

The Rapidly Emerging Off-Grid Solar Market

—Transcript of a webinar offered by the Clean Energy Solutions Center on 20 April 2016—
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Webinar Panelists

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Gaurav Gupta	Dalberg Global Development Advisors
Matt Jordan	CLASP

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Stephanie Bechler Hello everyone. I'm Stephanie Bechler with the National Renewable Energy Laboratory. And welcome to today's Webinar which is hosted by the Clean Energy Solutions Center in partnership with Global Lighting and Energy Access Partnership, and Lighting Global. Today's Webinar is focused on The Rapidly Emerging Off-Grid Solar Market.

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

Before we begin I'd like to go over some of the Webinar features. For your audio we have two options. You may either listen through your computer or over the telephone. If you listen through the computer please select the mic and speakers option in the audio pane. And if you choose to dial on by phone please select the telephone option and the box on the right-hand side will display the telephone number and audio pin.

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Today's Webinar agenda is surrounded by the presentations and conversation with our guest panelists: Russell Sturm, Itamar Orlandi, Gaurav Gupta, and Matt Jordan. These panelists have been kind enough to join us to discuss the highlights from two recent market studies and implications of the growing energy efficient off-grid compatible appliance market for industry, investors, and consumers, and the challenges of that off-grid appliance market must overcome to reach its potential.

Before our speakers begin our presentation I'll provide a short, informative overview of the Clean Energy Solutions Center. And then following the presentations we'll have a question and answer session where panelists will address questions submitted by the audience and then a brief survey.

This slide provides a bit of background in terms of how the Solutions Center came to be. The Solutions Center is one of 13 initiatives of the Clean Energy Ministerial. And that was launched of April of 2011. Its' primarily led by Australia, the United States, and other CEM partners. Outcomes of this initiative include support of developing countries, and emerging economies through enhancement of resources on policies related energy access, not cost expert policy assistance, and peer-to-peer learning and training tools such as the Webinar you're attending today.

The Solutions Center has four primary goals. It serves as a clearing house of clean energy policy resources. It also serves to share policy best practices, data, and analysis tools specific to clean energy policies and programs. And the Solutions Center delivers dynamic services that enable expert assistance, learning, and peer-to-peer sharing of experiences. And finally the Center fosters dialog on emerging policy issues and innovation around the globe.

Our primary audience is energy policy makers and analysts from governments and technical organizations in all countries. But we also survive to engage the private sector, NGOs, and civil society. A marquee feature of the Solutions Center provides the no cost expert policy assistance known as Ask-an-Expert. The Ask-an-Expert program has established a broad team of over 30 experts from around the globe who are available to provide remote policy advice and analysis to all countries at no cost.

For example an area of lighting energy efficiency we are pleased to have Gustau Mañez Gomis, an enlighten project manager, part of the United Nations Environment Programme serving as one of our experts. If you have a need for policy assistance in the lighting energy efficiency sector or any other clean energy sector we encourage you to use this valuable service. Again the assistance is provided free of charge.

And if you have any questions for our experts please submit through our simple online form at cleanenergysolutions.org/expert. And we encourage you to spread the word about the service to those in your networks and organizations.

Now I'd like to provide a brief introduction for today's panelists before we get started. First up is Russell Sturm, head of Energy Access/Cross-Cutting Advisory Solutions with IFC. Building on his work developing innovative sustainable energy market development projects for more than 25 years Russell provides thought leadership and oversight in leading IFC's growing energy access advisory business.

Next up Itamar Orlandi—Itamar manages the Applied Research practice at Bloomberg New Energy Finance. He works with the firm's sector experts and economic modeling teams, providing customized research on clean energy markets to a range of clients.

After Itamar we have Gaurav Gupta.

Gaurav Gupta is the Asia Director for Dalberg Global Development Advisors and is currently working with clients to refine off-grid utility models to support the development of the next set of products that help customers move up the energy ladder and stimulate entrepreneurship in the energy sector.

And our final panelist today is Matt Jordan. Matt is the senior manager with CLASP and leads their Clean Energy Access program which focuses on leveraging energy efficiency to accelerate the affordability—and social and environmental benefits—of access to clean energy throughout the developing world.

And I'm very excited to welcome Russell to the Webinar. Russell it's in your hands.

Russell Sturm

Thank you very much. Yeah it's a delight to be moderating this panel of friends and colleagues that are making such tremendous contributions to this sector. It's been really brilliant partnerships over time between IFC and Dalberg, Bloomberg, and CLASP. And so it's great to bring all these pieces of work together to give an update of what has become one of the most dynamic parts of the global economy.

And not just dynamic in the numbers that are being reached but in terms of the innovations that are emerging that have applications in other areas of economic development. Areas we are only beginning to explore. And the impact being felt—and this is really profound—this is an area, energy access, where there's essentially been a human tragedy unfolding. And it's an intractable problem where you still have 1.3 billion people without access to the basic electricity of the grid, and perhaps another billion whose access to the grid is inadequate and unreliable.

It's been an intractable problem following one traditional model which is the stringing up of power lines and hooking people in through a utility structure.

The elegance of that is that people have very high quality power when it works, and very large amounts of power. But the tragedy is that the numbers of un-electrified is simply unchanged since the time when Thomas Edison first commercialized electricity—still about 1.3 billion people.

And so ISC which is the private sector investment arm of the World Bank Group. Our mission is to eliminate poverty and improve people's lives. And the way we do that is through private sector development. In this area we recognize that unless there are commercial solutions there is no way to use public resources to reach 1.3 billion people. And so IFC's insights as we began working 15—20 years ago on the problem—

Our insights that have emerged over many years of work were that this is in fact a market. People were paying close to \$30 billion a year for batteries, candles, and kerosene—very inadequate transitional technologies—to provide basic lighting services. So you have a substantial but dysfunctional market. And that we saw emerging game changing technologies coming out. And the first ones really were about emergent battery technologies using lithium, chemical combinations.

The remarkable improvements and efficiency in price for photovoltaics coupled with LEDs. And today's conversation is really about how the emergence of super-efficient first lights and now other service delivery through appliances enables solar power to provide very useful levels of energy services for people. So that no longer do you need a 40 watt panel to deliver 2 CFLs worth of light. Now for less than 5 watts—less than 3 watts—you can have a remarkably high performing LED torch which also does phone charging.

And so what you saw was the emergence of technology. And our thesis was that if we could point companies to a market that they weren't focused on and then help the first movers to lower their first mover risk and do the things that companies couldn't do for themselves. Not dictating what the technology could be, not dictating the business models. But rather unleashing the private sector to innovate, giving them the space, but doing things they couldn't do for themselves.

That the technology could innovate, the business models would emerge, and the private sector would begin to move into a space where it previously had not really had substantial impact. So what emerged from this is IFC's portfolio of programmatic interventions. Lighting Africa was the first in Kenya. Now Lighting Africa is functional in four countries in Africa, Lighting Asia—four countries in Asia with Myanmar emerging now, and then Lighting Global Platform where we do quality verification.

Essentially everything we do is what the companies tell us they need in order to build this market. And so when we first entered this there were essentially no quality-verified products out there, and a dribble of usage of solar for off-grid power. Today there's an amazing story that's unfolded in the last six years. And it's a story that I'm going to turn it over to Itamar Orlandi who

leads the Applied Research Practice at Bloomberg New Energy Finance to tell that story.

Itamar is going to talk about the broader story of the emergence first of solar lighting and now kits and emergent models to not just do cash sales of products but enable consumers to pay as they go through a breeding if you will of the capacities of the mobile telecom industry and the solar off-grid energy sector. And Itamar is going to set the context of the broader transitions and broader dynamics of this amazing sector.

And he's going to be followed by Gaurav who along with CLASP has done a deep dive into what is the next appliance that is going to drive the uptake of solar with LED leading the way with phone charging. What sort of demand of consumers for cooling, for refrigeration, for entertainment is going to drive that next pull and that next leap up the S-curve. So with that I'm going to hand it over to Itamar to walk us through in about ten minutes the highlights of the dynamics of this industry. Itamar?

Itamar Orlandi

Thanks Russell. And thanks a lot for this excellent introduction to the topic. I hope I can add a bit with drilling down on some of the points you already mentioned. First of all I should very briefly say that everything I'm going to say is disclaimed by the usual disclaimers which you see on the screen. But I think you have quite nicely summarized the really exciting baseline of why this sector is all of a sudden gaining more attention and why I agree with you that it's a very exciting time to be looking at these sectors.

If you look at the next slide we at Bloomberg Energy Finance talk a lot about things like solar being an exponential technology. And we're tracking the cost reductions there very closely. We're doing the same thing with battery technologies mainly focusing on electric vehicles. What we have in off-grid solar in the context that you have outlined is that we have essentially three exponentially improving technologies packed into one system. And they're all key components of this system.

And hence these really rapid improvements really amplify each other. If we look at a system that just five years back cost almost \$20.00 which is quite a lot of money if you're living on the \$1.00 a day budget. That system—the amount of power—The LED has become much more efficient since. And hence you also need less PV in the smaller battery to power the system. And both of these components are also cheaper. So the same system that cost \$20.00 can now be produced for around \$4.00.

And these reductions are actually by all likelihood even going to continue even if at a slower pace. So simply these improvements are amplifying exponentially has done quite a lot and brought economics to a very different place from where we are now. And that is sort of an underlying stream. So if we go to the next slide actually I just wanted to get everybody onto the same page in terms of what we're talking about when we talk about off-grid solar today.

It's quite a broad segment but what we're going to focus on today is really portable light and solar home system. The whole area of mini- and micro-grinds was not within the scope that we looked at. There are some developments but the dynamics are a bit slower there at the moment. So we haven't focused on that. Drilling in purely at portable light at first if we move to the next slide please—what we can see is that as you mentioned a market has emerged for these systems.

And we took data that both the IFC provided as well as from other sources and we can see that today these simple portable lanterns and sub-_____ watt systems are affecting the lives of just under 90 million people. They do that in 20 million households globally. And we can also see that the markets are quite clustered actually. So India, which housed more than 300 people without grid access is by far the largest market.

But then we see a cluster in East Africa around Kenya, Tanzania, Ethiopia, and to a slightly smaller extent places like Rwanda and Uganda as well followed by other sub-Saharan African countries. That means that we've actually seen very different dynamics and we've sort of seen a leading path in East Africa running ahead where we have market penetration of more than 30 percent in places like Kenya according to our estimate. And other markets which are still far less penetrated.

What we've also done is we looked at a _____ series of how sales have developed. If we look at the next slide please—and what we notice there is we actually have quite good visibility on sales that are tracked by the companies that are Lighting Global quality-verified. So those are really—well as the _____ says quality-verified products. They're usually organizations that work together with Russell's team and the World Bank and sell product in a very organized fashion.

And there we see that actually the quality-verified products have a relatively high market share. But I think that the striking picture that we get looking at this chart is this sort of more blurry column on top of the market which is what we call the generics. There is less data on this segment and it's also less clear or it's incorporating an even wider range of product, really going from outright fraudulent fakes that even copy the brands of established players to other products that took a lot of inspiration from other people's design.

And all the way to very high quality products that are completely independent but don't really aspire to have their own branded presence in the market. And what we can see in this charge, based on our estimates, we think that for each sort of branded product there is another lantern that comes out of this generic pool of products that is being sold. I think the lesson here that we learn and that we also saw a lot of the companies learning from their experiences on the ground is that this product-driven market has been very effective at creating the original market penetrating markets where there hasn't been a market for solar product at all.

But those products also—or these companies, this space—have very low barriers to entry. So as soon as the market—As soon as consumers become

aware of what solar products are and competitors become aware it's very easy for other companies to compete. And that's what we've seen. We've done some analysis and it's quite easy to source these generic products some places like Alibaba that come and start competing with those companies.

And that makes it a very hard, a very tough competitive environment for what used to be the pioneers in some markets. We've seen that especially pronounced in places like Tanzania where the first adopters really have to essentially withdraw some of their operations because they couldn't compete with these newcomers. And companies—the previous Lighting Global and the Green Light Planet and the other big product companies in this space are reacting to this in a variety of ways.

But I think the single most pronounced reaction to this trend of what is essentially a commodification of the product market has been the pay as you go model which has emerged quite out of nowhere about three years ago maybe, but really scooped up far more financing and far more of the attention and the buzz around the industry in a very short period of time that have essentially attracted more than four times as much financing in half the time.

So if we move to the next slide please what we can see is that pay-as-you-go companies not just apply a very different business model but they also tend to provide much larger systems. It started with companies like Azuri selling relatively three watt systems at a range of sub-ten watt systems. But many of the newcomers that have entered the space since are aiming at much bigger systems. And that is of course partially a result of what pay-as-you-go is really about.

So what they're doing is they're coupling the product together with a consumer loan that comes in a variety of ways and maybe structured in a variety of ways. But it's essentially a consumer financing solution that is added on top of that. And it comes usually with a digital payment mechanism as well that can allow for very scalable micro-payments as well as for the ability to remotely shut down the system and therefore incentivize consumers to keep up with their payment in one form or the other.

Now what this combination of those things allows is a) it allows for larger systems which clearly has development impact but is also an attractive thing for the companies to do because it essentially allows you to power bigger devices, bigger appliances, which may prevent an up-sale opportunity for these appliances in the future. It also requires—or it makes best use of this financing ability. And the financing ability—again from a consumer _____ that allows you to go to bigger systems earlier on.

But from a company _____ that allows you to essentially log in recurring revenue rather than a one-off transaction. And that also means you have that customer relationship. And purely by having that relationship companies also gain a lot of data about consumers. They get to know these consumers really well in a quantifiable way by collecting digital data about their payments and in some cases even about their usage of the systems. And that seems to be something that is a very different business model.

It seems to be something that investors think have higher barriers to entry and therefore can allow for a more stable and potentially higher margin business model. And that is probably part of the reason why investors have been attracted to this model. But one of the other things that it also does, purely by combining this drive for data and this drive for bigger systems is that you're really seeing how solar starts to overlap with a lot of other sectors.

If we move to the next slide please you can see how solar overlaps with a whole—In a pay-as-you-go system you create this virtual cycle of a payment mechanism, the electricity application, but also the mobile connectivity that is needed. And that opens up a lot of partnership potential for a whole lot of industries. And we see that a few of those have emerged. And just looking at some of the headlines that we've seen out of the last few months—if we move to the next slide—you know this isn't a nice theoretical thing.

But this is something that the companies really start implementing or experimenting around with on the ground. We've seen companies like Fenix throw in feature phones if you sign up with their pay-as-you-go solutions. Companies like M-KOPA actually start to be on the trajectory to start looking more like a bank rather than an energy company by collateralizing the systems the consumers have already paid for and eventually even goes to finance new products such as cook stoves or such as school loans and the like.

To wrap that up and see where both this product _____ is going and the wider industry is going. If we move to the next slide please we can really see a bit of a bifurcation of the market in the sense that we have something that looks like a product market that is driven by at times very, very low priced simple systems, one-off transactions. Many of players that play there, low barriers to entry versus this digital what we call a relationship market where you leverage data and long term relationships.

You know there's a question is one better than the other which is probably a normative question. I think what we put in the report—We made a forecast that in the next five years the number of off-grid solar users is going to grow by—It's going to quadruple roughly from the 20 something million users that we have today to just under 100 million users that we'll have in about 5 years. And actually our modeling and projections indicate that the vast majority of these users will still fall into this product market.

They'll buy relatively cheap products outright because that is really a very scalable thing. Whereas the relationship business models have a lot of potential in terms of all these partnerships and data solutions and may provide a very different value proposition for investors here as well. But because they have higher barriers to entry that also means they will need more patience and more real business building and business model innovation that's going on there. So they will play a different role.

And I think that wraps up sort of the high level overview of this sector. And with that Russell I think back to you.

Russell Sturm

Thank you Itamar. Before I move on to Gaurav I do want to ask a couple of questions. And then after Gaurav we'll all be able to have a bit of a conversation and take on board any questions that the listeners have typed in. I'll bring those to the fore at that point. But the development of these individual country markets—So, I mentioned earlier that IFC manages Lighting Africa, Lighting Asia, country programs in eight countries presently.

And on the ground out teams are working with companies—both cash sales companies and pay-as-you-go companies—to develop those markets by doing consumer education, by connecting businesses with businesses, by trying to address access to finance issues. And what we see there is that a huge constraint on these markets is not demand. There is an endless appetite in some markets for phone charging, in some markets for fans.

So for example we offline call our Lighting Pakistan program Cooling Pakistan because the drive—what consumers really want, the service they want—Remember they don't want electrons. They want service. And the service they want is cooling. And so I'm wondering, and this is partly a transition to Gaurav, is just as we've seen phone charging driving the market in Africa so you see other —? What are the emerging new main markets for off-grid solar in the coming years? Are you there Itamar?

Itamar Orlandi

Yes. I think there are a variety of new business models coming in. The markets will develop quite regionalized I think. What you said is definitely true about different demands for different things. I think what we also notice is really this bifurcation by how developed markets already are. So in places like East Africa where we have—We've already reached quite a high level of market penetration where we think we might even see sort of a slowed down or stabilization of the number of new user that will come into the market each year.

So that means we'll see different growth rates. But at the same time you know that doesn't mean—many of these users will start with a very basic lantern. So they might start to look for upgrades to bigger systems, et cetera whereas in other markets that are less advanced there is much more of a demand or a need if you like for companies that really work on the ground and do a lot of this pioneering work of explaining to consumers what solar even is, really from the bottom up, raising awareness that this is a product category that works.

And that can provide a sustainable service and can provide for their needs, and is a valid alternative. And another area that we see of course is these—You know as these systems grow and become more powerful one of the drivers is—as you have mentioned—the set of appliances that people can power with the appliances. So there is a need, as I showed in my first slide essentially, that as costs have—

One of the big drivers that brought the lantern space to where it is now is that the reduction in LED costs—or the increase in LED efficiency—is sort of relatively easy to imagine and probably quite hard to do—to implement. But that can sort of draw the roadmap of what efficiency improvement in things

like TVs or fans or the holy grail of cooling can have when these appliances undergo a similar transition as lighting has.

Russell Sturm

So as I think about all this—the move to larger systems, the emergence of pay-as-you-go, and what we've seen at the country level where the constraint on the market is not really demand. It's supply. That all implies a lot of financing. And the financing has grown rapidly in the last few years. But last year I think it was—I think the figure was \$260 million of investment. I believe that was the number. You can correct me. But that's a drop in the bucket.

You know pay-go requires yes it's attracting investment, but it requires an extraordinary amount of capital to execute. It's essentially small utilities building out infrastructure. The cash sales market is also a very cash/credit driven business. And when the ability of global companies—manufacturing companies—to access more and more capital got constrained their ability to provide credit through the whole supply chain got constrained. And we actually saw a leveling of sales for the first half of 2015.

That picked up again in the second half as some of those supply constraints got released. But can you comment a little bit about to what extent the growing interest of investors in the sector is solving the problem? Or is it still going to be a supply-constrained industry in the future?

Itamar Orlandi

Yeah I think that's a good point. As you mentioned the number was around \$270 million that came in just last year mainly attracted—or the majority of that money went into pay-go and really into quite a small subset of the pay-go companies. So what we see is this split that the leading pack is sort of rushing away at the front and is attracting a lot of money which is increasingly—if even if not quite yet—very commercially oriented money.

It's sort of transitioning away from the development and impact community. And I think there is visibility that it can slowly but carefully eventually be picked up by more commercially-driven entities. But whereas these companies are find it increasingly easy to raise capital there is a still a gap both for very early stage companies. And everybody agrees that in order to electrify or get product into the hands of the 1.3 billion people without power it can just be the five to ten companies that are in this leading pack at the moment.

We'll probably need hundreds of companies. And most of them are at very early stages if they're around at all. And they still find it hard to attract money. And the other thing is what you mentioned—this working capital gap. So one of the things that the companies doing cash sales need is—You know it takes them about six months to—between the time when they pay their supplier in China until when they actually get the money in from the end consumer.

That needs to be financed. There is sort of much less financial innovation in doing that. So it's less exciting if you like. Or it speaks less to the story that venture capitalists like to hear. But the companies find it very hard to attract

this type of financing largely because even if you're a relatively cash sales solar lantern company in effect you're still a startup and you don't really have existing relationships with local banks that can fund it. And often they're growing very fast.

So new loans will actually have to be paid back by new debt rather than from product sales. And those are things that banks find hard to swallow. I think we should be very careful not to interpret this sort of record amount of money that is coming into the off-grid solar sector as an indication that all is well. And I'm saying all of this before we've even touched the currency issue which is a big issue on which—to the best of my knowledge—none of the companies including the pay-as-you-go companies have a very good answer yet.

So definitely still a need for financial solutions as well.

Russell Sturm

Thank you Itamar. I am taken by not only how exciting the development to date of this sector is but a little bit how scary it is right now. You know these are uncharted waters. The commodification process for cash sales you've described. And that can be beneficial with more competition. But it's also dangerous if you don't have companies that are stewards of quality and brand development to let the market mature. Those are unsettled waters—which potentially can be impactful and potentially be dangerous—for the market.

And the emergence of pay-as-you-go really whose numbers are small relative the cash sales to date but which is attracting so much attention and so much more capital. It's an exciting time. And one of the most exciting pieces of this to me is the continuation of technological innovation. And the technological innovation that I think is a game changer is the emergence of super-efficient appliances. CLASP has played a tremendous role in leading the light _____.

CLASP comes from a background of supporting efficiency in the grid space. And they've taken that expertise to the off-grid space now at a critical time. Acknowledging that when I first started working with the LED companies about eight years ago the efficiencies of LEDs has improved about 10,000 percent since then. And it was a great value proposition then. It's an incredible value proposition now—the delivery of light with small amounts of electricity developed through photovoltaics.

And now we have a very similar revolution taking place in the delivery of other services: radio services, entertainment through TVs and pads for the computer, cooling from fans, refrigeration. So with that CLASP engaged with Dalberg. And Gaurav who has experience having done the market trends report working with IFC and the World Bank for two rounds—going back about five years. So he brought tremendous experience understanding the dynamics of the sector to dive deep into the appliance sector.

And it's a great thing for me to be able to introduce Gaurav Gupta to talk about the findings of that study and give us some prognosis on what direction the super-efficient appliance sector is and where that's going to take the

delivery of energy services, and how it's going to catalyze the next chapter in the solar off-grid sector. Gaurav?

Gaurav Gupta

Thanks Russell. That's a very kind introduction and also Itamar for setting this up so nicely. I'm going to just load the presentation up. But while I'm doing that I wish Dalberg has as great a disclaimer as Bloomberg did. So we don't have a disclaimer but our only disclaimer will be we tried our best on this report. And if there are any thoughts from the audience and corrections please do send them to us.

But let me really just take off from where Russell brought us in which is that really if you think about where we're at on this journey there's been a lot of attention that's been paid towards lighting, mobile phone charging, cooking on a separate front. And really the question is where to next? I mean the end beneficiary in this regard is on an energy ladder. And it's very clear that we need to be thinking about what are the next sets of appliances that they're going to consume from a beneficiary perspective, from a user perspective.

But I want to also emphasize that this is a symbiotic issue. Even the energy companies—some of the great excitement that's there around all the growth that has happened on lighting—even these companies need this ladder as much as the end user because the economics for them really rely on the end consumer actually having somewhere to go on the energy ladder. As we'll talk about a bit later in our presentation it's not enough to do lighting and mobile phone charging.

It's an expensive market to serve. There's a high _____. It's _____. It costs a lot to get there. So once you do spend all that money to actually go and serve this market you need more products to sell as well. Part of the message that we're trying to give out of today's presentation is there's a really exciting emerging market of appliances. That market is going to become a reality because of efficiency. And this is a great economic opportunity from a business perspective while also delivering some essential services.

Let's actually go into a bit of these numbers 'cause there is money on the table. And the way we've thought about this is really to differentiate between actual today, potential today, and potential tomorrow. If we just look at a number that's pretty hard to deduce—so we've done some modeling to really work it out. If you look at spend by off-grid and bad-grid households in 2015 on appliances at the moment it's a pretty small amount.

Fans \$60 million, fridges about \$75 million, and televisions are the real key driver—about \$390 million. That's what we estimated currently being spent by people who actually don't have much electricity at all and yet are still taking these product sometimes to simply use them for a few hours or even one hour, and sometimes purely status symbols. So _____ is it's small, but in some ways it just shows the latent demand that exists in the market.

And then when we looked at understanding where the constant _____ patents and especially looking at what happened when these people gained electricity. What did they start spending on? We were able to actually estimate the

potential spend on appliances if an actual viable product was in the market. And so if you look at the next set of numbers in light green this market starts to get pretty exciting.

So in 2015 the potential spend by this market is much larger—up to \$1 billion willingness to spend on televisions. What's even more exciting is if you build in the trends that we have identified around additional efficiency, the spread of solar so that there's more access, and the fact that the market itself will grow you start to look at what the number could look like in 2020. Here you see first a \$500 million potential that we're estimating for off-grid appliances that are efficient.

Efficiency is a key driver of actually achieving these kinds of numbers because if you look at the next slide the thing that's holding the market back are these very serious discontinuities in power needs. Essentially what LED solved was the ability to actually take very small amounts of power and still deliver a service. If we were still in the incandescent world we would be talking about a very different set of drivers and numbers that Itamar described to you.

A similar thing needs to happen with these appliances because as soon as we step up from lighting to even what is a very small television—a 19 inch television—or a table fan running for 5 hours there is a big leap in power need from that lighting up to that initial use of a television. And if you go up to the next Holy Grail which is really cooling or refrigeration—and again we're talking about a pretty small refrigerator here, 60-80 liter fridge—the jump goes up 5X. So there are very serious discontinuities that need to be solved for. And this is where efficiency becomes a key driver.

Let's actually have a look at the economics that sit behind this. There's really a huge amount of power needs. The slide that I've put in front of you really describes but the upfront appliance cost that most consumers are _____ in the market. Then the annual energy costs if they were to be using the average off-grid energy source. I mean we have to recognize that solar is still at the smallest scale quite expensive relative to grid. And as a result the pull watt cost is extremely high.

So if you align that with the fact that appliance once you get beyond lighting and need much more electricity consumers are actually saving a remarkable ongoing cost. And as you heard from Itamar financing remains a challenge even in the lighting industry today which is relatively mature. So you can imagine how much of a burden this poses for the purchase of a television or a refrigerator. Again this is why efficiency is key to this market.

But there's good news. One of the things that we tried to do is to talk to a lot of innovators out there—people currently producing DC based appliances and understand from them what would drive further efficiency. And where do we think we can get to in the next five years. What we present here is our best analysis in terms of not only where re appliances today and where can they actually get to?

So in the darker green on this slide you've got mainstream appliances in 2015. So a 19 inch television for example consumes about 30 watts. If you then compare that with some of the very specialized off-grid appliances the best performing appliances today for example in televisions are consuming around 15 watts. So that's already a remarkable difference for the DC energy efficient appliance versus the mainstream appliance.

And in terms of where they can get to by 2020 we believe you can shave off another—anywhere between 30 to 60 percent depending on the type of technology. So what is exciting about this is the next 5 years is not just about the spread of solar which will really enable this market and the fact that you have rise in incomes. What is also exciting is that you achieve a change in already efficient DC appliances. And that will really make this market come alive.

And I think since we actually did this analysis one of the areas we've already seen remarkable leaps is in the television space. The numbers that we are assuming we'll get to in 2020—it's quite possible we'll be hitting those actually in the next year. So I think there's already a huge amount of innovation. Having said that I think the numbers—if we look at refrigerators that still remains slow going in terms of really achieving the kind of step change that would allow that market to come alive.

So what does this mean? If you actually look at the discontinuities that I described earlier this is what it looks at today. So once you're able to actually make these efficiency changes this is what that power consumption _____ looks like. We made a very strong step change in the kind of power that consumers need to actually be able to use these appliances. And that is what fundamentally energy efficient appliances can do.

It can essentially smooth the _____ for consumers to go up the ladder. Again cooling will still seem like a pretty large step change. But relative to where it is today it can actually come into the purchasing capabilities of a much larger pool than there exists today. Now by doing all of this we can actually get to a very virtuous place. One of the important things is that not only do these appliances rely on the spread of off-grid power technologies like solar but that they can actually drive those businesses themselves.

You know underlying this very basic logical presentation we have in front which is to get accessibility of off-grid appliances to increase; this will actually increase the demand for energy. Therefore energy becomes more accessible and this increases the demand for off-grid appliances. So you get this virtuous circle but really underneath of all of this is some very tough economics. The truth is that if we look at most lighting providers even the most successful ones, it's very hard for them to make the economics work even at a very large scale without actually having more to sell.

The amount of light that people are consuming at a very basic level is critical for those businesses to succeed _____ their largest systems. Use some of their salespeople to actually sell much more—and therefore get much more scale economy. For there to be these kinds of appliances present makes the

economics. And this actually means that instead of thinking about this market as a single product market.

Which is how I think you know in the first five years there has been a lot of focus on solar lantern which has been a really important first step onto the ladder. But even solar _____ systems you can point to actually start to think about this as an appliance market rather than a single product market. And I think one of the things that we are saying to a lot of the early entrepreneurs in the market today –

We're seeing incredible success in terms of growth of a revenue base and customers still looking for that strong profitability number. Really today off-grid energy companies can be the major consumer brand of tomorrow. For many of these households their first touchpoint with an electronic product, with an appliance product, is in fact solar appliance or a solar light. And that allows you to actually on-sell a whole stream of household products.

I think it's sort of instructive to think about some of the companies that started out this way: Matsushita—the first product was an attachment plug. And that company grew from selling that to being Panasonic. Similar if you look at the history of Philips it was a one product company that really focused on carbon filament lamps. Now it's sort of that giant of you know multi-product. And I think I would ask all of our listening audience today to imagine if they can even think about a company that is really a single product electronics company or an appliance company.

It's extremely rare. I think the endpoint of the market that we're discussing in the off-grid space has to be companies that can really serve the BOP on a multiple set of their appliance needs. That's where naturally the economics start to work. What's critical here is that not only are energy efficient appliances important for actually driving the next step up on the ladder but they're really just critical for this market to become attractive and to grow.

And what can the rest of us do? A lot of what we've described is some really good trends that are happening. A lot of this innovation is being drive already. A lot of even entrepreneurs in this space are selling appliances. They're integrating them into their products. But they need some help. We've identified three important areas. What is the idea of innovation diffusion? A lot of the innovation that is going on today—that's driving this market—is not happening for the BOP segment.

If you look at something like _____ at the power _____ it's really sort of changed or is attempting to change scale economics and factory storage. So how do you get some of the technology that's happening in other markets—technology that's been developed so that your iPhone can work for longer—how do you get that down to the BoP level? This is one area where the idea of accelerating that diffusion can really help. Another important area is to facilitate enterprises finance for both manufacturers and distributors and also product level financing for end consumers.

This is something that Itamar talked about in the lighting space. As you can see with the numbers in appliances which obviously have a higher upfront cost and also a larger ongoing cost from an energy _____ that we need to sort of work on access to finance as well and to actually encourage and incentivize manufacturers _____ to really produce these kinds of products. It's one of the areas that CLASP, IFC, and _____ have been promoting.

And then finally the third one that is always critical is quality reforms. We've already talked about quality issues from a lighting perspective. In fact all of the lessons that have happened in lighting apply to the appliance space—and perhaps even more so because the risk that the end consumer is taking is much higher. So the outlet is much higher. You really need to build up that trust even more.

And just like in the early years especially of solar there's a lot of convincing that needs to be done in different markets to bring down the import duties and tariffs that are associated with these products. But again these products have an ability to be life changing for end consumers and drive this market, but continue to have especially in certain markets very, very high tariffs. So that's another area where the rest of us can really help drive this market.

I think that effectively brings us to the end of the presentation. The key message that I wanted to leave our listeners with is that this is a market that's in itself exciting. It can get to about \$5 billion in 2020 using fairly conservative estimates. It's going to be driven by the fact that solar itself is spreading and the fact that larger solar _____ systems are becoming cheaper. A lot of the entrepreneurs that Itamar was describing are moving to selling larger systems.

So that will actually create a symbiotic relationship with appliances that can actually run on those systems. There's a huge amount of effort going into actually increasing the efficiency. As you get a step change in efficiency of these appliances you will get a step change in the affordability for the final consumer.

And finally this virtual cycle really plays back into the health of a lot of the energy businesses that we care about because it's an essential market for the scale economics to work. And send out a person to sell a light becomes much better if they can also sell a TV alongside. And that's what's been missing to date. And it's exciting to see that these products are coming online and will actually be one of the main drivers to take what have become very highly scaled high revenue businesses into actually profitable business.

Let me end there and turn it back to you Russell.

Russell Sturm

Thank you Gaurav. And I'm monitoring questions from the people listening in. And I realized that we sort of hopped over an assumption that everyone understood. And I think it's important to explain it. That's with regard to what's the significance of DC appliances? And I'll take a quick stab and Gaurav you can elaborate if you want. But essentially the electricity system from a utility operates on alternate current AC.

And so all of our domestic appliances in our house that run off the grid are AC. The solar generated power that is stored in batteries comes out and is stored as DC—direct current electricity. In order to use an AC appliance on a DC appliance you have to transform the AC to DC—excuse me the DC power that's stored in that battery to AC. And there's a loss in that process. So there's an inherent inefficiency in driving an AC appliance with a solar driven battery which is essentially how solar works.

You store the power in a batter and then run an appliance. And so the significance of the emergence of super-efficient DC appliances is that it's an inherent efficiency improvement that allows the entire system to be lower cost and more efficient. Do you have anything more to say on that Gaurav?

Gaurav Gupta

I think Russell you would make a great engineer. I think that's exactly right. And I think –

Russell Sturm

I think just the fact that I'm –

Gaurav Gupta

[inaudible comment] DC is a—I mean the fact that this is a DC market is sort of a critical part of the equation.

Russell Sturm

And so much of the work—and the work that Gaurav referenced that CLASP is doing—is to try to represent to appliance manufacturers that there's this entire market representing a quarter of the world's population that is a market they're not even looking at by building products that can be driven by solar efficiently. And so part of the work is to lower first mover innovative, first mover risk to allow there to start to be quality products competing in the sector.

And so that's a lot of the catalytic work that has to happen at the front end of the market. It's quite analogous to the work that we did for solar lighting originally. One other clarification I'd like to make before I ask you a question Gaurav is that really what we're talking about is the paradigm of combined cost of a system needed to deliver a service. And so if you look at the cost of a solar system with a TV, a fan, and a couple of lights ten years ago it would be four times what that is today.

But the percentage of the cost that goes into the high efficiency appliance relative to the low efficiency appliance is a lot higher. But that more efficient appliance allows you to downsize all of the rest of the system: the battery, the photovoltaics, the electronics, and the total capital costs of delivering that TV service, that fan service is reduced if you invest more upfront in the efficiency. And so that's really the paradigm we're talking about.

And that's why it's a game changer that you don't need 12 watts to drive an 8 watt AC lightbulb, and the same paradigm applying for appliances. So tell me Gaurav when do we get the holy grail of refrigeration? This is an immense, highly transformative market. If you think about the impact of being able to have affordable refrigeration for people off the grid and what that does for food security, what that does for the entire food chain, what that does for commercial retail, choices people have, clinics, and vaccines.

What's the sticking point for refrigeration? There's certainly need and demand.

Gaurav Gupta

Thanks Russell. I'd say there's sort of good news and bad news. It's mixed news. I think the good news is that while it's very important for this market it's also just efficiency on the refrigeration side is just critical for many markets. If you look at just the overall pressure from climate change there are a lot of people looking at how do you make cooling more efficient? So that's I think the good news.

And our own numbers when you interview people around what could specifically happen for a fridge is that it would be possible looking at some of the best DC-based fridges today you could actually cut that power by another 60 percent which is substantial. It would come from—Most of it would come from two things. Brushless DC variable speed compressors; a lot of these variable speed DC motors which have started to become really, really efficient and the kinds of things you are so often seeing in a tiny fan that you can power off just your laptop itself.

That technology can actually drive a compressor. So some of the efficiency that's coming from there you see can cut down the compressor costs—compressor energy usage—which is one of the key drivers of an energy efficient fridge. The other of course is _____ and less to do with energy itself. But vacuum _____ panels and some of the technologies that are coming in can really increase the efficiency of a fridge.

That's about 60 percent that you can get. And that's what's projected for the next 5 years. Having said that, we haven't as of yet seen real step change. And if you look at the last 5 years of refrigeration there haven't been incredible increases in efficiency. So while a lot of efficiency is projected over the next 5 years the last 5 years do suggest that there's some caution around how much we can really do.

There's a lot of global interest. There are huge amounts of R&D going into this space. But the current ways in which basically a refrigerator runs—there is a limitation on how far we can go. Our best projection is about 60 percent. If we get to that 60 percent will that revolutionize the market? It'll certainly expand it in the off-grid space, but I don't think it'll revolutionize it. It's not at the extent that LEDs were—really up to 100X at one point.

Russell Sturm

Yeah it's not solid state technology. So you don't have that Gordon Moore curve going for you right?

Gaurav Gupta

That's right.

Russell Sturm

Okay, but it's not due to a lack of attention from companies in a position to innovate?

Gaurav Gupta

Well I think where there might be something is the diffusion aspect. There is definitely a huge amount of attempted innovation going on globally, not necessarily to make 80 liter fridges. So I think keeping abreast of what's

going on globally—I mean CLASP itself is pushing some really interesting _____ and innovation in the space of air conditioning for example. You know a lot of all of this stuff is very much interlinked on the same basic technology.

So there's a lot of effort I think going into the R&D. The key is when change happens in that technology how quickly does it translate down to a BoP level? I think that is something that we can do a lot more about.

Russell Sturm

Thanks Gaurav. One more question: when we were talking to companies about making solar lanterns for a market they hadn't thought of before one of their key concerns was that if they were to make a market a quality product that they face a risk where the entire market gets spoiled. In an immature market where consumers cannot differentiate quality, there are no established brands in the market; they thought it was essential that consumers had some sort of a signal of what is a quality product.

And that led to IFC filling that void and developing the quality verification protocols. And we have extended that for systems up to 100 watts in kits that are sold with the appliances. But it's really quite limited what we do. CLASP has begun to give awards for quality products and start to differentiate giving signals to consumers about quality appliances. How important—and what would be the role of quality assurance in enabling the market to reach its next stage of development for off-grid appliances?

Gaurav Gupta

Great question. Look, I think it's extremely important but perhaps in a quite different way to how the lighting market played out. I think in the lighting market quality assurance was important for reassuring the consumer. Actually quality assurance is really important here to reassure the solar entrepreneurs because a lot of these products are going to be sold by them. They're going to be important intermediaries in this process. We're adding a level of complexity once you bring appliances in.

So what's really going to happen is people are going to sell a particular size of solar home systems. This is already going on _____ packaged with certain appliances. That's going to be an important driver of the market in the next few years. I think _____ distribution where people are piecing all of this stuff together themselves is probably going to happen more at a mature end. So right now if you're sitting there and you know how to create a great solar light and you know how to distribute a great solar light you actually need some assurance on what TV should I pair with my solar home system when I sell it?

We know that it's unlikely one company is going to become a manufacturer of all of these things. They're either going to be contract manufacturer or they're going to be sourced. Often the entrepreneur on this with the customer relationship—the business of the customer relationship—they almost need more quality assurance than anyone because it's their reputation that's on the line. We really need to differentiate between the brand that the consumer sees at the end.

Who knows? It could be a Green Light Planet or any of the other companies. This is where a lot of these products may actually come from. So it's the owner of the brand that must be quite concerned because they've so far been able to say, "Look I've got bullet proof solar lanterns." But what can I say about a television? What can I say about a fridge? And so quality assurance is very critical but it's almost as critical for the intermediary or for the other businesses that will package this as opposed to the consumer.

I think where the market's going to move for the consumer is consumers will start to see brand. Solar lighting should now be seen as the way—not just a stepping stone but also as a way of creating brand awareness. Brands that have stuck it out and played the quality game; they're the ones that are always going to be long term. They are obviously a lot of complaints about spoilage in the market. But that also means that they have to play the long term game.

And for them the realization of that long term will be that they will be the ones that will sell a television branded under their name. They're the one that can sell a fan brand under their names. While the guys that have gone in for lower quality products are going to have to constantly shift the name of their company. So I think quality assurance is critical—almost most critical for the existing entrepreneurs.

Russell Sturm

Thanks, and investors I would say. Investors use whether or not a company is selling quality products as a proxy for determining partly their technology and market risk. Before I move to Matt and ask him to talk a bit about these programmatic platforms to support transitions I just have to clarify a couple of points that have come through on questions from people. One is just a very basic question. Gaurav you've been referencing a BoP market and I'm just going to presume that what you mean by that is essentially the underserved populations which for the most part are the base of the pyramid in terms of income.

But that's the BoP market we're talking about—correct me if I'm wrong. Right Gaurav?

Gaurav Gupta

Absolutely.

Russell Sturm

Okay. And then another clarifying question. There was a question someone had about policy advocacy and an interpretation from one of our slides that policies are needed in order to—this question was—make people move to off-grid. And it's very important to understand what we're talking about here is a population of people who in the lighting sector—So the questioner referenced \$.12 per kilowatt hour grid power in India and why would anyone move to pay more like \$1.00 a kilowatt hour equivalent for service for off-grid?

And the answer is we're not trying to move anyone off the grid. What we're acknowledging is that the grid is inadequate to provide services to people that don't have grid power. And 80 percent of them in Africa live in rural areas where arguable the grid is not a cost effective solution that will happen in my lifetime. And the comparator is not \$.12 per kilowatt power. It is paying over \$100.00 a kilowatt hour equivalent for kerosene for lighting, or paying close

to \$1.00 a kilowatt hour closer probably right now with oil prices to \$.50 a kilowatt for diesel generated power that is dangerous and noisy and disruptive of people's lives.

So that's the comparator. It's not the grid. If people have the grid, all the more power to them. But there are over one billion people that don't. With that I will introduce Matt. Matt Jordon is a senior manager of Clean Energy Access at CLASP. And Matt has been a partner with Dalberg, a partner with IFC in much of this work. And Matt tell us a bit about Global LEAP and the programmatic platforms that are driving this solar off-grid appliance sector forward.

Matt Jordan

Thanks all—thank you very much to the Clean Energy Solutions Center for having us. Just a quick recap I work for CLASP. We're an NGO. Historically we've focused on appliance energy efficiency policy. Increasingly we're sort of using our experience in that field to help nudge the global off-grid appliance market sort of in the right direction. We work very, very closely with the Clean Energy Ministerial's Global Lighting and Energy Access Partnership which is led by the U.S. Department of Energy.

And all of our work on that front relates to sort of nudging this market in the right direction—sort of mitigating early mover risk and providing clear market signals about off-grid appliances. I'd like to talk a little bit today about some of the work we're doing. This is a big upside market as Gaurav I think put forward pretty clearly. There is a lot of commercial opportunity in this market. There's a lot of opportunity for innovation and growth.

And a lot of the work that we're doing in support of the Global LEAP initiative is sort of built around trying to get market actors plugged into this market and plugged into sort of different areas of the supply chain and really working on driving this market forward. I think it's important to note that this is—Did my slide move forward? Just a moment. It's really important to note that this is a very young, very nascent market.

The off-grid appliance market is not as mature as the off-grid solar lighting marketing, as the off-grid solar home system kit market is. I would say that it's a few years behind that market in terms of its development and competitiveness. It's hampered by many of the issues that have plagued sort of earlier stage BoP markets. Many off-grid solar companies, off-grid energy service companies, struggle to find off-grid appliances that are appropriate for deployment with their systems.

And few of them have the necessary resources, human capacity, and expertise to develop their own appliances. Meanwhile appliance manufacturers aren't necessarily aware of the off-grid market whatsoever. They aren't aware of the commercial opportunity. And many aren't aware of what it takes to appropriately design and market off-grid appliances. Investors and MFIs don't necessarily have the information they need, the data they need, to do due diligence on investment, into target investment.

And policymakers don't have the data they need to target and scope effective policies and programs. The good news, as Gaurav put very, very clearly I think, is that there's no lack of demand for the right off-grid appliances. This is a high upside market. And throughout the value chain people want these products to be developed and marketed and sold. The challenge is that the market ecosystem needed to make good on this demand is disorganized and a bit underdeveloped.

So it's not really a lack of demand. It's a matter of lacking information and market infrastructure to enable that demand and really get early movers up and running. So what we're doing in support of the Global LEAP initiative is trying to mitigate a lot of these risks and a lot of these information asymmetries. Through a variety of targeted programs Global LEAP is working to address disorganization in the off-grid appliance market and fill information gaps really with the purpose of enabling faster, better informed action by market stakeholders.

To provide a sense of some of the opportunities for people who are interested in sort of exploring this market or moving faster in this market I'm going to do a quick run through of some of the things that Global LEAP is working on in support of the off-grid appliance market. It's really difficult to target market action, be it procurement, be it investment, be it policy if you can't reliably compare and differentiate between products.

And until recently no appropriate test methods for off-grid appliances have existed. So what we've been able to do recently is develop Global LEAP test methods for off-grid TVs and fans. These test methods are being sort of beta-tested in laboratories worldwide and are in the final stages of development. If you visit <https://www.globalleap.org> you can look at the beta versions and the process that went into developing these test methods. That's where you'll want to check back soon for the final test methods when they're published.

The Global LEAP awards is a program we've been managing for about three and one-half years now. It's a program to identify and promote the world's best off-grid appliances. We evaluate them on the basis of quality which is very, very important as we've already discussed, appropriateness for off-grid application, energy efficiency, and cost. This has proven to be a highly effective program and it gives off-grid energy companies a jump start in their search for great appliances.

And it gives appliance companies really sort of a clear point of entry into the market. The latest round of the Global LEAP awards was announced last fall in October at an event at the White House and received 44 total nominations which is a number we're pretty excited about. Winners and finalists are going to be announced this June at the seventh Clean Energy Ministerial. So stay tuned for more details on that.

Global LEAP+RBF is a program that we're piloting right now in Bangladesh. We opened up that program in late February and it's in its early stages. It's a program to couple the Global LEAP awards with results-based financing incentives to mitigate risk for early-mover off-grid solar and appliance

companies, and really drive best in class off-grid appliances into the market at scale. And the purpose of this really is to demonstrate to appliance manufacturers who might be sitting on the sidelines that there is a market here.

And there is a market at scale, and also really in the end to demonstrate to commercial finance actors that these are investments that are worth making. Again we just launched the pilot year of this program about one and one-half months ago. But we're already seeing some pretty exciting early results. There's a lot to be done in terms of finalizing and verifying the program's early results but we hope to share more with the broader energy access community soon.

Another program Global LEAP is running is called the Global LEAP Off-Grid Appliance Data Platform. And through this program what we do is we test products. We find them through a variety of means in the marketplace and through working with off-grid distributors and manufacturers. We test products using the Global LEAP test methods we've developed. We aggregate the data so it's sort of easily comparable and we share that data with market stakeholders from policy makers to investors to appliance manufacturers to companies looking to procure off-grid appliances.

I think this is going to be an important program moving forward. The response to the program by the market so far has been really profound. And you know we're really excited about the things that we think the market can do with this data once this program is sort of scaled up and more broadly distributed. As Gaurav discussed in quite a bit of detail Global LEAP also supports market research to inform smarter action throughout the value chain. And there's been a fair amount of sort of business to business in _____ to investor industry matchmaking where finding best actors in the market and connecting them to really drive business forward in this market.

We also have some slowly emerging work in policymaker support. There are increasing signs from policy makers in markets that are really leading the way off-grid energy that there is interest in putting smart policy into place in support of the development of the off-grid appliance market. And we're doing what we can to assist those policy makers to make sure that truly market support of policy gets put into place.

And you know the benefits of all this really is that market stakeholders, policy makers, investors, et cetera have more information, are better equipped to make faster, higher-impact decisions with regard to off-grid appliances. And really the end benefit is that consumers in the BoP get more liable, higher quality, more cost effective, high impact energy services. We think this is a fairly exciting dynamic.

So I would invite anybody listening in that's interested in learning more about these programs, learning more about the off-grid appliance market, checking in, plugging in to visit <https://www.globalleap.org> and be in touch. And that's it for me.

Russell Sturm

Thanks Matt. We've got about five minutes and I invite folks that haven't already to send in questions online. But there are a couple that are out there and one of them relates to the dynamic of competition. The questioner is wondering if because it's an early stage market are there price fixing price makers from sort of monopolistic or power from the early entrance into the market. So are we seeing –? I guess the question is are we seeing pricing that is inappropriate or does the pricing reflect actual costs?

And the related question is what will be happening now with the dynamic as more entrants come into the market? And I think Itamar spoke of the commodification of the market at the global level. And I think the questioner is wondering how this is manifesting itself at the local level. Are we seeing that consumers have a fair shot at getting good pricing of products? And I think this applies to both pay-go pricing and cash sales pricing at the market level.

Itamar do you want to comment on that?

Itamar Orlandi

Yeah sure. I think—Sure, sorry Russell. I think the commodification is sort of a very natural part in the innovation chain almost if you like, certainly for innovations where it's hard to protect the IP. So one of the things we might see is actually even in the pay-go space we'll see some of the technologies and the software backing, et cetera to become more ubiquitous and thereby lowering—if not as low as for product sales—but lowering the barriers to entry allowing smaller and more local pay-go players to come in and offer solutions as well.

In terms of price fixing I haven't come across this notion in this market. I mean it's sort of very obvious from the research we've done that the companies that you know try to imitate some of the more established products tend to undercut them. I guess if you don't have the branding power often those are companies with lower cost of capital. And their argument there is of course the pricing argument. I would be hesitant to—You know I wouldn't underestimate the ability of consumers to actually make informed decisions.

And personally I'm a bit on the—I think there are consumers—There are both types of consumers. There are consumers who might actually be fooled and think they're buying a high quality product that isn't. But I think you know if you look at other markets like the market for battery powered torches their people are quite knowingly opting for what are essentially more or less disposable products but may last a month or two or three—maybe six—but are then replaced by new very low cost product.

So I think consumers are to some extent also sometimes aware that they're buying a low quality, but low upfront cost product, and are happy to replace that. I think that's a pattern we're seeing also in developed countries in a variety of markets that the consumers take informed decisions to prefer lower cost over quality. And I think that's a fair consumer choice as well. I'll hand it back to you so we have a little bit of time for other questions.

Russell Sturm

Yeah I'll just note that this is a game of distribution. And Itamar talked about unbranded products coming in—the Alibaba purchases. But really this about getting products to people in remote areas where there's not infrastructure. And the cost of doing that is really substantial. And I don't see any evidence of consumers paying more than is a reasonable or necessary price at this point. Until that infrastructure is built out more substantially it's really quite expensive for folks to receive technology.

And another question came in wondering what about the big guys? Where are the big branded companies for example in the lighting sector? Why aren't they in this space? The reality is they are trying—sort of—in the lighting sector with the expectation of General Electric all the major brands have taken some sort of stab at this sector. But the innovation, the success, has really come from smaller companies that are very targeted on the sector—that can move quickly.

They don't have a two year product development cycle. They just make it and where they are starting with a blank slate to think about a market, to understand a consumer, and to build distribution. And I think the larger companies—the multi-billion dollar companies—that are trying to fit a new product space or a new segment here; it's more difficult to innovate in a company like that. And it is more difficult to resync your distribution if your entire distribution as an appliance manufacturer has been focused on grid-connected distribution in the capital city.

And so the big buys have just not been winning yet in this space. And maybe they'll make a secondary play once the market reaches a certain point. But they're there, but they're just not leading the market. I realize we are at the end and I guess—I'm seeing questions come in now. So what I understand and I'm going to turn it back over to Stephanie to give details on this. But what I understand is that the panelists will be presented with the questions that have come in.

And we can reply either to all of the participants or to the person that submitted that. And Stephanie will talk us through how that works. We appreciate folks—there are still 82 of you out there—that have participated in this. And we really appreciate the efforts of Matt, Gaurav, and Itamar to prepare for this and to share their knowledge and wisdom with everyone. Stephanie?

Stephanie Bechler

Thank you so much Russell. And thank you everyone. This was a really, really great conversation. And just a reminder to everyone, yes if you continue to submit your questions we will be exporting all of the questions that were submitted today and getting them to the panelists for answer. So you still have another minute or two to get those in. Right now we want to jump into a quick survey so we can get some feedback from the audience and see how we might improve our Webinars in the future.

If you could just please answer the first question that's popping up on your screen: the Webinar content provided me with useful information and insight. Great, we will now go to the second question: the Webinar's presenters were

effective. Thank you. Our third question is: Overall the Webinar met my expectations. The fourth question: Do you anticipate using the information presented in this Webinar directly in your work and/or organization?

Thank you and our final question: do you anticipate applying the information presented to develop or revise policies or programs in your country of focus? Thank you all so much. That's our final question for the survey. On behalf of the Clean Energy Solutions Center I'd like to extend a thank you to all of our expert panelists and to the attendees for participating in today's Webinar. I invite our attendees to check the Solutions Center website if you would like to view the slides and listen to a recording of today's presentation as well as previously held Webinars.

Additionally you will find information on upcoming Webinars and other training events. We are now posting the Webinar recordings to the [Clean Energy Solutions Center YouTube channel](#) as well. So please allow a week for that to be posted. We invite you to inform your colleagues and those in your networks about the Solutions Center resources and services including no cost policy support.

And now we just want everyone to have a great rest of your day and hope to see you again on future Clean Energy Solutions Center events. This concludes our webinar.