

Quality Standards for Energy Access: How International Standards can Support Off-Grid Electrification in Developing Countries

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Webinar Panelists

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Vimal Mahendru Legrand – India

Pierre Sebellin IEC Systems

Paul Johnson African Electrotechnical Standardization Commission

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Sean Esterly 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 United Nations Foundations Energy Access practitioner network and the International Electrotechnical Commission. Today's webinar is focused on the quality standards for energy access, how international standards can support off-grid electrification in developing countries.

And, 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.

And I just want to 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. And if you choose to listen through your computer, please go to the audio pane and select the mic and speakers option. And if you dial in by

phone, go to the audio pane and select the phone option, and a box on the right side will display the telephone number and the audio PIN that you can use to dial in.

And if anyone's having technical difficulties with the webinar platform, you may contact the GoToWebinar's help desk at the number at the bottom of the slide. That number is 888-259-3826. And if you would like to ask a question during the webinar—and we do encourage all attendees to do so—just use the questions pane, where you type in your question and submit it there. And we will address those during the question-and-answer the session following each of the panelists' presentations.

If anyone's having difficulty viewing the materials through the webinar portal, you will find PDF copies of the presentation at cleanenergysolutions.org/training, and you can download those and follow along as the speakers present. Also, in the audio recording of the presentations, will be posted to the Solutions Center training page within about a week of today's broadcast and will also 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.

We do have an exciting agenda prepared for you today that's centered around the presentations from our guests' panelists: Vimal Mahendru, Pierre Sebellin, Paul Johnson, and Dr. Arne Jacobson. These panelists have been kind enough to join us to introduce the IEC system approach to evaluate the status of standardization in low-voltage direct-current applications, as well as nonconventional distribution networks.

Before our speakers begin their presentations, I just want to provide a quick informative overview of the Clean Energy Solutions Center initiative. Then, Yasemin Erboy Ruff will provide an overview of the United Nation Foundation's Energy Access Practitioner Network. And then, following the presentations is when we will have the question-and-answer session where panelists will address any questions submitted by you the audience.

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

And the Solutions Center has four primary goals. First goal is to serve as a clearinghouse for clean energy policy resources. Second is to share policy best practices data and analysis tools specific to clean energy policies and program. Third is the delivered dynamic services that enable expert assistance, learning, and peer-to-peer sharing of experiences. And then, finally, the fourth goal is to post your dialogue on emerging policy issues and innovation from around the globe.

And the primary audience for the Solutions Center is typically energy policymakers and analysts from governments and technical organizations in all countries. And then, we also strive to engage with the private sector NGOs and civil society, as well.

And one of the marquis services that the Solutions Center provides is its no-cost expert policy assistance known as the "Ask an Expert" service. And Ask an Expert has established a broad team of close to 40 experts now from around the globe who are each available to provide remote policy advice and analysis to all countries at no cost to the requester.

So for example, in the area of demand and policy evaluation, we have expert Bruno Lapillonne, who is the vice president and co-founder of Enerdata, serving as one of our experts. So if you had a need for policy assistance and demand and policy evaluation, you could submit your question to us, and we could send it along to Bruno who would then respond, or we could send it along to one of our various experts on the team. And again, the assistance is provided free of charge to you.

So if you have a question for our experts, please submit it through our simple online form at <http://cleanenergysolutions.org/expert>. And we also encourage you to spread the word about this service to those in your networks and organizations.

And so now, I'd like to provide brief introductions for today's panelists. Our first speaker is Yasemin Erboy Ruff, an officer with the UN Foundation's energy and climate team, primarily assisting in coordinating efforts to scale up energy access in developing countries. Our second speaker, following Yasemin, is Pierre Sebellin, and Pierre works for the IEC central office in Geneva and is responsible for setting up and promoting the development of the systems approach for the standardization work of the IEC.

And our third speaker today is Vimal Mahendru, the president of Legrand, India, a subsidiary of the French multinational Legrand. Vimal is a prominent member of the Indian electrical equipment industry and was president of the industry association, IEEMA in 2010 and 2011. And after Vimal, we will hear from Paul Johnson, an engineer who holds the position of executive secretary of the African Electrotechnical Standardization Commission and also currently supports the South African National Committee of the IEC as national committee secretary and employed by the South African Bureau of Standards.

And our final speaker today is Dr. Arne Jacobson, director of the Schatz Energy Research Center and a professional in the environmental resources engineering department at Humble State University. Dr. Jacobson serves as the technical lead for product quality assurance for Lighting Global, which is associated with the Lighting Africa and Lighting Asia programs. And so with those introductions, I'd now like to welcome Yasemin to the webinar.

Yasemin Erboy Ruff Thank you very much Sean, and thank you everyone for joining our webinar this morning or this afternoon, depending on your time zone. I'm going to try

to keep this short to spare all of our members and repeat attendees. But for those of you who are joining us for the first time, I wanted to provide a brief introduction to the UN Foundation's work on energy access before turning it over to our speakers. Next slide, please.

So the Energy Access Practitioner Network is the UN Foundation's primary way of engaging with the energy access space and as a network and a global platform that brings together energy service providers and stakeholders from around the world who support the delivery of cleaner, reliability, and affordable decentralized energy, as a contribution to the Sustainable Energy for All initiative. Here is how you can reach out to us, and please do join us if you're not a member already. Next slide, please.

I probably don't need to go into this much at all with our current audience, but I just wanted to obviously mention it. We're looking at energy access as an access issue and that a lot of our practitioner network members have a range of options that are existing and ready to scale for off-grid rural electrification. The network supports peer-to-peer learning, and this webinar is one of the ways in which we do try to provide that. Next slide, please.

The practitioner network, in the past five years, has grown to over 2300 members working across 170 or so countries. And the network tries to provide a number of doorstep services to our members to promote new technologies and innovative financial and business models, provide a platform for our members to convene and connect around new partnerships _____ financing, and also to facilitate the development and adoption of quality standards, which we'll be talking about today. Next slide, please.

Practitioner network members have collectively provided over 30 million people with clean energy products and services in the last year, and many of these are Lighting Global _____, which I'm sure you'll hear more about shortly. But I just wanted to mention that we have had longstanding partnerships with the IEC and Lighting Global in establishing and disseminating quality standards for decentralized systems and making them more accessible to energy access practitioners.

So we're very happy to be here with our colleagues from IEC and Lighting Global, today. I'm looking forward to the presentations and discussions following that. Next slide, please.

Once again, if you would like to join us if you're not a member already or if you have any questions, please do reach out to us via our website, and then, with that, I would like to turn it over to Pierre for his presentation.

Pierre Sebellin

Okay. Hello, everybody. This is Pierre Sebellin speaking. I hope that everybody is hearing me clearly. So I'd like just to start with my presentation here. So in fact, I will talk about the IEC, if you would, about the IEC and also what we do regarding microgrids in standardization for microgrids in rural electrification. So the IEC—okay. Oh. Okay.

Yeah, so the IEC is a global organization that publishes consensus-based international standards and not just conformity assessment systems, and the IEC works together with ISO and ITU in _____ organizations to prepare international standards to comply with the World Trade Organization agreement on technical barriers to trades. At the IEC, we have a group of 167 countries working with us to develop standards, and then they are, also, of course, adopt these standards nationally.

And the _____ process ensures transparency about the requirements standardized and also about the approval. We are in a system where we have one vote per country.

So the IEC standards, in fact, they apply to millions of electric and electronic devices that use or produce electricity. They deal about safety, performance, interoperability, environmental aspects, _____ compatibility, and many other aspects of the product. We've got, at the IEC, more than 9000 standards in our catalog, and every year, we produce about 900 or new revised standards—500—sorry—500.

So the standardization work in the IEC is divided into 178 subsectors of the electrotechnology, and they are all under the responsibility of so-called technical committee or technical subcommittees. And the standards are written by a community of 20,000 experts that come from the industry, government, testing laboratories, academia, and consumer groups.

So this is just a short overview of the products that are addressed by the IEC standardization. It goes from the power distribution functions from the hydraulic and nuclear plants, the solar panels, down to the transmission of energy and the electrical installation in the buildings, in your houses, and industries' buildings. We also deal with use of electricity in transports, like in plane, trains, boats, and also e-mobility, e-cars, and e-vehicles, in general.

We also deal with medical equipment in the hospital, in emergency, for elderly people, and so on. We also deal with the multimedia and mobile equipment, data centers, and all these port supplies and also behind names like Wi-Fi, USB, MP3, MPEG, JPEG, and all these you have behind these names you have IEC standards.

We also write standards about safety and performance of home appliances, the big, large ones, the small ones, like, for example, the NRG Scale is an IEC standard, also about hand tools, LED lights, batteries, and many, many other products and subjects related to electrotechnology.

In order to follow the increase of complexity of all these products, we have implemented, at the IEC, the so-called "systems approach." The systems approach, in fact, is led by the need of, I would say, to answer to the multiplicity and the conventions of technologies. If you think about telephone maybe 20 years ago and the mobile phone, today, you have many, many more functions in there and so many more standards involved, as well.

There's also a development of large-scale infrastructures, like smart cities, smart grid, Internet of Things, and so on. And there is also the need to address complexity and interoperability within these large infrastructures. And so the systems approach of the IEC has the objective to build larger collaboration platforms outreaching _____ organizations and also to have a top-down standardization approach and start really writing standards at the systems level rather than the product level.

And in the IEC, this is implemented by having new type of committees that we call "systems committees." And they are mainly the main difference between the systems committee and the regular technical committees that it brings some kind of a platform—a collaboration platform engaging several technical committees and external standardization organizations that can be _____ here and more, I would say, worldwide organizations.

And we also have so-called "systems _____" groups, which are some kind of incubators of the systems committee, and they are temporary and completely open groups. And these groups, their mission is mainly to evaluate the relevance for the systems approach in these new emerging subjects.

So what do we do regarding microgrids and also microgrids and also microgrids for electricity access? First of all, we consider microgrids like, I would say, as an interconnection of several homes in a community, but we don't only talk about rural electrification.

We also consider, I would say, _____ suburbs. We are also—have the goal to really share the resources provided by all the solar energy or the wind energy _____ energy in order to, I would say, merge this resource and be able to offer punctual high power, as well. And then, you see in the second stage, there's also the goal to provide some standards for the interconnection of these microgrids and create regional grids or maybe even national grids.

So what kind of benefits can standardization bring to microgrids? First of all, they're standards. They provide reference, technical information, about safety and protection against electric shock about microgrid design, what's the best structure or topology for a microgrid, how to benchmark various solutions that can be provided by various suppliers. You will also find standards about energy metering and about general microgrid management like how to install and test the operation, the maintenance, the interoperability of microgrids, the integration into a main grid, like how to connect the microgrid to the main grid, disconnect, synchronize, the _____ requirements, and so on.

Also, standards, they can be used regarding microgrids to provide, I would say, technical reference information for issuing tenders and comparing offers for developing regulations and for a detailed interpretation of the load. So in fact, standards contribute to removals of technical barrier to trades.

I will just have a short—a few words about two of the groups that are really focusing on electricity access in the IEC. First, one is the System Evaluation Group 6 about nonconventional distribution networks and microgrids. So this group has been established because of the recent technology evolutions that

speed up the deployment microgrids, and the industry is requesting standardization on that subject. And also, microgrid technology is a complex, transversal technical sector, and there is a need to have a holistic approach.

SEG 6 is mainly addressing all types of microgrids like microgrids that are established in larger cities for disaster recovery purposes like the floods we had in New York, for example. They also established to prevent blackouts at peak consumption periods, and you know you can have—like also in the U.S., there was a complete blackout of the whole east of the U.S.A. when there was a peak consumption. Everything was broken down. So microgrid can be a solution there and also, of course, for electricity access.

And SEG 6 is not writing standard. SEG 6 is just there to analyze the status of standardization to evaluate the gaps and the needs in standardization. There are also the stakeholders that needs to be part of the standardization and to propose a global strategy for the IEC.

The other group, also, which is dealing with electricity access, is SEG 4 on low-voltage DC. So that group is led by Vimal Mahendru, who will then present that more in details later on. Basically, that group was established because of the increasing use of DC—"DC" means direct current—loads, like LEDs, like multimedia and mobile devices. Also, now, in home appliances use DC electricity and e-mobility, of course, and many others. So there is the increasing, also, use of power generators and also the DC power storage. So when you think about solar panels, about wind energies, and _____ and so on.

And in fact, when we look at us existing in standardization, we realize that AC standards and AC requirements and standards are really spread out in many, many various standards. And if you want to extend these requirements to DC, we need, really, to look and revise a very large number of standards, and we need to do that in a coordinated way. And this is why, I would say, we went into evaluating the systems approach for that purpose. And so SEG 4 is working to provide a global strategy to shape the IEC _____ standardization and is also focusing on electricity access.

I'd like to have a last word about how the IEC is supporting rural electrification, and I want you to check into the IEC Web store where you can purchase standards. And you can see that we have special discount prices for standards about rural electrification. Discounts go from 50 percent to 75 percent. So I really invite you to follow that link here and check whether you can—how to take advantage of this.

And this about it regarding microgrids and electricity access, so thank you for your attention. And I pass the—I would say to give the floor to Vimal Mahendru. Thank you very much.

Vimal Mahendru

Good afternoon—morning—good evening, wherever you are. This is Vimal Mahendru. It's a privilege to have such a wide audience today and talk about a subject which is actually at the core of what we are trying to do and achieve in electricity access. Let me begin where Pierre left off.

Today, almost all of the things that we love and like are already running on low-voltage direct current. We live in a DC world—electric cars, solar lanterns, LED lights, computers, mobile phones, tablets, aircraft—inside of the aircraft, the entertainment systems, lighting systems, electricity access, irrigation systems. Almost everything is already working in DC. But it's amazing that we still end up getting alternating current—AC—in the walls.

While we, on one hand, are living in a world of DC, but at the same time, in the 21st century, we realize that about 1 in 5 people have absolutely no access to electricity. Roughly, three out of five people are using wood, bio waste, or coal for cooking. And all of this is leading to rapid degradation of our environment, let alone the fact that it's not helping bring people into a kind of inclusive development. Frankly, poverty and energy poverty are almost synchronous. If you try and map areas of the world where there is no electricity, you will see those are also pockets on our shared planet where people are absolutely poor and have no means of trying to improve or develop their living or living spaces.

This kind of dichotomy in our world, where on one hand, we have people and geographies where everything is available; energy is abundant. We're talking of going to Mars and colonizing Mars. On the other hand, we live and share the same planet where there is absolutely no electricity, and people continue to remain in absolutely dark homes, not necessarily dark ages but dark homes.

This kind of dichotomy cannot go on, and increasingly, we realize that policymakers, governments, politicians are saddled with the issue of inclusive development. In India, this is a huge challenge because India has approximately 300 million people who have no access to electricity. It's the single-largest population of people without electricity in the world.

And the government is trying to address this with seriousness and with earnest and, in the process, exploring all potential avenues through which we can rapidly bridge this gap. In the process, one of the areas that India is looking at promoting and to—India, you know, now working on IEC platform is low-voltage direct current.

The next two slides are a little technical just to explain what LVDC is. "Low voltage" means anything up to 1500 volts. So in fact, it's almost comical that right from the USB stick and your mobile phones, to most railway networks or metro networks, which are working on DC, come within 1500 volts. So it's a fairly wide range. It does not include maybe wind generation or maybe beyond that into power generation, but almost all the consumption that is taking place in DC is covered by LVDC.

And DC, as opposed to AC, is a straight line. There is a positive and negative instead of going through a _____, which is typical of alternating current. This battle of the currents started about 150 years back when electricity itself was invented, so to say, and rapidly proliferated through Thomas Edison and Nikola Tesla. And Tesla was promoting AC or alternating current. If you just do a Google search, you will find a lot of

literature, and those who are interested will find it quite a fascinating story how it started.

But when electricity started off in the early 1900s or late—at that time, AC and DC, both, coexisted. There were small power plants. It was localized power generation. Coal, oil, or wood was the main fuel, which was used to get steam, and steam would turn the turbines, which would produce electricity for consumption.

Electricity, at that time, was still a novelty. It was a bit of an elitist product used more by royalty and the rich. Obviously, environment and energy have _____ absolutely non-issues, and they were not even existing in normal language. And the proliferation of AC and DC was purely to cut out smoky lighting, which was prevalent at the time.

Move another 50 years, and in those 50 years, there was rapid industrialization and adoption of electricity with everything. And AC began to dominate because one main benefit technology provided at that time was that AC networks provided that you could have large centralized power plants away from the cities or away from major points of consumption. And AC was easier to transmit given the technology available at that time over long distances. So you could be in cities and the polluting power plants could be far away from the cities the pollution was on.

And so in the '60s—'70s, environment and energy efficiency were non-issues. And at that time, the loads were predominantly alternating current because electronics was still not really embedded into our day-to-day lives. Lighting, which is the single-best consumption point for electricity, was the conventional incandescent bulb, and those bulbs worked all on alternating current.

Come now, in the last 15 years or so, we've certainly seen an explosion of electronics into everything—mobile phones and tablets, computers, electronics embedded into anything and everything that you do. If you look on yourself today, while you're a part of this—maybe not—almost anything and everything that you are interfacing with is working with direct current. It's embedded with electronics, and all electronics inherently works on direct current.

At the same time, solar PV, the costs have come rapidly down and is becoming more and more viable. LED lighting has, by and large, replaced almost entirely incandescent bulbs or even CFLs or compact fluorescent lamps. Batteries are becoming popular for storage, and all of this, this green circle you see at the bottom, shows that all of this are actually operating in a DC environment. This is totally DC.

So the big question we are now saddled with is if all of this DC and all the electricity that we are consuming is in DC, then why do we still get AC in the walls? And this question is beginning to _____ policymakers, and the answer clearly is AC is not as energy efficient as DC is. And AC does not provide for this same level of environment protection or environment safety as DC does

because of solar PV, which is becoming part of the network. So it addresses environment as well as energy efficiency.

LVDC has major benefits, especially in electricity access. If you look at island, which presently may not have electricity or it may have electricity through expensive diesel generation, they are increasingly looking at LVDC so that the entire network can be an energy efficient, low-cost network-based on environment-friendly solar PV, which is then proliferated within that area around the solar PV panels.

Rural electrification, irrigation systems, and villages, business activities, which needs small amounts of power and electricity, all of it requires DC. And so solar PV becomes an integral part of delivering electricity. Not only is LVDC relevant to electricity access. But _____ buzzwords that we hear in our industry, in our ecosystem today, Internet of Things, smart homes, smart cities, active assisted living, all of them _____ have data and electronics embedded into them, and data—all electronic. Given that data is electronic, it means, inherently, it works in a DC environment, and so LVDC standards increasingly become relevant in this field, also.

One of the most interesting studies available these days is from—by the World Bank, which has done a pioneering job of creating a measuring tool for measuring energy access. It's a multi-tier framework, where Tier 0 is those homes, dwellings, huts, which have absolutely no electricity, no wire of electricity even coming in _____, and that would be Tier 0.

And Tier 1, for example, would be about 4 hours of electricity at around dusk or dawn time, where there is just enough electricity for 4 hours for some indoor lighting—nothing beyond that—and thereby going from Tier 1, 2, 3, 4 to Tier 5, which is a fairly modern and contemporary today, where you see at least 23 hours of guaranteed electricity available almost throughout the day to around air-conditioning, kitchen appliances, entertainment, cooking, and lighting, et cetera, in the homes. And increasingly, governments are using this kind of a multi-tiered framework to take people from 0-electricity access, which is Tier 0, to Tier 5.

And IEC is now using this kind of framework to build standards for electricity access. As Pierre also mentioned, the system evaluation group for LVDC is a fairly rich resource. It has about 125 experts from 25 countries from all over the world, developing economies, as well as developed economies.

India is leading the way in this development, and the idea is to address a low cost, relatively easily accessible technology to be standardized, which almost all countries, which are even developing, can adopt, which can be safe, quick, and efficient way of delivering sustainable electricity to rural interiors of the countries.

And we do see standards work has already commenced, and I want to take this opportunity to invite you all to visit the IEC website and join IEC SEG 4. Every individual is free to join this group so that you can have access to all

the information. The final report is going to be ready and available in October this year, and it would be a _____ [break in audio] to share that report _____. Thank you very much. Over to you, Sean.

Paul Johnson

So Paul Johnson here, if you can hear me, and thank you for the opportunity. I'm just going to share a few slides on what AFSEC, the African Electrotechnical Standardization Commission, is doing to support electrification for Africa and what it's doing and what it plans to do.

Just some statistics, which I'm sure many of you are familiar with, but it's worth emphasizing the context of Africa and Sub-Saharan Africa, in particular. If you look at the overall population that's estimated does not have any access to electricity on the continent, then it's in excess of 600 million. And unfortunately, it's growing in terms of absolute numbers while the percentage has gone up slightly over the last few years, from maybe 15 to 17 percent.

The actual number is increasing due to rapid population growth, and so that tends to add pace to the rate of electrification and can see the progress that is being made. And just to underpin that number 600 million compared to the population of 4 developed countries—U.S.A., U.K., Japan, and Germany—if you can imagine all those countries with no access to electricity for older populations.

In terms of the African continent itself, it's big, and I think it's the overlay maps on this map emphasize that. And that means there are huge opportunities for infrastructure development for the African electrotechnical electricity infrastructure, and that requires appropriate standards. And then, for those populations that do not have access, they're waiting to use electricity to have appliances conforming to appropriate standards, standards that work in the African environment.

The other thing to emphasize in terms of standards is because Africa is so big, while we want to collaborate on standards, we have to recognize the differences. We're spread across several time zones, several geographic areas, with different climactic zones to different geographic challenges.

It's against the background that AFSEC was established in 2008 and really recognizing the lack of a focus on standardization in the African electricity sector. Its members are the National Electrotechnical Committees and representing stakeholders, and that's very similar to those of you who are familiar with CENELEC in Europe, the same sort of structure and really based on how the IEC operates.

Its initial focus areas, to get agreement on what existing standards can be promoted for common adoption. So we have a growing catalog of what I refer to mainly IEC standards, recognizing that IEC is the preeminent body that's producing electrotechnical standards in the international arena and then to have capacity building in the application of these standards, particularly in the area of conformity assessment and to increase the knowledge on the application of standards, in general.

Our membership, as the beginning of this year, we have National Electrotechnical Committees from those 11 countries. We also have provision for affiliate members, and there's some acronyms there that may not be familiar to all of you. APUA is the Power Utilities Association of Africa, the African Energy Commission, the Power Institute for Eastern Southern Africa. SADC is the standardization expert body for SADC in the Southern African region, COMESA for Eastern Southern Africa, the Southern African Power Pool and East Africa Power Pool.

And gradually, we hope those other regional economic communities in Africa and power pools will join us. _____ that have affiliate membership, and hopefully, they will return to full membership soon.

The issue is, "What are the prospects for access to safe, reliable electricity for populations?" like those in the picture you see I hope. "What's the role for standards and standardization?" Certainly, from this on the left, the paraffin, the kerosene lamp, to a solar-powered LED lamp is a step change, and it's one step towards universal access, and safety is inherently improved, and it's a reality that maybe the only improvement that many communities will experience for decades.

And certainly, there are many organizations that are promoting to replace the paraffin lamp with LED lamps. The question is, "How do we ensure the quality, efficiency, reliability, and long-term effectiveness of those products? Do the organizations, the NGOs, and the financing institutions, are they fully aware of the standards that should be referenced and specified? Do the countries where these equipments is being offered have the right technical regulations in place to make sure that within six months, the year, the equipment has not failed, and people returned to using kerosene lamps?"

Isolated systems are a fast-growing alternative. I think we've heard to from the other speakers. And certainly, AFSEC has recognized that the whole series of IEC standards in the 62257 series that are very useful to ensure that we specify the right things and achieve the quality required. In fact, it's that series that Pierre mentioned are now available from the IEC at a specially reduced price structure, and that's certainly helping in this context.

With that in mind, what AFSEC has done recently is to brief its first application guide, Guide for Application of Standards for Rural Electrification in Africa, it largely, in its first edition, references that IEC 62257 series that I mentioned previously. It's produced bilingual, recognizing that, certainly, in Africa, we need to cater for both Anglophone and Francophone countries.

Just to acknowledge the support we had from PTB and DKE Germany, there's a soft copy available on the AFSEC website, and the website there is there. Certainly, while it's produced by AFSEC for Africa, I'm sure that guide could be useful in other areas. Vimal, maybe for India, you might like to take a look at that, and it could be promoted for application in India, too.

It doesn't stop there. Pierre mentioned microgrids and integration into the general grid. That's a reality for Africa. It's a big challenge, and the power pools are working towards integration, and the African grid is, again, interconnected to the power grid in Europe. For that to work effectively, you have to have agreement on the operational and network system standards.

It's also an opportunity to take account of smart grid opportunities, where we're actually have a number of green-field areas throughout Africa, and we can adopt the latest standards in technology. AFSEC's there to provide guidance on the standards to be adopted.

Our next step for AFSEC is to look at IEC standards under development and make comments, maybe to share the comments among our members, and we have mutually agreed to make comments to IEC. The aim is to influence IEC standards for increased suitability for direct adoption and application in Africa. Certainly, in our guides, we've also recognized that there are some national standards developed in Africa that could be more widely used, and, for example, in the guide, I mentioned there's some South African national standards, which could now be considered for common adoption more widely.

In the area of conformity assessment, IEC has its suite of conformity assessment systems, and AFSEC has been collaborating with IEC to have seminars and build capacity in those, particularly IECEx and IECCE. We've run four seminars already and should have another one this year.

In summary, AFSEC _____ use its structures for members and stakeholders to promote the standards from either _____ IEC and other standards organizations where relevant. We need feedback from practical implementation, from projects, to know where adaptation is needed, especially in relation to safety and reliability, and that relates to development of appropriate technical regulations. Collaboration amongst AFSEC members will be used to influence future revisions of IEC standards, and we'll continue to collaborate with IEC in the application of conformity assessment systems.

So in conclusion, electrotechnical infrastructure development in Africa is certainly a reality with many challenges. It's very exciting—power pool integration, cross-border trade of power, multi-country project, mega projects like Inga, Grand Inga, the DRC, Pan-African power grid, smart grid evolution, and universal access.

Quality of electrical equipment, materials, and appliances is a necessity. And for that, we need appropriate standardization frameworked, and AFSEC's been established for that purpose. To be fully effective, we need increased membership, and we're looking forward to seeing more African countries join us soon. Thank you.

Sean Esterly

Great. Thank you very much, Paul. We'll turn, now, to our final presentation from Dr. Arne Jacobson.

Thank you. And thanks to everyone who's listening. I really appreciate the opportunity. I will spend just a few minutes talking about the Lighting Global Quality Assurance program, which is an effort of the International Finance Corporation and the World Bank, which is underpinned, I think, importantly, with IEC standards. So close collaboration between Lighting Global and the IEC.

Pico-solar products have been selling in increasing numbers across—especially in off-grid areas of Sub-Saharan African and South Asia. And the graph here shows sales just in Sub-Saharan Africa but also rapid growth in countries like India and others in South Asia. And with the growth of these sales, there has been a real need, a recognized need, for an effective quality-assurance program. And the Lighting Global program has been set up and has been operating since 2009 in an effort to address quality assurance in this market segment.

Once you consider the products that are not quality-assured selling into these markets, you can see that the scale of the pico-solar market—and by "pico solar," I'm talking about products that have solar modules that are less than about ten watts. It's quite a large market with estimated in the first half of 2015 on the order of 44 million units. So that's just during a six-month period.

And the quality-assured products are a significant fraction of the sales, but the un-quality-assured products have a larger share at this point. And there's a need to continue to build quality assurance structures and to continue to expand our collective ability to protect the rights of consumers who buy off-grid solar products.

So just a few take-home messages in relationship to off-grid solar and quality assurance. First is that the success that off-grid solar markets have had to date are critically linked to quality-assurance efforts that have been in play. And there, I think Lighting Global and the IEC have both played very important roles, as well as, importantly, some early-stage national adoption of quality standards for the sector.

African governments, including Kenya, Tanzania, and Ethiopia, have adopted or are in the process of adopting national standards for off-grid solar products, and a number of other countries are also at early stages in that process. And I'll talk about that further a bit later on. In addition, ECOWAS has adopted standards that reference relevant IEC standards or IEC documents, covering 15 countries. So that's a recent development.

As governments begin to adopt standards, it's very important to make sure that things proceed in a harmonized way. I think that's the way that markets will grow most effectively. And IEC, in particular, can play a very important role here, as I think governments are often quite comfortable adopting documents coming from IEC.

And national adoption, which is a very important and recent trend within the off-grid solar sector, provides a great opportunity to reduce the presence of low-quality products in these markets. But I think we all have to work

together quite closely to ensure that this potential for success is realized and that we find ways of ensuring that harmonization is maintained and that implementation is able to move forward smoothly.

The Lighting Global quality assurance program is a collective effort. It's a program of the World Bank Group and is associated with both the IFC and the World Bank, but it's been very much a team effort with a number of different organizations playing key roles, including the U.S. Department of Energy through the Global LEAP initiative. UN Foundation has been a key partner, as I've mentioned, IEC, as well, as well as a number of others, including, very importantly, the Global Off-Grid Lighting Association, which is an industry association representing a number of companies in the sector. Lighting Global has been developing a test laboratory network with some of the laboratories, key laboratories being shown here, and others in the process of joining.

And in terms of the structure of the Lighting Global program, really, I think of it as being broken into three pieces, one focused on test methods and standards. And there, IEC plays a key role. The test methods that are utilized within the Lighting Global program are ones that are within IEC, the IEC document indicated here, and IEC has been a key partner in that process. And currently, the quality standards that specifically the thresholds for meeting the requirements outlined in the test methods are—continue to be managed by Lighting Global.

Now, those test methods and standards provide the foundation for a testing and verification program, which is managed by Lighting Global. So there are companies that are interested in having their products certified, submit those products for testing through our test laboratory network, and we determine if the products meet the standards through that testing.

The laboratories that provide qualification testing and determine if the products meets the standards all have ISO 17025 accreditation with specific test methods within their scope. And that's a critical element of ensuring consistency in the test lab process and also ensuring that governments and other entities feel comfortable to adopt that framework and to accept test results generated through that process.

Now, once a product is qualified through the program, it's also important to make sure that what gets delivered out into markets continues to meet the standards. And so we have a market surveillance effort, as well, primarily through market check testing, and we have a network of test laboratories there, as well.

Some of the key laboratories associated with the market check testing include TERI, which is based in India, the University of Nairobi in Kenya, and the Ethiopian Conformity Assessment Enterprise in Ethiopia. And we're in the process of working with additional labs to continue to build our ability to conduct market check testing across Sub-Saharan Africa, as well as South Asia.

Now, once products meet the standards, the next key step is communicating that information to the market, and so products that do meet the standards receive a verification letter, a specification sheet, which provides a summary of the test results, and a type approval document. And those are all posted to the Lighting Global website, and the Lighting Global Website acts as a venue for verifying that particular product that meets the standards. So if you're trying to evaluate if something meets the standards, we always recommend that people go directly to the website so that they can be sure that the certificate that someone is showing them is a valid one.

So those are three of the key elements of the program. Just quickly, by the numbers, you can see some of the metrics associated with the program. We've been in operation since 2009 and, at this point, have had more than 170 product models submitted for qualification testing through the program by over 40 different companies. At this point, about 60 products meet the program's minimum quality standards, and over 15 million products that have met the program standards have been sold on a commercial basis, and that number grows by millions each year, so a rapidly increasing number.

In terms of country adoption of pico-solar quality assurance standards, we're now entering a phase where governments are beginning to adopt. In Sub-Saharan Africa, Kenya [sneezes]—excuse me—Kenya and Ethiopia have adopted national standards that reference the relevant IEC test methods and are harmonized with the Lighting Global Quality Standards, and there are national-level programs within Bangladesh and Nepal that also reference those documents.

ECOWAS, as I mentioned earlier, recently adopted a quality-assurance framework that references the IEC test methods and has a set of standards that are very similar to the Lighting Global Quality Standard. And that, as I understand it, just happened last month, and so countries are now at the stage of deciding how they want to—within ECOWAS—are deciding how they would like to link that framework to national regulation. So no enforcement has taken place yet in that framework or in those countries, but we expect that that will begin to happen soon.

And we've also had inquiries about adoption from Tanzania and Uganda and several countries, as well. And so we're entering a phase of national adoption, of standards for pico-solar products that are largely harmonized based on adoption of IEC test methods and the Lighting Global Standards.

Lighting Global recently expanded beyond pico-solar products to include solar home system kits. And those test methods are now in play. Lighting Global is, at this point, testing products on a commercial basis that are submitted by companies.

It says here that six products have met the standards, but I was actually told yesterday that that's very recently been updated. So there are now eight products that have met the standards and are listed on the Lighting Global website. And the test methods associated with evaluating pico-solar products

are in the process of being submitted to IEC, and we expect that to happen fairly soon.

I think, in closing, the key methods that we have within the lighting global program and through our work closely with IEC is focused on the importance of both a rigorous quality-assurance effort but also a harmonized one. Harmonization, I think, is the key for continued growth in the off-grid solar sector across both Sub-Saharan Africa and South Asia.

And "harmonization" I think means not only having programs in countries adopting a single set of test methods and standards. And I think seeing the importance of having IEC at the center of that effort but also making sure that there is mutual acceptance of test results across countries and across programs so that if a company tests their product once at a qualified lab that has the appropriate accreditation, then that product should be in a position to enter multiple markets without having to be retested. Of course, market surveillance should be in play, and so products need to continue to meet those requirements.

But we want to avoid a situation where there are different requirements or different testing required to enter multiple markets. We see this push for achieving a harmonized approach as being one of the key challenges going forward. We think there are good possibilities but recognize it'll take quite a bit of effort to ensure that that happens and also that implementation of standards from country to country is done in a way that allows smooth entry for those that do meet the standards but provides an effective barrier in cases where product does not meet the standards.

With that, I'll close and happy to take any questions when they come. Thank you very much, and I'll pass things back over to the organizers.

Sean Esterly

Great. Thank you, Dr. Jacobson. Very much appreciate the presentation. And also, to the rest of the panelists, thank you very much. We will move right into the question-and-answer session, now. We have quite a few great questions that have come in from the audience, so just a reminder, unless I direct the question towards one particular panelist, this is more of an open-discussion format. So please feel free to chime in and answer the questions.

That being said, the first one is for Vimal. Vimal, the attendee asked, "How can they range of AC/DC supplies and appliances available today be coordinated? It seems like there's no single solution that is the best for all applications. Can there be a universal standard in the future? And do you see any path to getting to this ideal?"

Vimal Mahendru

Yes. That's a tough one, but it's interesting that in IEC data, there's a lot of thinking around creating escalating set of standards, whereby the smallest devices we have, which need very low power to the highest energy, let's say, which is consumed in railways, et cetera, in between, there are several categories of power requirement for doing the job efficiently.

And in IEC, we are coming up with multi-tiered voltage levels in DC, as well as _____ [break in audio] required at a voltage so that the current standards will address that. _____ [break in audio] solution the standards will take at least another two years to come up, and the full set of standards could be even five years from now.

Sean Esterly

Thank you, Vimal. And I'm actually going to stick with you, real quick, for the next one. One of our attendees wanted to know if you had any more details on the World Bank multi-tier model. Is that publicly available yet? And do you know if there's a website that people can access that?

Vimal Mahendru

Yes, it is available. I have the Web link somewhere in my mailbox. If it is okay with you, I will embed it into my slides and send it to you for putting up on the Web or whatever way. I have those documents with me on my system, also.

Sean Esterly

Perfect. Definitely. And I—

Vimal Mahendru

And they are publicly available.

Sean Esterly

And, we could also—we'll put it in the presentation as you recommended, and we'll also e-mail the link out to the attendee after the webinar, as well.

Vimal Mahendru

Okay.

Sean Esterly

Great. So moving along now, this question's for everybody: "What plug-and-socket standard is IEC recommending for portable LVDC appliances?"

Vimal Mahendru

Can I—sorry—jump into this one?

Sean Esterly

Oh, of course.

Vimal Mahendru

It's interesting. I wish there was a straight answer. It is fairly complex. What is emerging right now is that the USB and the emerging USB-C standard, which can deliver power up to 100 watts, may be ideally suited for portable devices, which are up to 100 watts. Anything which is more than 100 watts, right now, there is no standard per se.

I know in pockets in Korea, Japan, Germany, France, in the U.S., there is some work happening. A standard has not yet emerged which will go beyond 100 watts. Two-hundred watts, it seems to me, that the USB-C standard would be adequate as long as it is used for portable devices or even for fixed devices, which are being connected.

Pierre Sebellin

Yep. Yep. Maybe if I can step off into the discussion. I think that the role of the IEC and these groups is _____ anticipate the emergence of global _____ and to try to, I would say, avoid the multiplicity of various national plugs and voltages and frequencies that we have in the AC world, where each one is discussed _____, where uniformization worldwide was not that much a concern. So at that time, the IEC is trying to bring together, through SEG 4,

the main stakeholders about this problematic of unifying and reaching the unique system of DC.

But at the end of it, the IEC is just bringing the people together. And we expect that—and we hope that—we can build the consensus between the various stakeholders, mainly the industries, the users, the regulators around that.

Sean Esterly

Great. Thank you, both, for the response there. Next question is just asking about upper regions for quality standards. They're wondering if any of the panelists have been the insight into work being done in Southeast Asia in terms of assuring quality.

Arne Jacobson

This is Arne Jacobson. I don't know of efforts in relationship—specific efforts in relationship to upgrade solar in Southeast Asia. Most of the activity that we've seen has been in South Asia when it's been in Asia. But there are some emerging discussions around quality assurance in Myanmar and in Papua, New Guinea, but I think those are at a very early stage. There may be others that I'm not aware of.

Sean Esterly

Thank you, Arne. And where can attendees find more details or information on companies who offer testing, verification, and surveillance services?

Arne Jacobson

In relationship to the Lighting Global program, visiting the Lighting Global website, there is a list of test labs that are part of the Lighting Global network and are qualified to provide testing services in relationship to that program. And so in that regard, I think that's the go-to location is the Lighting Global website.

Vimal Mahendru

Additionally, if I may, in India, the Bureau of Indian standards maintains on its website a list of Indian labs which are qualified and accredited for doing lots of testing. It could be for lighting products, as well as for other DC products.

Sean Esterly

Great. Thank you, Arne and Vimal. And sticking with Arne, Arne could you talk a little bit about how the AFSCC and Lighting Global work together?

Arne Jacobson

In terms of that relationship, the main conversation has been through joint membership between AFSEC and IEC. So there are members of AFSEC that are also members of some of the IEC working groups, and so we've indirectly had conversations with AFSEC and AFSEC members about mutual adoptions of standards and have gotten input from AFSEC members through that framework. We've had early-stage discussions about finding ways of coordinating even more closely.

Paul Johnson

Paul speaking. Just to continue that, I've made a note that I think it's probably appropriate we have a formal AFSEC Lighting Global assurance arrangement, and I'll pick up on that offline. Thank you.

Sean Esterly

But Paul, could you speak a little bit? Your volume seems to have gone down a little bit.

- Paul Johnson** Okay. Let me just add... Is that better?
- Sean Esterly** Yes—much. Thank you.
- Arne Johnson** Okay. Apologies for that. I was just responding, saying that I think it's a good opportunity for AFSEC and Lighting Global, actually, to formalize some arrangement, and I'll be in contact offline about that.
- Sean Esterly** And, we're happy to have that conversation.
- Paul Johnson** Great stuff.
- Sean Esterly** Great. Thanks, guys. And next one is more of a comment and observation from one of our attendees. They wanted to thank you for a great webinar and good information and just mention the concern on the approach of international standardization that there's little involvement, oftentimes, of developing countries during the drafting and development of the standards.
- They know that IEC and AFSEC are making efforts to change this and definitely commend them. But however, do point out the need for deliberate strategies to have experts from developing countries involved right at the commencements of the drafting and during the course of the development, as this will make the standards more applicable, especially to developing countries. So just an observation and comment from one of the attendees that I wanted to point out, not sure if any of the panelists have anything to that.
- Vimal Mahendru** Hi, this is Vimal. May I just give a quick comment? I am from India, and I grew up in India. And I've dealt last 25 years with Bureau of Indian Standards, which is tasked with the standards and certification activities in India, and I fully echo and empathize with this comment. The challenge of developing economies remains that there is not enough money to go around to standardization meetings, et cetera, and participate in activities which are all over the world. And second, the experts are required, many times, in the home base to actually do the technical work and the manufacturing and productionizing and commercializing, so it's a real challenge.
- The good thing I see is that countries, economies, are realizing that they cannot do without influencing standards and making them directly relevant to their home markets. I see a very positive shift in India. Thankfully, for the work that I am doing at IEC now in SEG 4 on LVDC, I am coming across several government and standards bodies in different developing economies—Africa and Asia.
- And I must say that I see a general positive movement toward taking standards and standardization activities seriously. So while I echo your comments, but I am optimistic that you'll see more and more developing economies involved in these activities.
- Pierre Sebellin** Now, if I may add that the IEC has a special program for developing countries to support, I would say, their involvement and their engagement into the IEC standardization work. Basically, the IEC welcomes everybody

there, and each country can provide experts. The problem is that, in Africa, the people are _____. It's very difficult for African countries and African industry to provide and support experts in participation into this standardization work.

So anyway, I invite you to have a look into the developing countries program that's called the "affiliate programs," as well, that we have on the IEC website. And I'm really confident that with the development of online tools, online participation through meetings, I would say flying to many places around the world will be less and less necessary. And then, it will be much more accessible and affordable for, I would say, African and developing countries, as well as small and medium companies in developed countries to really engage into standardization.

But everybody is welcome. And we expect, from an electricity access standpoint, really expect to have the engagement of the developing countries into that standardization work. Definitely.

Paul Johnson

Maybe just to add to that—Paul speaking—in relation to the affiliate program that Pierre has referred to, any affiliate is able to select up to ten IEC technical committees or subcommittees and receive the working documents and make comments. And I'm certainly aware that that program is not fully utilized yet, partly maybe because of confidence to use the system and identifying the right people to comment. But certainly, in principle, it's available. The IEC has made it available, and it certainly can be used more.

Sean Esterly

Great. Thank you to each of the panelists for your responses. Another question, just looking for the panelists' input. How can we go about preventing companies from installing microgrids and then not keeping up with maintenance and operation of that?

Arne Jacobson

This is Arne, and I've been involved in an effort that's actually led by Global LEAP and NREL. That has, to some degree, focused on this question, which is saying, "Look, if we're thinking of developing a quality-assurance framework for microgrids and other similar systems, part of that standard should be a framework that involves verification of delivery of services on a truth-in-advertising basis." So looking at what was promised and then verifying, through monitoring, whether or not those requirements have been met.

And so there's been some work that's been done on that so far, and I think there's room to follow through and to finish that. But I do think that focusing on that question of verification of service delivery is a very critical element within microgrids and other similar systems.

Pierre Sebellin

Right. So typically, this is the kind of issues that standardization can help to work on because—and it can bring, really, together experts in that area that would list the minimum requirements that are needed to ensure the maintenance and _____ maintenance of, I would say, the microgrids. I'm thinking about, for example, the possibility of local sourcing for the spare parts and these kind of things.

But basically, all these kind of requirements that are specific for this environment of developing countries can be, then, listed into standards. And then, the regulators and administrations in the developing countries, they can make reference to that standard when they send out, I would say, request for quotations for projects.

So it's really the way the standardization works is we can, when we have these type of issues, we can, then, bring together experts who really have—make up the list, have that voted and approved. And then, the regulators and governments and administrations can make reference to these technical requirements that are, I would say, based on the experience of the group of experts.

Paul Johnson

Paul speaking. Just to add to that, I think the development of the IEC Conformity Assessment System for renewable energy equipment used in renewable energy systems could also help in that it's intended to also cover the certification of installation personnel and personnel involved in the commission of the equipment. And I think if companies are serious about being in business, that can also be put into the technical requirements that personnel are certified in that system.

Vimal Mahendru

Sean, may I give another perspective, which is a little away from standardization, but perhaps pertinent to this question? In India, our experience is that we've burnt our fingers and lots of money on projects which were implemented, but no service or maintenance or assurance of delivery of services down the line after the payments were made. And so now the government has, increasingly, in the last two or three years, come up with BOOT projects—BOOT—build, own, operate, and then transfer projects, where the service levels—service quality—are built into the tendering requirements.

This goes beyond standardization. I think the seriousness on the policymakers and the financiers to ensure that it's not that they're setting up a microgrid or a DC grid or something. It is ensuring that the end service that is to be provided is assured, and that's built into the project itself upfront in the tendering. Those kind of projects we've seen in India have been more successful. So while we need standards, but beyond that, we need the policy framework also, which will enable adoption of such standards and practices, which bring a kind of tendering reforms. Thank you.

Sean Esterly

All right. Thank you, everyone. Next question's for Arne. It asks, "Under the Lighting Global Equality Assurance Framework, what provisions are being made for communicating quality standards to consumers whom have had an increased exposure to substandard products?"

Arne Jacobson

So the communication framework for the Lighting Global program focuses primarily on communication upstream in the supply chain to distributors, to financial organizations, and also to governments that are interested in understanding whether or not products meet the standards. And so in many ways, a good portion of our effort has not been consumer facing, but instead has focused up further up the supply chain. And that has been in part based on

resources because it's much more economically efficient to—or just easier to reach that group and because decision-makers at that point have a very strong influence on the quality of products that entered the supply chain and become available.

With that said, we have some efforts that focus on providing information about quality consumers. That's primarily happened in the context of specific country level efforts in the context of consumer awareness campaigns, which have taken place in countries like Kenya and India. And there have also been activities in Bangladesh and are emerging or ongoing activities in Ethiopia, I think just beginning—or soon to begin—in Nigeria and in Tanzania.

And so reaching consumers with information about quality, I think, is more costly and more difficult to do that effectively than it is to reach other parts of the supply chain. But it is an important part of the overall effort, and that is something that we have sought to do where resources were available to do that.]

Sean Esterly

Great. Thank you, Arne. So at this point, I know we have a few questions from attendees that we haven't gotten to yet. Some of them are specific to certain IEC standards. So I do want to assure all the attendees. I have taken down those questions, and I will e-mail them directly to the panelists.

We're running into our last couple minutes here, so we'll have to move on and wrap up the webinar. But again, I did record all the questions, and we'll send those along so that they can respond by e-mail to you. So we'll move ahead now.

We do have a quick attendee survey for everyone. So if we can go ahead and display that first question, and you can respond directly through the webinar platform. And first question is, "The webinar content provided me with useful information and insight." Please note if you "strongly agree," "agree," "not sure," "disagree," or "strongly disagree."

Great. Then, the next question is, "The webinar's presenters were effective."

And then, third one is, "Overall, the webinar met my expectations."

Great, and just a couple—two last questions, so quick yes-or-no questions: Do you anticipate using the information presented in this webinar directly in your work or at your organization? And then, the final question is policy related. It asks, "Do you anticipate applying the information presented to develop or revise policies or programs in your country of focus?"

Great. Thank you very much for responding. We do appreciate that. It helps us just improve our webinars going forward and evaluate how we're doing. Again, I would like to thank each of the panelists today for the excellent presentations that they provided and for the thoughtful discussion for the question-and-answer session.

Again, a reminder to the attendees, my apologies if we didn't get to your specific question. But I have received those and will forward them along to each of the panelists. So with that, just again, wanted to say we appreciate everyone's time, and I do invite the attendees to check the Solutions Center training page if you'd like to view the slides from today's presentations and listen to a recording of the webinar, which will be available in roughly one week from today's broadcast.

Additionally, you'll find information on upcoming webinars and other training events offered by the Solutions Center and our partners. And just a reminder, we are now posting all webinar recordings to the [Clean Energy Solutions Center YouTube channel](#), as well, and we have a variety of other clean energy topic-related videos on there.

So with that, I would just like to wish everyone a great rest of your day. And we hope to see you again at future Clean Energy Solutions Center events, and this concludes our webinar.

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