal, especially if you can offer them some political wins as well and play that game right. So, I think the resistance that we've been met with so far is that the only reason that these public grids want to actually connect these people who are near the grid but aren't connected is because they're getting $500 per connection on the back end subsidized by donors through the government that make it worth their while to do it. Without those subsidies, they wouldn't really care to do it. So, again, it comes down to the subsidy parity issue. If the subsidies keep being plowed into the public utilities and not private, it's gonna be very hard to justify our existence long-term.

Chris I guess I would just add on, Sam, another key question is what's the price of the electricity that the SPD purchases from the main grid and is that viable for you to have a business?

Sam Well, the [inaudible] is probably, well, it hasn't happened yet so definitely not yet, but that will be a big issue. And then you run smack into the op-ex subsidy question, which is can one run a rural-only grid without a load center and sell power at the same rate as the main utility which has load centers, and the answer to that question is almost always no. And so, we come into this problem of how do you redistribute urban surpluses to rural people, and that becomes another challenging topic.

Katie Wonderful. Thank you so much for these great answers and discussions. We're having tons of questions come in, so again, if we're not able to get [break in audio] have the panelists connect with you afterwards. Our next question—we're having a lot of questions about certain regions and the case studies you all mentioned. Dipti, our next question is about Nepal, and it is—sorry, I lost it here. We're having so many great questions, it's just great to go through all of 'em. Our next question is—oh, I'm sorry, we're gonna go to Bangladesh. Why interconnections are not happening in Bangladesh compared to Cambodia, Nepal or Sri Lanka. What are the main barriers, if

you know of any, that are occurring in Bangladesh? Does anyone—can anyone speak to that region?

Chris I can take a stab at it. I haven't worked in Bangladesh, so this is more kind of what I've picked up at conferences and so forth. Bangladesh has an extensive energy access program that's been very successful through solar home systems, a somewhat smaller mini-grid program. And my understanding is that Bangladesh's mini-grids in a lot of cases have been built in kind of delta island areas where there are not power lines, and so the interconnection hasn't yet really arisen as an issue. And these are also fairly new. They haven't been installed for a number of years, but I'm sure there's probably somebody listening that would have a much better answer than mine.

Katie All right, well great. Thank you. And going back to Dipti on Nepal, the question is, you know, you mentioned in your case studies about hydro, is there—whether you're aware of any other case studies with renewable energy technology such as wind or solar.

Dipti In Nepal specifically?

Katie Yes. This is the—yeah, Nepal specifically.

Dipti Yeah, there are solar and wind mini-grids done by the same agency, but they are not interconnected. I'm sure they have some solar projects in the pipeline, solar mini-grids to interconnect. This policy is not just for hydro that's been developed recently. It's for all mini-grid technologies. I can share the contact for—if you'd like specific info.

Katie Great. Thank you so much. Our next question for the panel is how common is storage in mini-grids that are being installed currently? Let me repeat that again. Sorry, I got jumbled. How common is storage in mini-grids that are being installed currently?

Chris I could take a stab at this. It depends on the technology. So, for hydropower mini-grids and biomass mini-grids using gasifiers, typically storage is not included. But for solar and solar diesel hybrids and wind, which is a pretty rare generation, especially with the fairly recent drop in photovoltaic solar prices, storage is—it is almost always an element, and that's just because the intermittency of solar and wind compared to hydro and biomass. With biomass, the storage is in the sense of it's in the unburned fuel. If you want more power, you can shove in more fuel. In hydro, typically these things are running 24-7 and it's—the electricity—the levelized cost of electricity is cheap enough that it makes more sense to just burn off the excess electricity as—in a ballast regulator than it is to add storage. It's cheaper to build a bigger hydro project than it is to add batteries.

Katie Great. Thank you so much, Chris. Our next question is for Sam. Sam, how is the grid connection helping with the energy access problem? Or how could the grid connection help with the energy access problem?

Sam Great question. I think in two basic ways. One is that there are a significant number of people who don't have energy access who are near the grid and they could benefit from grid-connected micro-grids being developed right from the beginning. That's the first method. Otherwise if people are in the strange sort of no-man's land where often they're waiting for the main grid to get to them, which could take many years, or they're using solar homes while they wait, which is always kind of absurd because they're paying $5.00 per kilowatt hour for a few lights when they could be using a 15-cent kilowatt hour that's maybe a couple hundred meters away. So, that's the first way.

The second way is by clarifying a methodology and a mechanism for grid integration, you open the doors up for investment in off-grid mini-grids as well because investors are much more excited to invest in off-grid mini-grids if they know there's a clear methodology for how those will someday be integrated into the main grid if and when it does come. So, both in addressing an immediate problem of under-grid connectivity and in giving investor comfort in building off-grid mini-grids now, getting this interconnection issue resolved is quite important.

Dipti Just to add to those very good points, often mini-grids become overloaded as the population grows or demand grows, familiarization with electricity. And so, when you connect to the main grid or connect to other mini-grids, you can address your overloading problems more easily.

Katie Great. Thank you both. Did anyone else jump in? I thought I heard someone jump in. Sam, going back to you, what is the equivalent, do you know, in East Africa of the hydro empowerment network?

Sam Good question. So, countries in the region typically have a renewable energy association. So, in Kenya, there's KREA, in Tanzania there's TREA, and I believe there's some efforts underway to pull together like a sort of federation of those renewable energy associations. There isn't, to my knowledge, a dedicated hydro-based organization, probably 'cause there's a bit less hydro maybe than in Southeast Asia. But I guess the closest—the strongest organizations out here are the renewable energy associations, KREA, TREA and their equivalents in other countries.

Chris Through my work in Tanzania, there's a fair amount of small hydro mini-grids being built, but they seem to be kind of on their own. I think that a role that HPNET plays in Southeast Asia is played by some NGOs. I'm trying to think—maybe help me here, Dipti—the one that used to be the Schumacher organization.

Dipti Practical Action.

Chris Practical Action, yeah. [Inaudible]

Dipti Yeah. Also, GIZEDS work on hydro in Africa. There as an internal group. And also, HPNET, we are—we have an eager board member with lots of work in Africa that is encouraging us to consider a platform for African countries, so we have requests from Nigeria, Uganda, Tanzania and other

places. So, yeah, definitely reach out if you have ideas on what you would like to see such a platform do. Thank you.

Katie Great. Thank you, everyone. And I think we have time for one more question, and for any questions we didn't get to, we'll connect with those—the attendees afterwards. And in just a minute after this question, I'll ask for all the panelists and Ruchi, the moderator, to just kinda give us some closing thoughts as we leave the webinar today. But our final question for the webinar today for the panel is, has anyone ever thought of using crowd funding as part of the blended finance for financing or refinancing mini-grids?

Chris Sam?

Sam Yeah. We have. There are some platforms emerging out there that are trying to do just this and hold promise, and we've seen some initiatives in the US in particular where crowd sourced capital for—usually utility tide projects has been quite successful. So, this sort of thing is starting to percolate and happen, but the reality is, even with that sort of capital available, there's still gonna need to—going to be a need for this leveling the playing field in subsidy reform.

Katie Okay, great. Thank you so much. So, now I'd just like to go to each of the panelists just to give any closing remarks to today's webinar. Ruchi, I'll start with you.

Ruchi Thanks, Katie. I really want to just thank all the speakers, Chris, Dipti and Sam, for a great and riveting discussion. I personally learned a lot, and I hope this is one in a series of such conversations still move the needle faster on mini-grids development and implementation and addressing challenges including these of interconnection. Thanks.

Katie Great. Thank you so much. Chris, we'll go to you next. Do you have any closing remarks to leave us with today?

Chris Sure. Thank you. I think this has been a fascinating discussion and it's wonderful to see the really significant interest based on the number of attendees. My closing remarks are we're in a fascinating situation where we have—where there's a real proof of concept or an existence proof that there are now scores of mini-grids that have connected, but there's many the orders of magnitude, more mini-grids that end up being abandoned when the main grid arrives. And so, from the ones that have connected, we have some inkling of the recipes that's necessary to make a viable business. And as Sam mentioned, the technology's not necessarily the issue. The real challenges are regulatory in nature, having inconsistent frameworks, having arrangements and relationships with utilities that are conducive to interconnection and positives, and addressing subsidy parity.

Katie Great, thank you so much. Sam, would you like to have some closing remarks for today?

Sam Sure. And at the risk of sounding a little repetitive, private utilities offer the ability to connect the 500 million people in Africa who don't have power with a solution that is not only the cheapest but will ensure that Africa builds a future-proof distribution network throughout the continent. The expense is not that high, under $1,000 per connection. Full in cap-ex including generation, we're talking about a problem that if you spent $6 billion on it for 15 years, it's solved. I think our sector needs to have a much more aggressive approach to getting this solved in the next 15 to 20 years. It is solvable, and in the grand scheme of things, the investment required is not that huge, and by doing it right, we will solve the problem not just for now but for half a century or a century to come as we future-proof the infrastructure in Africa through this method. So, if we can get the funders to coordinate a bit more, get a more harmonized approach to subsidies and structural support for financing these assets, there's a clear plan in place to get that done and is—has published a whitepaper that outlines quite a bit of this vision and also the—our suggestion for how to structure an effective RBF program is available online as well. There's a link to it in the presentation. Thank you, everybody, for attending.

Katie Great. Thank you. And certainly, last but not least, Dipti, would you like to give us some final closing remarks for today's webinar?

Dipti Yes, thank you. So, I'd like to just remind everyone that within our community of practice, decisions get made at the country level with local or in-country stakeholders who often aren't fluent in English, not so analytical as we are in the West, and so it's really—I hope that such exchanges like this webinar and other knowledge products coming out are always translated, always simplified so that our in-country stakeholders can understand and that our community of practice really pushes the boundary, not just gain the knowledge and talk, but we really have to show that mini-grids are not an interim temporary solution as many national plans perceive. They are a solid solution that deserve to be integrated to the main solution that's accepted right now. Thank you.

Katie Great, and thank you again. On behalf of the Clean Energy Solutions Center, I'd like to extend a thank you to all of our expert panelists. The presentations were so wonderful today, and especially to all our attendees for participating in today's webinar. We had such a great turnout, and again, for any question we didn't get to, we'll definitely follow up with you. We very much appreciate your time and hope in return there are some valuable insights that you can take back to your Ministries, departments or organizations. We also invite you to inform your colleagues and those in your networks about the Solutions Center resources and services, including no-cost policy support through our Ask an Expert service. I invite you to check the Solutions Center web site if you'd like to view the slides and listen to the recording of today's presentation as well as previously-held webinars. Additionally, you'll find information on upcoming webinars and other training events. We are now posting the webinar recordings to the Clean Energy Solutions Center YouTube channel. Please allow about a week for this posting that will include the slides to be posted. Finally, I'd like to kindly ask you to take a moment to complete the

short survey that will appear when we conclude the webinar. Please enjoy the rest of your day, and we hope to see you again at future Clean Energy Solutions Center events. This concludes our webinar.