Full Transcript of the IEG Event: Has Off-Grid Electrification Come of Age?
February 21, 2017

Jose: Welcome, everyone, and thank you for joining us in this learning event, which is going to be focused on a learning product of the independent evaluation group, a report entitled, "Reliable and Affordable Off-Grid Electricity Services for the Poor." My name is Jose Carbajo and I work as a director in the Independent Evaluation Group in the department that has been responsible for this report. I want to welcome all of you here in the room but also those that are following us on live stream. You can entertain yourself if you like Twitter, as some of us do in this city. You see the address, #goal7, for things that will become evident in my next comments.

I just want to make a very brief comment by way of introduction before leaving the floor to the real experts. Now, there are, by the last count, we are in this planet about seven and a half billion people, so a little bit over 1 billion, 1.1 billion, according to our report, are people who have no access at all to electricity, most of them, the large majority, would be in sub-Saharan Africa. There is another one billion of people who have access to electricity but pretty unreliable. The focus of this report is really on the first 1.1 million, which are people who have no access at all.

You can imagine the importance of access in electricity services. It's one of the critical sustainable infrastructure goals identified in the sustainable development goals. Actually, it's goal number seven. That's the Twitter address, hash goal number seven. Now, the goal, sustainable goal seven calls for is a quite demanding goal because it calls for affordable, reliable, sustainable, and modern energy. It's quite an undertaking, by all for 2030, no less. Which means that this really places a great urgency on supporting low access countries, as I said, mainly sub-Saharan Africa, to move towards universal access in a way that is hopefully commercially viable, efficient, and sustainable.

Basically what this report does is have a look at what the World Bank Group has been doing over a number of years, recent years, and identifies what are the good practices and the good experiences that come of it, particularly to learn from them and address the issue of the scale-up, the scale-up challenge that is embedded in that definition of goal number seven.

Now, of course, I'm going to blow a little bit my horn here. This is a learning event, or a learning product and event produced by my department, independent of ICE group, but it doesn't come out in isolation. We have done all the reports that are linked to this. For example, we did a recent evaluation on the World Bank Group support to electricity access, over the years 2000 to 2014, reviewing the experience.

This learning product also compliments another one that we did recently on financial viability of the electricity sector in developing countries as well. I hope that today the presentation and the debate will trigger critical, productive conversation among us, that will energize the entire room, pun intended, and that we will be able to draw conclusions from the findings of such report.

Just by way of completing my opening remarks, I'd like to thank everybody who belongs to the World Bank greet, so to speak, IFC World Bank, but also our guests from off grid the World Bank, come from private and World Bank sectors. For your time, for being here, to help with your perspectives, your expertise and your experience, and make more helpful the comments and opinions on this report.

Without anything else to say, I'd like to now hand over the podium to Charles Collier, a colleague from the World Bank Group, who is practice manager for the West Africa Energy and Instructive Global Practice. Charles?

Charles: Thank you, Jose. Whoa. Thank you, Jose. Just got electrified. Welcome to this panel. I think you're in for a treat. I see lots of great expertise around the table. I'm looking forward to the discussion. I was asked to make a few opening remarks on behalf of the practice. As we all know, we have the goal of entering full access by 2030. The goal is very challenging. There's more than 1 billion people on Earth right now that don't have access to electricity. The needed pace is about 113 million connections per year if we're going to reach that goal. The banks, traditional access, has been about four or five million per year connections, so we're about 5%, 6%, 5% of, let's say, of the total.

One of the roles of the Bank, of course, is to develop business models and to do learning and to understand how to accelerate accents, and so we have this specific role. We have a lot of partners working on this. I see for all being one, but several other donors working with us, so that's important. One thing I wanted to comment on is when I look at this agenda, one thing that ... The amount of money we need is about 30 billion dollars a year, so huge amounts of money, and we don't see that scale yet. Even though we have that sustainable development goal we don't see the scale of investment yet.

The other thing to say is that affordability, I think Jose spoke about the challenge. Affordability is a key challenge. In Africa, where I work, about 600 million people don't have access to electricity, and in West Africa for instance, half of the people live on less than two dollars a day. Whatever solution we come up with has to be affordable. Seventy percent of the people live on $3.10 a day. Affordability is a real, real key issue.

The good news is that we all know that we're living in a disruptive technology, so solar PV's cost has come down significantly, 60%, between 2009 and 2014. Firstly, from where I'm sitting I find the technology not disruptive enough, meaning that we know costs are going to come down further, but the big issue is

also storage and how do we get access for the night peaks that we have in Africa, is really at night and how to crack that nut. That's a significant issue.

I wanted to say that the Bank, I would say the world, and the Bank being a leader in that, we've done a really good job I would say about the small level of consumption, so the lighting Africa program that we work with, IFC, there's now Lighting Global. If you see that, it's really done a good job at improving the standards and improving the quality of the products out there, and had a significant market penetration. The numbers I could come up with over the weekend was 13.5 million people have access now, and we could scale that up to 250 million people by 2030, so those programs have been fairly successful.

I think the challenge is a bit about the higher levels of tier of access. If you're trying to electrify to build a business and to make sure that hospitals and clinics and schools and so on have access, we're looking for many more hours per day, so up the tier that we've developed. In that case, I think the challenge is still there. We've tried several things that the donor community used to provide, just subsidized access for everyone. We've found that three or four years down the road, those business models don't work, just a pure subsidy, specifically because there's no money for operational maintenance and then the materials would deteriorate.

We're off of that. We've tried several different models. There's concession models that have worked in places somewhere it does not always work. The issue, affordability, is quite there. I'm quite interested to understand from the experts how we can crack that nut. The bank is investing significant ... We have several projects under preparation now. The model we're looking at is quite different. In the early projects that we did, we looked at the barriers, and we found that it doesn't help just to subsidize, but the problems along the value chain is more access to financing from importers of technology and people not having access to financing to be able to pay the connection charge.

We've worked on those types of models, and we have several of these types of projects, but I would say that the storage is not ... The cost of storage is still significant in some places. The business models don't always work, though. Sometimes concessions work, sometimes they don't. Utilities sometimes are good at this, sometimes not. We're going to try several pilots over the next year or two with our programs, and significant investments, several countries, but I'm also looking forward to the discussion amongst the panelists about how do we come up with, what is the delta and where can we improve our impact on access. With that, I'll pass the floor back to IG for the presentation.

Speaker 3: Thank you very much, Jose. I'd like to start by thanking my team members, Aaron Sangri, who is not here right now, Natsu Kotoba, and Katsu Hamaguchi for their contribution to the report. I also want to thank you manager, Madori Makino, my director, Jose, and former director Marvin for their support. Also, to all the

GP staff who were really patient with us when we met with them for their inputs over the last several months.

Has off-grid electrification come of age? We begin by taking stock of the electricity access gap. It's quite well-known that there are a billion people without electricity access. This number has been bandied about so much. It's not as well known that 40 out of the 51 low access countries, those with less than 50% access, are in sub-Saharan Africa. Out of these, about 22 countries have less than 25% access, and seven have less than 10% access. At current growth rates of electrification and population, there would be still a billion people in sub-Saharan Africa in 2030 without access to electricity, and yet another generation in Sub-Saharan Africa could be denied the potential opportunities provided by electricity access.

The World Bank Group's response has been timely and appropriate, along with the United Nation's. It has committed to the sustainable energy for all by 2030 declaration, and the corresponding SDG goal. In its directions paper, it states that grid, mini grid, and off-grid solutions will all be pursued for electricity access. At this stage, it would be good to clarify what exactly we mean by off-grid electrification. This report treats off-grid sources in three categories.

Pico-solar products, these provide simple lighting, cell phone charging, and a small radio. Rooftop solar systems can additionally power a few light bulbs and a small television. Larger kits can serve community centers. Micro grids and mini grids generate and distribute power to several households, and the number of households depends on the size of the mini grid or micro grid. Again, depending on their size, they can support household gadgets like a refrigerator and the productive applications like processing of grain, milling, water pumping, those kind of activities. They can be powered by diesel, which they have been conventionally powered for a long time, or a range of renewable energy sources.

The World Bank's experience, as well as experience outside the World Bank, helps us come to some simple but useful conclusions. Access to even small quantities of modern electricity is transformative for those who are totally unconnected. Over time, but then over time, people's expectations tend to grow, especially as incomes grow. They do finally look for electricity that is of the same level of grid quality electricity. Off-grid options have a crucial pre-electrification role, until grid quality electricity arrives. This dynamic transition from lack of access to pre-electrification, to grid quality electricity, needs comprehensive planning and staged implementation.

The global tracking framework distinguishes between these levels of access. Tier One corresponds to pico products, and all the way up to Tier 5, which is like the grid quality electricity that we take for granted.

We will now look at pivotal achievements supported by the World Bank Group over the last several years. These, just to quickly get a feel of them, pre-

electrification scale-up in Bangladesh, rapid market penetration of solar products lighting Africa and lighting global programs, staged pre-electrification in Sri Lanka, remote area electrification, Argentina, Peru, and the special case of electrifying or providing electricity access to nomadic populations in Mongolia, and many grids and micro grids.

Back to Bangladesh. Bangladesh has well-known experience with solar home systems, essentially responded to the stalling of the grid in the late 1990's. In 10 years, from 2000 to 2010, about three-quarters of a million solar home systems were installed. In the next six years, till 2016, the number rose exponentially to four million. The World Bank played a big role in this, in supporting an autonomous public sector intermediary [inaudible 00:16:15] which developed [inaudible 00:16:16] vendors, provided them with finance, and ensured product quality control and after-sale service.

The products were initially subsidized with donor funds, but ultimately, but over time, these subsidies have been practically phased out to make these products merely commercially viable.

Pico solar products were provided a big boost by IFC and the World Bank through the Lighting Africa and Lighting Global programs. The crucial input that was provided here was to stimulate the market for these products through targeted technical assistance, for quality assurance and service generally. A relatively small amount of resources leveraged a large output or outcome. As a result of this, the IFC and the World Bank can claim much credit for the 14 million or so quality-certified pico solar products. We need to keep in mind that there are several other products that are not quality certified. The essential role that Lighting Africa and Lighting Global played was to give the assurance to the customer that their money gets value, the product that they get gives value for their money.

About 14 million or so, to repeat myself, have been sold over the last several years, making a transformative change in a conservatively estimated 21 million people in Africa and Asia. In Sri Lanka, Sri Lanke, which is a country with higher access, was supported by the World Bank for building or rehabilitating about 268 village mini hydro projects. In a planned manner, 70 of these were absolved into the grid, which is a win-win situation. Those who own the mini grid, the village, it gets a remunerative tariff, and it gets on the whole better quality electricity and greater reliability.

Remote area electrification. Argentina and Peru are high or universal access countries, but they do have remote populations which probably will never get grid electricity, probably ever. Those small percentages were covered by solar home systems using a different model. What's interesting here was, solar home systems here were anchored by private utilities working through private contractors, and the Bank played the honest broker. It not only, I mean, these were true Bank projects, and the Bank, one of the Bank's important roles was to

help in this concessioning process and in designing the whole process, the whole scheme.

The World Bank has supported mini and micro grids in a few countries, Nepal, Sri Lanka, Mali, and Cambodia. IFC's recent review of business models for mini and micro grids concludes that this sub sector holds real potential and merits far greater attention of operating companies, policy makers, and investors.

We now turn to the World Bank's support to low access client countries, for planning and implementing a least-cost, coordinated, grid and off-grid rollout to move towards universal access. This approach was pioneered by the Bank in Rwanda and Kenya, and is now underway in Myanmar.

The first step in this approach is really to develop a comprehensive, least cost geospatial plan. This plan helps to locate and target beneficiaries geo spatially, enables least-cost placement and expansion of electricity access infrastructure, and helps guide a dynamically coordinated, strategic rollout in space and time.

This map is an illustration of this process. The first stage shows the spread of grid and off-grid till 2013, and the next one after 2030. There are of course, there was stages before this. Now, such a geospatial plan, apart from what we just mentioned, helps to anchor a financing prospectus. That is, this plan which reaches out what in space as well as in time helps to anchor a financing prospectus so that multilaterals, bilaterals, and the private sector can draw assurance from such a plan.

Of course, it needs to be backed by appropriate government policies and regulations. There needs to be comfort there. The plan, plus the comfort and the commitment of the government altogether helps different parties to choose and take a slice of the financing requirement. In this, we have highlighted how the European Commission, which is interested in ... I mean, one of its interests is to spread off-grid electrification, picked up a slice for off-grid electrification.

Rwanda, as part of its plan, since the grid was going to progress slowly, decided to install SHS's in community centers, schools, and primary clinics all across the country so that they have something to work with in the advance of the grid. This shows how well this plan worked out. Ahead of schedule, they have managed to provide solar home systems to 100% of schools, administrative centers, and health centers. This may not have been possible without a clear plan.

Now, quickly, we come to the strategic lessons and implications from these experiences, the stand-alone experiences and the experiences based on the plan that we looked at. Putting people first. Time is of the essence. Deploy the most appropriate technology to provide at least basic access quickly. Plan for the fact that over time, almost aspire to electricity services comparable to that of a well-run or well-managed utility-run grid system, and grid and off-grid technologies

and access service delivery. Grid and off-grid technologies are not necessarily either/or options.

This combination can play out differently in different contexts. We already saw some examples, Bangladesh, Sri Lanka, et cetera. Off-grid electrification clearly has a significant role in most low-access countries in the near future. Both the private and public sector have an important role. The World Bank Group's combined strengths can come together for catalyzing and enabling early-stage pre-market development, of which there is already so much experience. Designing the participation of the private and public sectors the way they can work in partnership.

In sum, to answer original question, off-grid electrification has come of age in Tier 1 and Tier 2 categories of electricity access. The viability of off-grid electrification has been proven in many situations and through different varieties of service models, service delivery models. Universal access and low access countries calls for comprehensive national plans, for coordinated off-grid and grid electrification in space and time. Such a national, geospatial, least cost strategic role or plan also serves to align donor programs and to syndicate financing from wider public and private sources.

Thank you very much.

Vivian: Good afternoon, everybody. We're now moving on to the more interactive part of our discussion on the topic of whether off-grid electrification has come of age. While the panel is settling down, I would like to remind you that as regards to the questioning process, we're on a level playing field, so whether you're sitting in this room or somewhere else on the planet, you must employ the same system for supplying questions. We won't be doing the handheld mike, traditional approach. Please go to www.PaulEv.com/IEGnow and type your questions in there, and it will magically reach me in due course.

Let's start by introducing our panelists. On my far right, we're delighted to have with us today representing, if I may say, the private investor perspective on this topic, Ethan Zindler, who's the head of United States Research at Bloomberg New Energy Finance based here in Washington, DC. He leads a team of analysts, researchers, and news writers investigating renewable energy trends around the Americas in particular, and covering also the US Clean Energy Policy developments, so welcome to Ethan.

On my immediate right here we have Sarah Ladislaw. She's director and senior fellow for Energy and National Security Program at the Center for Strategic and International Studies, also based here in Washington, DC. She's a well recognized expert in US energy policy, global oil and natural gas markets, as well as climate change, but has also worked a lot on CSIS's program in other regions, including China, Europe, Africa, and western hemisphere energy issues, so welcome to Sarah.

On my immediate right here, we have Russell Sturm, who's the head of the Energy Access Business at the IFC, where he works with the private sector to mobilize commercial investment for off-grid energy access. Russell is a long-standing innovator in the off-grid energy access field. He's well-known for his work in creating the World Bank Group's Lighting Africa and later, Lighting Global Program, which focuses on innovative business models for energy access.

Last but not least, on my far left, we have Dana Rysankova, who's a senior energy specialist in the World Bank's energy and extractives global practice. Dana's been working for about 15 years spearheading many projects to actually roll out energy access in many parts of the world, particularly Latin America and Africa. Her experience includes Bolivia, Brazil, Honduras, IT, Kenya, Tanzania, and Guinea, as well as also the World Bank's engagement in the Lighting Africa program. Currently, Dana Rysankova handles the energy access portfolio of ESMAP, the Energy Sector Management Advisory Program.

The way that our session will work this afternoon is that we'll have a couple of rounds of questions with our panelists before opening things up to questions for the floor according to the method that we mentioned.

As you noticed, we have in a sense represented on this panel a whole different range of perspectives on the energy access issue. Sarah here has done a lot of work with policy makers and governments. Ethan represents the private sector investment community, and on my left-hand side I have the multilateral development banks, whether it's the public or private sector window. In a first round of questions, let's try and understand the different perspectives and roles that these different players will bring to the energy access issue, particularly the off-grid space.

I'd like to start with a question for Sarah on the issue of policy makers. Do you think that policy makers are taking off-grid access seriously enough? They're used to the traditional approach of grid-based electrification. There are well-established methods for doing this. Are they seeing off-grid as some sort of a side show or are they really taking it seriously now?

Sarah Ladislow: Well, thanks for the question and thanks for the opportunity to be here. I think I have a lot less experiential learning to bring to the table than many of you around the room but I do spend a lot of time talking with policy makers from around the world about what it is that's driving some of the energy decision-making that they're up to these days.

I would say one of the biggest things that always comes into play in the conversations that we're having with countries from, quite frankly, various regions of the world, is trying to manage a couple core variables that seem out of their control, and one of that being sort of volatile energy prices in more traditional markets, especially for oil and where it is applicable, natural gas.

I do think one of the interesting things over the last several years that gets to your question of whether or not they're taking off-grid electricity development seriously has been the level of interest that they are seeing from the private sector in providing those solutions. I think it's a new level of interest that they're seeing, and quite frankly, trying to figure out how do they capture it in the smartest way possible.

I do think that at the core of many of the conversations we're having is this idea that governments are not putting necessarily first and foremost access issues as their only overarching energy priority. I do think that this question of energy access at a stage of development and in a way that is a driver for growth and quite frankly, able to accommodate some of their growing middle class is both the largest area for where they're seeing private sector interest.

If you want to sort of step back on this for a bit, most of the global energy industry and the folks that are purveying some of these technologies, one of their main interests is the fact that many of these communities and countries are going to be the big energy consumers of the future, and they are fundamentally shifted from a place where [inaudible 00:31:29] economies are the ones that they're investing in, the ones that they're looking to make their customers. They're looking to sort of capture this new element of demand. I think that countries that are looking at developing electricity access or trying to figure out how to capture and prioritize all of that private sector interest in the most rational way. Right?

Vivian: Mm-hm (affirmative).

Sarah Ladislow: In a way, I do think that the access agenda is certainly an important one but not the only one that they're grappling with. If it was only people coming in saying, "Hey, we'd like to do off-grid access as the quickest way to electrify at the Tier 1 level access in your community," that would be one thing, but it isn't the only thing that they're grappling with. Which is why I think this question of, and the issue of, geospatial planning and this concept of broader planning about how you can eventually marry those two issues, one, which is energy access for the purpose of driving economic growth and development, and two, energy access for the purpose of getting people the least connected in some way, shape, or form, is a really important element of the debate.

It's funny that the conversation starts with the idea that these two things are not intentioned as an assertion, but it is good to go back and talk about all the ways in which, when you talk to particular companies or countries, they actually do find them to be intentioned. Right? They don't have to be, and they shouldn't be, I think is the point, but as a practical reality sometimes they do find them to either be intentioned or be part of two separate conversations that they're dealing with as they look at their own priorities in policy-making and incentivizing electricity solutions.

Vivian: Thank you, Sarah, that's very interesting. What I'm hearing here, it's not just about getting policy makers to take off-grid access seriously, it's about getting them to take access seriously, period, given that there are many other competing priorities within the energy sector whether it's energy security or maybe just serving existing customers better, many of whom are also having a hard time getting a decent energy supply.

I'd like to turn to Ethan Zindler. As you know, Ethan, we've heard all the excitement, if you like, around the technology revolution that we're experiencing in the off-grid space. I think there are a lot of hopes, high hopes, for this. Yet, on the other hand, we get the sense that maybe things are not scaling up as rapidly. We're not experiencing this huge wave of diffusion that we're all poised to see. Maybe partly it's because we're not able to measure it yet, very well, but what's your take on this? What's holding back the private sector from moving more rapidly on this? Is it realistic, when countries have spent decades subsidizing grid electrification, that now we're going to get off-grid with no public involvement at all? Is that a realistic proposition?

Ethan Zindler: Really good questions, and also, Vivian, if you're capable of keeping up with these questions and these questions [crosstalk 00:34:28], I'm impressed.

Vivian: No, no, someone else is doing that for us, as I should mention.

Ethan Zindler: Because they're kind of rolling through. I'm feeling overwhelmed. Look, in short, I think, I've got to just speak from our perspective. What we do is, we're an energy markets research division of Bloomberg. Most of our clients are private sector clients that basically are interested in clean energy, not necessarily for altruistic reasons, but because they want to make money.

We've ramped up our interest and coverage in this area, again, not just because we think it's important to mankind but because our clients want to know more about it so they can make money at it. I mean, a billion and a half people or whatever the number of people who are off-grid is not just a massive humanitarian problem and crisis, it is also a massive commercial opportunity. Some of the largest corporations in the world are increasingly interested in this area.

Last week we had an event in San Francisco which I know Russell was at, and we had about 50 people there. Representatives of some of the biggest power and oil and gas companies in the world were represented there because they want to know more about this space. I take that all actually as a very good sign. Certainly we've seen more pure, private capital flow into this area in the form of private equity investments, over $200 million last year alone in investments in a variety of startup-type companies that are out there trying to do this.

I think the interest is growing. I think it's not just those who are totally off the grid. It's also those, I don't know what the number is, a billion people who have some access to a grid but it's not a great grid and they want to improve it, and they want to have better energy experience generally. The opportunities are there. I would say we're seeing growing interest. I would say this that it's, one basic point which I think the speaker earlier made, which is that the size of the challenge is so enormous that there doesn't have to be one answer to this.

There's nothing mutually exclusive about wanting to support grid scale projects and the distribution of pico scale lanterns, and everything in between - mini grids, micro grids, whatever it is. There's plenty of room for everywhere. Similarly on the financing side, there's opportunities for pure private capital. Then clearly there needs to be capital from multilateral institutions as well that come along and play a role also.

I guess I would say we're just getting started in many ways. There's just clearly need for more capital, which we hear from various players for various types of things, but there's a great deal of growing interest which I think is a very positive sign.

Vivian: Mm-hm (affirmative). Thanks very much. I'm hearing that you think that there's a lot of money coming down the pipeline. It's just beginning to get started, is what I'm hearing.

Ethan Zindler: I think we're beginning to get started. I think, like with everything, that investors are going to look for opportunities where they feel they're going to earn a decent rate of return on investment and that there's a certain amount of certainty around policies and policy structures, and tariffs, and things like that. Those are all works in progress, to be clear, but there's a lot of people who are kind of looking around and are interested in this area and want to make more investment.

Vivian: Key issues are the prices, and we're actually getting quite a lot of questions on affordability, and sustainability, and tariffs, so we'll come to those in a moment, but also the regulatory environment. Also, the regulatory environment. In fact, last week we launched a product called Rise that looks at the regulatory environment both for grid and off-grid access. We found that about half the countries in Africa had barely begun to develop a regulatory environment for off-grid. I think that really points to the need to make progress in this area. I'd like to turn now to Dana Rysankova, who I know has been very much engaged in looking at the World Bank Group strategy, or the World Bank strategy, on energy access. I know you took a look at how we were doing in the past, what the approaches have been. You've been helping us to shape our position for future engagement. What have you learnt from looking at how we've engaged and how do you think it's going to change over the next few years?

Dana Rysankova: I think it's already changing. I think what's interesting, what has happened in the recent years. I do agree that the governments don't always prioritize energy access as the first thing, but I definitely see more interest in governments taking the universal access to energy services goal as more serious than before, now being [inaudible 00:39:02] goal. That opens a way of different thinking because I think in the past they all had some kind of universal access targets, but they were totally, mostly totally unrealistic, and mostly didn't consider off-grid solutions.

I think now seeing the pressure and increasing competition among themselves about reaching the goal, and also seeing what has happened in the recent years on the technology side and business model side, that the off-grid solutions actually are spreading out. They are beginning to consider them more seriously as a part of their official government programs. That's important for us as the World Bank, because we, being an institution that lends to the government, governmental clients, we cannot decide our strategy is to do more off-grid as much as many would like us to say that. Our strategy has to be related to the government strategies.

We see increasing demand from the governments to borrow for off-grid, and were, for example, in 2010, if you look at our access portfolio and access meeting here in this context, just that last month, the grid connections or off-grid. We had about a quarter of our lending in off-grid. Now, it's about half of our portfolio is in off-grid. There's definitely a trend towards increasing of our lending for off-grid solutions, and definitely an increasing demand from the government to borrow. That creates sort of new types of challenges, because of, and just following up on the presentation from IEG, there is an opportunity to integrate too in planning but it's really, really hard to do because on one hand you have this sort of top-down grid electricity planning.

The good example of Rwanda, Kenya, and other examples where these least cost, geospatial plan was developed, that's very positive, but what we often see is that if you look at the least cost, yes, over a very long term, the grid actually may be the solution. Often at least very small portion for off-grid. That doesn't take into account whether it's realistic to develop the grid at the pace as it is. The tools are good only as well as they are used.

The other issue that we see is the government often maybe confusing a little bit the issue of equity and affordability. With the idea of being concerned about affordability, they say, "Oh no, but off-grid users shouldn't pay more than the grid users," and that basically creates conditions where off-grid is no longer a possible solution because it just doesn't work. They say private sector should charge as much as the national utility, but that doesn't work if you don't have access to the same long-term subsidies, as well as the economies of scale of the utility.

As a result, people get fewer services rather than more services. I believe that our role, of the World Bank and other development partners, is really to help

governments to help navigate in this new space, where on one hand they continue with the grid program but there is this opportunity for the off-grid, and integrated in a smarter way in some way that basically allows private sector to operate and to get to the universal access faster.

Vivian: Thanks very much, Dana. It's very exciting to hear that the World Bank's energy access lending is already about 50/50 between grid and off-grid. That indeed represents a huge shift. Can you give us a little bit of an insight, follow-up question here. When countries are borrowing for off-grid, what are they actually borrowing for? Is it subsidies for the systems? Is it more about putting a framework in place? What does that public money actually go to when companies borrow from us for off-grid?

Dana Rysankova: I think it varies, and it's also evolving. In the past, most of our off-grid portfolio were two types of projects. One was Bangladesh, per se, because this was a very large project, and it was a very unique model that was based on micro financing. Basically then our lending went into on lending to the microfinance institutions to finance the systems for the household, and the household would pay back to the microfinance institutions.

The other part was very much in Latin America, Argentina and Peru were mentioned here, where really our focus has been on the last mile of grid electrification. These are countries that have reached 90% plus access typically and are looking for the last 5%, last 3%, and often have been using type of concessioning approaches. There, actually the bulk of our support would go into subsidies, because it's really to reach the most remote. Now, with the new type of projects, and increasingly we have an increasingly higher share of African countries borrowing for off-grid, it's a mix.

As Charles has mentioned, we have learned that when you talk more about pre-electrification or when you need to really reach masses, the subsidies on their own really is not the best way to support. I think it's two things. On one hand, we're looking at how to sort of help governments to set up frameworks that work, so it's more on the technical assistance part. Then it's financing, but financing not necessarily being subsidies and much more looking for ways how we can channel our funds through, for example, local financial intermediaries so that we cover the gap that often in the countries exists that the off-grid companies, often being startups or SMEs, have very difficult times to get access to finance.

Basically covering the access to finance gap that often includes a combination of lending, sometimes even equity, and some grants, but grants mainly related to sort of development of sustainable private sector rather than grants to subsidize the users.

Vivian: Thanks very much, Dana. I'd like to turn to Russell now, and I'd like to understand specifically the role of IFC in the energy access space. How does it complement

what the World Bank is doing? How does it maybe bring new perspectives and new approaches, and what can we learn from IFC's engagement today?

Russell Sturm: I guess the insights that drive IFC's work in this area is recognizing that the kind of scale that we're talking about doesn't happen unless companies make money. That's the engine that drives commercial investment. It's the engine that drives innovation. It's the engine that creates incentives to actually reach this target.

We view the vehicle for achieving energy access is the private sector, inevitably. Everyone uses that as poetry but what that really means is that the conditions have to be in place that create a, and I'll amend what Ethan said, it's not just return. It's risk versus return. There's a distinct public sector role to address risk, create certain conditions that enable investment.

It's often challenging, just a sidebar observation, that we treat energy access as a special needs child. We want to see that happen, but we're operating in environments where fundamental macro-economic issues are profound. Right now, there's a lot of interest in the access community around Nigeria. It's very difficult to address energy access in a context where you have depreciation of the currency by 50% in one year. That just puts the kabash on everything commercially that's happening, and sets that back. It's an observation.

Back to the answer to your question, it starts from the understanding not just that the private sector is the key to achieving scale, but also that there is an existing functional market. It's a dysfunctional functioning market where the poorest people on the planet are paying the equivalent of $100 a kilowatt hour for their lighting services by having kerosene from a can, but that's an existing market.

Where we came into this space was recognizing that just on the horizon, and now coming at us, were technological innovations that made the incumbent technology obsolete. Essentially what we did was we characterized this market and went to the companies that had the technology and said, "By the way, you have LEDs. LEDs are able to convert a small number of electrons to useful light. I'm going to show you an income industry, $30 billion a year being spent for kerosene that goes in this can with a wick in the top, and this is the level of services these people get."

When the people that had technology saw this market, they were all competing to sell to these guys and to these guys, and to automobile manufacturers, that was the LED industry, and saw that there was this incumbent industry that Exxon Mobil controlled that they had a superior technology for. Essentially what we did was we said, "What do you need to lower your first mover risk to come into this space?" That became Lighting Africa.

The partnership, really, with Dana and before her with Enil Kabral was around the Bank's desire to be relevant and ahead of the market, and then a

collaboration of trust where we started to learn that there's certain things IFC's dysfunctional about and Dana and team could fill that void, and there's certain things the Bank's dysfunctional about, and I could maybe move quicker. For example, this sort of work, this market development work, requires patience.

We had to hide from management very often to do what we were doing because there wasn't a lot of patience, honestly, and boots on the ground, and people to work with companies. IFC can hire people to do advisory work. The bank has certain metrics around volume versus people, because the business is to lend at its core. That's what we do. That's what we've tried to do, and we continue to look out on the horizon for where the emergent technology is.

Reference was made in the opening about storage. Storage is the frontier where I think the conditions are here now that were here nine years ago with LED, solar, and storage, and to address a market where people have grid access. They say they have grid access but it may be for 10 hours a day.

You have a similar set of conditions where the price of storage fell 40% last year because of big volume manufacturing for automobiles. This drives a coincident opportunity to address the incumbent market where people are using diesel gen sets. Similar set of conditions and we're looking at it the same way.

Vivian: Thanks very much, Russell. You made a very fundamental point there. You said this is going to take off when companies can make money out of it, that it's just that kind of commercial viability that's really going to make this go. At the same time, we've got a lot of questions coming in from the audience around affordability, tariffs, sustainability.

It seems to me that on the one hand, you have to recover costs to create that profit margin. On the other hand, you have to provide a service that's affordable to these very, very poor populations that Charles was referring to. As technology drives costs down, that reconciliation becomes ever more within our reach. Are we there yet? Are the current costs affordable to customers and can they at the same time provide enough of a profit margin to detonate this commercial wave that you're discussing? I'd like to open that question to any panelist that wants to come in.

Ethan Zindler: I would say yes, but, in the sense that, just to build off Russell, totally agree with what Russell said, and Charles gave figures on solar through 2014. I'll give them through 2016, which we've seen the PV costs come down 90% since 2010. They were about 40 cents per watt at the factory gate from China. Now, it used to be $3, $4, $5 a watt not that long ago. On storage, we're at about $275 per kilowatt hour down from a $1,000 just four or five years ago. There's major progress being achieved.

The good news, bad news about renewable strategies generally, and this really applies well beyond the off-grid space is that, the good news is that there's no

marginal cost. Once you've put it in place, you don't have to buy fuel for them. They operate themselves. The bad news is that means that all the cost is up front. You have to put the system in, which means you need capital. Yeah, once you, if you've got a diesel generator you have to just keep buying the diesel. That sucks, and the price can go up and down, and all the negative effects that come with it, but your monthly fee is relatively small.

If you then want to convert to a PV system, that might require a bit more upfront capital, and that is really where finance is so critical to all of this because the cash has to basically come, generally speaking, up front when you want to make the switch over to clean energy. The good news is that the economics definitely do pencil out. For instance, one example is in India. I'm just looking here, our chart, looking at our rooftop level of electricity is about $110 per megawatt hour. The actual average commercial tariff in most cases in states there is well above that. You can beat with solar, but you need to finance the system first.

Russell Sturm: If I can draw a line from Ethan's point to what the bank's role can be now, so innovations in this space, it's happened so quickly. We were working with the notion of a solar light, and now a lighting global quality verified products go up to 350 watt systems. Just like LEDs allowed conversion of a few electrons to useful light, we now have 17-inch, eight watt TVs. No longer is a 60-watt system required to a do a crappy little black and white TV. We're talking about computers, TVs with 15-watt peak capacity. It's profound and that affects affordability.

Ethan made reference to financing. The other innovation has been around business models for delivering. Recognizing that first cost is a barrier, but that it is profoundly competitive against the incumbent technologies, whether it's diesel or kerosene, or crappy grid. That businesses have come forth with a variety of models, often deploying partnerships with mobile telecom, riding that horse that's already penetrated to do pay as you go type of models. Essentially imagine a virtual pre-pay meter, using mobile money, to enable a solar system to operate that you are paying for use of on a daily, weekly, or monthly basis.

All of the investment that's happening in the sector is in the pay go sector, where there's immense opportunities on the upside, and this is allowing affordability. The dotted line to the Bank group is new industry. Wall Street doesn't get it. Wall Street doesn't understand the risk profile of this, just like they didn't invest in mobile telecoms 15 years ago because they were analyzing mobile telecom companies just like they would AT&T, but it's a different business. This is a different business that's never existed on the planet before, so it requires an entity like the Bank Group or some other third party that has an eye on the development impact and recognizes there's this interim stage where some sort of risk-sharing has to take place to enable these companies to prove themselves and become commercially fundable.

About $270 million of commercial and quasi-commercial investment in these companies last year, and it's not a bad first start, but what could happen with additional investment if, alongside that, was some public money taking a first loss in these things? Not at a level that creates moral hazard or that crowds out the commercial investors, and we've seen that happen, but where this is a tricky role because we're intervening in markets, but it's a critical one to reach scale quickly.

Vivian: Did you want to come in on this, Dana?

Dana Rysankova: Yeah, I just would like to add maybe another element of affordability, and that is, I think if you look at the range of the solutions that today exist that really are from very basic, small, solar lantern that can cost less than $10, to all these more sophisticated products, you find basically always a product that can, price-wise be comparable how much people are spending now for the solutions. That assumes that for maybe some households a lantern would be a solution.

Often, what we see, when the governments have these universal access roles, and maybe we are responsibility because we established the tier system, that they say, "Oh, it has to be at least Tier 2, or it has to be Tier 1," obviously as much as is happening with reduced cost, these sort of higher value systems are not affordable to everyone. I think there is affordability as long as it is acknowledged that some households will need to rely first on smaller systems, and that includes lanterns, and maybe grow to the bigger ones over time.

Vivian: That's a very important point. We're saying, it's affordability of what? We have now this vast menu of things that really could potentially cover every pocket, in a sense. Not only that but we have parallel advances in energy efficiency that mean the appliances need less and less energy, and when you put the two things together that's really quite powerful. There's a couple, I think, of very interesting points that came out of the last few remarks that I'd like to pick up on.

We heard that really affordability is about affordability of upfront costs, because there's no recurring tariff, so that it all comes down to the financing mechanism. We've heard that Bangladesh did it with microfinance, but the new tendency is pay as you go. Can you tell us a little bit more, can we hear a little bit more about pay as you go? Why is this making such a difference vis-a-vis more traditional microfinance solutions, and is this potentially going to be the thing that makes a difference?

Russell Sturm: Since I let the cat out of the bag, I'll also be a voice of sobriety on it, because while it's been the focus of investors to the exclusion of investment in cash sales type businesses for solar off-grid, because the upside is so good, it's also ... The precautionary tale is these are very, very complex businesses. They tend to be vertically integrated by the startup companies that are doing it, but they're functioning as banks, as service companies, as manufacturers, as designers, as distributors, as the whole gamut. It's an immature market. I think when we

worked with Bloomberg to make projections about the next five years, where the market would go, the vast amount of energy access, Tier 1 and Tier 2, we projected still to happen from cash sales businesses or some sort of variant of that.

EMCOPA is the leading business in the market. They work for three or four years under the cover of darkness before they started to actually execute their business. Now what you have is investors coming to the market leaders on manufacturing and saying, "You can have $30 million of investment, but by the way, use it for pay go. Go invent your pay go business." If our expectations are that these are going to flip overnight and deliver energy access overnight, I think we're a little misguided.

Ethan Zindler: Just one thing to add on it, and I realize I'm the one who made the point about the high upfront costs, but actually one of the interesting things that's going on and sort of the threats to some of the players who Russell knows so well and are certified, is that there's a lot of activity going on out there that's uncertified. There's all kinds of Chinese-made solar lanterns and other equipment that are out in the market now, probably just as easily the same volume that we've been tracking. More than double that is out there. Sorry, 100%, the same amount or more is out there that we can't really keep track of. That is just collapsing prices.

There is the risk to the pay as you go guys that they've got a good thing going with a client who's supposed to pay this system off in, I don't know, a year or two, and then that person is just like, "Oh wow, I could just go buy a much cheaper Chinese product for a lower cost." That is definitely happening out there. I think that's the risk, on the business side. In terms of doing good for the world, the proliferation of this stuff is fantastic provided that the equipment is of decent quality and functions and delivers what it promises.

We have certainly less certainty about that if it's not been certified, and that's really been part of what Russell and the Global Off-Grid Lighting Alliance has tried to focus on as well. There are those questions, but it is a hopeful sign, in some sense, and I guess it's just back to the original question, which is, can you make money trying to serve these markets? Well, clearly there's a number of Chinese players who think they can just sell this stuff out there and that that's a good business model, and it seems to be working for some of them.

Vivian: Another interesting question that came up in that round of responses was to do with the public, private leveraging, or bringing together the two sources of funds. Russell, I think you alluded to this issue of the first loss approach. I'd like to hear a bit more about that. Dana, you alluded to credit lines as being another channel for public money to go in. What is the state of our understanding on this? What are the best ways to marry these two sources together? Again, it's a question to any of the panelists who wants to come in.

Dana Rysankova: Maybe I can just give an example of what we're doing in some of this new generation of off-grid projects, and why we are coming in. I think we don't have to finance all off-grid in everywhere. In some cases, I think the private sector money is just much more efficient to come in than the World Bank. I think we're looking at the places where the private financing doesn't go. This can be for segments of the market within a country, or for a country that is just not as attractive for the private sector.

Giving two examples that I'm involved in, one of them is Kenya, where Kenya is known as being basically the most active solar off-grid market. One would say, why does the World Bank have to come and finance off-grid companies? But we got a request from the government, and the government being, we are really serious about universal access. We know we have this dynamic solar market, but the off-grid companies are really focusing on areas that are relatively densely populated. In a sense they are the same areas where we focus on with the grid extension, so it's nice that the users have a choice between grid and off-grid, but how do we actually get access to places that are really remote, and much poorer?

We're developing a mechanism that consists of some grant financing and some loan financing for the companies to expand into more remote regions. The grant financing is there to help them to set up the infrastructure and the sales infrastructure, and to compensate them for actually going into these more remote regions and make the two areas hopefully equally attractive, and then loan financing to help them with inventory financing as well as for the pay go companies to extend the financing to the consumers. We're basically using the World Bank funding within a country to go to the areas where private sector doesn't go on their own.

The other example is Haiti, which, if it was in Africa, it may be actually a more attractive market, but it's not in Africa. In addition, it's a fragile state with a very difficult political situation. Again, it's very difficult. There are actually companies who are trying to operate in the country, but they cannot get any financing because the local financial markets, and when they go to the international donors or private financiers, they tell them, "Oh, if only you were in Africa, I could actually finance you." We're setting up a fund that could compensate them for being in Haiti, and a fund that can finance equity investments, loans, and limited grants for this country that otherwise, it's very difficult for the private sector to get any access to finance.

Russell Sturm: If I can do my cautionary tale thing again, I'm weary, very often, when we use public money in an emerging private market. I think we are not very nimble with our tools, and often it can lead to crowding out the private sector. It's important to, I think, use the same principal that I mentioned IFC tried to do in our starting point in getting into the sector, which was recognizing that private sectors, what we're trying to catalyze, it exists without us. The same can be implied to financial markets.

The solution on financing requires the access to local currency financing. It's not something we as the Bank Group can do well in all of these countries. Local currency financing in Madagascar or Rwanda is difficult with swaps, and it's expensive. Essentially, the end game we seek is that local banks in these markets see this as a viable market and are able to provide local currency financing. Otherwise, we get into situations where we're loading up startup companies with currency risk that will implode them as soon as you have a depreciation like you do in Nigeria.

It has to be local currency financing, and for it to be sustainable it has to be local banks. I think the conversation really needs to be with those banks about this being an emerging market. What do they need in order to enter the space? What sort of risk tools can we provide them that allows them to begin to get their feet wet, get comfortable with the new asset class, and take off, and then we ride off into the sunset.

Vivian: Okay. Any further interventions on that topic?

Sarah Ladislow: Can I just -

Vivian: Yeah, Sarah, please.

Sarah Ladislow: Very quickly. I mean, I think one of the important - two, maybe just two small points. One is, I think the idea that there is a private sector out there that is interested in these opportunities opens up an opportunity for development organizations that have been engaging with the governments and have hidden impasse on what they're willing or capable to do in terms of their centralized planning or their regulatory structure, or any of the other programs they were already engaged in because they see this as a new competitive dynamic they think they don't want to lose out on.

In a way, off-grid seems to be unlocking a conversation about the larger planning around electrification wholesale, which I think is a great opportunity for everybody to look at what the art of the possible is, even if we haven't solved that question between on grid, off-grid, and how you actually merge the two and make that transition.

The second thing I find really interesting is the access conversation has all of the attributes that we talked about at the beginning, which is affordable, reliable, sustainable, all those sort of things. When you get to the brass tax of having the conversation, it goes right back to affordable and financable, like just immediately goes back there. I think it's important to recognize that sometimes when we're having this conversation about centralized versus off-grid, there is that big sustainability portion of it where there is a preference among some in the donor community or some in the private sector to be incentivizing the

generation of things that are more renewable in nature or higher efficiency in nature.

That isn't necessarily to say that we should just own the fact that there's this big controversy over whether it should be fossil-based or it should be renewable-based. We should understand that that is actually a dynamic that's out there in a lot of these conversations, and is actually one that drives a lot of the off-grid interest, which is if you can make some of these micro grid opportunities work in some of these settings and you can drive the cost down, it's actually quite important for the larger vision of some of these companies as well. There is that broader strategic dynamic there too for them.

Vivian: [crosstalk 01:08:15].

Dana Rysankova: I just wanted to react quickly to what Russell said. First of all, I completely agree, but I think it's a bigger point here, that the opportunity of the public sector finance is to fill in the gap and do the things that would bring in the future private sector finance, right? It's not necessarily that the two has to go hand in hand forever, but how do we use the public finance in areas that private sector is not yet in, but do it in a way that it doesn't prevent them coming in.

I think that is the key role. The local currency lending is one area. The ones that I mentioned, going into areas that are just not yet attractive, but doing it in a way that we could demonstrate that this can be an attractive investment for the private sector in the future. I think that that's sort of the key.

Vivian: Important to marry those two perspectives and keep the public sector's role always as a catalytic role that's pointing towards a longer-term private sector sustainable solution. We have another cluster of questions that are around the topic of grid versus off-grid in the planning. How do you define where one ends and the other one begins? What if the grid comes later and you've already invested in the off-grid? Is the off-grid really sustainable, people are asking. Do we have evidence that these models are actually sustainable from a maintenance and operation perspective as well as a financial perspective.

People are also asking quite a lot about the technologies that are being used. To what extent is the off-grid now largely renewable or not, coming back to Sarah's point about the fossils versus renewables debate, and are there other sort of path-breaking technologies that are going to further ease development in this space. Again, I'd like to open that to anyone on the panel who's interested.

Ethan Zindler: I'll just chime in for a real quick second and say, in terms of the technologies, certainly as I mentioned earlier we're starting to see battery storage, really the prices have come down substantially, seeing players, even Tesla in one case and others around the world who are getting out. A company called Fluidic the other day raised money. It's a via Scottsdale, Arizona based company to do mini grid projects around the world. Typically, I would say most commonly, it's storage

partnered with PV, but there's some partnered with wind as well, and other technologies, and that's starting to happen.

I think to your first part of your question, which I think is an important one is, what about ... What happens when the grown-up grid starts to extend out and eventually starts to connect with the mini grid that's been built some place? What happens then? I think that, for the private sector perspective, is a really important question because ... That's where this issue around tariffs is really key. It's not just that you should be able to charge a tariff that allows you to earn a decent rate of return when you build the mini grid, but you should also be assured that you can keep that tariff if and when the mama grid extends out and attaches and connects to you.

What an investor can't have is three years in, when the main grid arrives, suddenly have to go down to the existing lower tariff level and see the returns disappear. That kind of long-term assurance, now I'm kind of getting into the technical aspect of this, but that's an important point, I think, for investors who are looking at these opportunities.

Vivian: Thanks, Ethan, and you're really reminding us that that tariff issue is both an equity issue but also a financing issue. It's a very trick thing, because as Dana said, it can be tempting for governments that want to have a unified tariff because why should a middle class household in the city get it for cheaper than a poor rural household, but you do have to be cognizant of what happens when these two worlds start to intersect. Were there any other points on this issue from other panelists?

Dana Rysankova: On the grid and off-grid planning, I think it's still sort of an emerging methodologies that are being put together. There are a number of geospatial planning tools that are able to compare grid and off-grid, but I think there is still learning to do it in a more efficient way. Partly because often there is an inherent sort of bias to the grid for a number of reasons, one of them being that the off-grid solutions, often they improve services to people by improving energy efficiency and that doesn't come across when you're comparing kilowatt hours produced. Partly because there is just so much development that is happening that is increasing this efficiency or using costs over time. How do you factor that in?

I think there is still a lot to do to improve this grid, off-grid comparison in those least-cost plans. There was a question about sustainability, do we have the evidence that off-grid solutions are sustainable? I think we do have evidence that they can be sustainable. Do we have evidence that they are always sustainable? No, but we can say the same thing about the grid. Do we have evidence that people who have grid connection have sustainable service? No, because sometimes they get grid connection. There is power. A year after there is no power in the grid connection. I think in both cases it depends how well the

programs are being done, how well the, both grid and off-grid is managed so they can be sustainable. Obviously that doesn't necessarily mean that they are.

Russell Sturm: I think it's important to note that it doesn't matter whether we prefer renewables or non-renewables. It doesn't matter if we are thinking the grid or not grid. This is an incredibly dynamic market right now. The way electricity delivery services will look in 10 years, we could write down on a piece of paper right now, all four of us, and we'll all be somewhat right and mostly wrong because the pace of innovation around appliances, productive uses ... When refrigeration efficiencies start to make cold chain available with renewables, but also just this integration of these different models. Distributed solar, mini grids, and utilities. Such a blending there of what's happening in these markets.

What's affordable is, there's so many segments of the market, so many different types of service delivery, that hybrid everything is really the reality of the future. People currently reliant on diesel gen sets for backing up a bad grid probably won't throw those away. They'll buy storage. They'll buy solar. Then they'll use the diesel at the peak to, and it will operate a lot more efficiently, because they'll run it at its highest efficiency. You'll have optimization enabled by intelligent systems.

It doesn't have to be a smart grid. It's hard to imagine a smart grid in a situation where a grid doesn't work half the time, but intelligence in the grid system and what all that looks like is so different, and these simple little lines we're drawing calling this mini grid, this solar, and distributed solar. This pico. These are artificial lines that are disappearing fast.

Vivian: Okay. I've been asked people in the room an opportunity to ask a question directly, where we've got a few minutes left. If there are any burning questions in the room that maybe we haven't done justice to in the conversation. I don't know if we have a roving mike or whether we should ask people to come up to the podium. Is that right? Is anyone from the floor who would like to raise a question for the panel?

Speaker 9: I've done such a good job.

Russell Sturm: The questions coming in are so good.

Vivian: Yeah. We are actually drawing on the questions very much. In that case, I would maybe like to leave a final question with the panel, if I may, which is to do with the whole issue of productive uses that's often discussed in the context of off-grid electrification and electrification more generally. The idea is to create this financial sustainability of the service, you need to give people maybe support to actually figure out what to do with electricity, how to put it to good use, how to use it in businesses, for livelihoods. I know that's been one stream of efforts that takes place in this space. I'd be interested to hear from our panelists any views

about how to support productive uses of energy. Ethan, did you want to comment?

Ethan Zindler: I'm going to pass on that one. It seems to me that every time you give people some kind of energy access, they pretty quickly sort out what they want to do with it. Usually it's charge a phone, get some refrigeration. Sadly, watching TV seems pretty high up the list also.

Russell Sturm: It's just happening, and so one of the more interesting companies that we're starting to work with is applying pay as you technology for solar irrigation with pumping, for agricultural purposes. Then you have productive uses emerging with hair barbers and hair cutters. Also, if you just think about what we saw happen when people got a solar light. It was a psychological flip. Previously, they were the other, and they would walk past peoples' homes that had electricity, and the self-perception was, "That's them. This is me. My world is dark, and I'm going to go by my kerosene."

What you saw was a flip as soon as people actually started having modern light, and the modern phone charging. Aspiration and innovation kicked in. The businesses and the applications of the energy became more and more obvious and more and more adopted. Again, I go back to what I said really about the future of the grid and then non-grid. It's happening at a pace beyond highly educated people sitting around a table conjecturing. It's just happening.

Dana Rysankova: I would like to disagree a little.

Russell Sturm: Okay.

Dana Rysankova: I think the productive uses sometimes happen, and sometimes don't happen. This is, I think, what the evidence that we sort of have, is when people get electricity in some cases suddenly you get all these businesses emerging, and in some cases don't. There is something else that is happening. Often it is related to, often in places where there have been already some activities, people realize that they can do them better with energy.

If this was a sleepy village and nothing was happening in the village, it's unlikely that getting electricity will necessarily get something started. I think what is important to also address, one misconception that often one hears, and that's you need grid or at least mini grid to support productive uses. I think there are lots of productive uses that can be supported with individual systems.

Now that we're moving to having a range of systems, having these larger systems, having companies actually developing the productive uses for DC power to appliances that can be used productively for larger systems, it is no longer true because, again, it doesn't make sense then to develop a mini grid somewhere just to hope that because you have a mini grid you'll get productive uses. I think what you need to look at is what other loads do they justify the mini

grid, and if not, if you have 100 households that will be using power just for lighting and you have one productive use, maybe it's more efficient to use individual systems.

I think that's the other thing also that is important to have in mind in this continuum of option that Russell mentioned. There are just many more opportunities now, and we don't have to say productive uses equals grid or mini grid. I think there are increasing opportunities for productive uses with individual systems as well.

Russell Sturm: I think the IEG slide that showed neatly Tier 1 and 2 for solar home systems is obsolete, or will be in 10 minutes. Just like the units sold, as of January, December, we're now at 24 million lighting global quality verified products, not 14. That's not because your data's so outdated. It's because things happen quickly and that the proportion of larger systems, the growth has all been in larger products. The proportion that were just solar lights is diminishing and diminishing.

Vivian: Very good. I think the time has come for me maybe to make a couple of final remarks and wrap up the session. I'd first of all like to thank very much IEG for the great idea of using the launch of this report to host an interesting discussion on, I think, a very relevant topic. I'd obviously like to thank our panelists for bringing their diverse perspectives to the issue. Russell has already said that anything we say today will be 90% wrong tomorrow, so I don't want to be on the record with my closing remarks.

What I'm hearing is a very lively and dynamic space where a certain number of debates and tensions are being played out. We heard about the whole grid, off-grid, where is the frontier, how to use planning to map out the frontier, how do we ensure that when the two come together that it's a harmonious transition and it doesn't leave people with stranded assets or unremunerated investments. That was one whole area of tension.

We then heard about the whole issue of public versus private finance. Maybe you do in these remote segments, but at the same time you have to be very careful that you're not undermining a future private area of enterprise, because as we heard from Russell, it's when the private sector finds us viable that this huge wave of diffusion that we're all equally anticipating will finally materialize.

A lot of tensions and dynamics around that public-private finance space. Then the whole issue of tariffs. We have this tension around affordability and viability. How do we get this right? Is it by going for ever smaller systems, because the technology is so smart that we can deliver a smaller and smaller solution to where it fits your pocket? Does the state still have to kick in? What about the equity issues between subsidies going to the grid versus the off-grid space?

Clearly, another third area of tension to name, but three that stood out for me from our conversation. This is a topic where, as we heard, things get obsolete very quickly. We'll all need to stay tuned. I think for the time-being, it's great to have IEG's pronouncement on the subject, and to hear this very kind of balanced view of grid and off-grid that IEG is putting forward. I think that's really a very sound place to strike the balance in this conversation. Thank you very much to everybody.