

Clean Energy in Island Settings

—Transcript of a webinar offered by the Clean Energy Solutions Center on 11 March 2015—
For more information, see the [clean energy policy trainings](#) offered by the Solutions Center.

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Sean	<p>Hello everyone. I'm Sean Esterly with the National Renewable Energy Laboratory, and welcome to today's webinar, which is hosted by the Clean Energy Solutions Center in partnership with the United Nations Foundation's Energy Access Practitioner Network and the International Renewable Energy Agency, also known as IRENA. Today's webinar is focused on Clean Energy in Island Settings.</p> <p>One important note of mention before we begin is that the Clean Energy Solutions Center does not endorse or recommend specific products or services. Information provided in this webinar is featured in the Solutions Center's resource library as one of many best practices resources reviewed and selected by technical experts.</p> <p>For some of the webinar features, you do have two options for audio. You may either listen through your computer or over your telephone. If you choose to listen through your computer, please just go to the audio pane in the GoToWebinar window and select the "mic and speakers". Doing that will help to eliminate the possibility of any feedback and echo. If you choose to</p>
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We encourage anyone from the audience to ask questions at any time. We have an interactive question/answer session following the presentation and we can introduce those questions then. To ask a question simply go to the "Questions" pane and submit your question there. If anyone is having difficulty viewing the materials through the webinar portal, you will find PDF copies of the presentations at cleanenergysolutions.org/training and you may follow along as the speakers present. In addition, an audio recording of the presentation will be posted to the Solutions Center training page within about a week of today's broadcast and will also be added to the Solutions Center YouTube channel where you will find other informative webinars, such as video interviews with thought leaders on clean energy policy topics.

Today's webinar agenda is centered around the presentations from our guest panelists Yasemin Erboy Ruff, Stéphane Tromilin, Stewart Craine, Yao Zhao and Chitra Narayanswamy. These panelists have been kind enough to join us to showcase IRENA's work on capacity building and assessment of non-conventional renewables in island settings. The speakers in this session will showcase financing models and capacity building efforts tailored to clean energy in island settings. They will elaborate on their current and future activities on resource assessments of renewables in the geographic contexts of the Pacific, Indian Ocean and Caribbean region, and present their respective challenges and successes to help to provide collective best practices.

Before our speakers begin their presentations, I will provide a short informative overview of the Clean Energy Solutions Center Initiative. Then, following the presentations, we will have a Question and Answer session where the panelists will address questions submitted by the audience.

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

There are four primary goals of the Solutions Center. The first goal is it serves as a clearinghouse of clean energy policy resources. Second is to share policy best practices, data, and analysis tools specific to clean energy policies and programs. Third is to deliver dynamic services that enable expert assistance, learning, and peer-to-peer sharing of experiences. And then lastly, the Center also fosters dialogue on emerging policy issues and innovation from around the globe.

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

This slide shows a little bit more about one of the marquee features that the Solutions Center provides, which is its no-cost expert policy assistance known as the “Ask-an-Expert” program. The Ask an Expert program has established a broad team of over 30 experts from all over the globe who are each available to provide remote policy advice and analysis to all countries at no cost. For example, in the area of Finance and Markets and Island Energy, we are very pleased to have Toby D. Couture, Director of Renewable Energy at E3 Analytics, serving as one of our experts. If you do have a need for policy assistance in island energy, or any other clean energy sector, we do encourage you to use this service. Again, it's provided to you free of charge. If you have a question for our experts please submit it through our simple online form at cleanenergysolutions.org/expert, or to find out how the service can benefit your work, please feel free to contact me directly at sean.esterly@nrel.gov or at 303-384-7436. We also invite you to spread the word about this service to those in your networks and organizations.

Now, I would like to provide brief introductions for today’s distinguished panelists. Our first speaker that we'll be hearing from is Yasemin Erboy Ruff, a Senior Associate with the UN Foundation's Energy and Climate team, primarily coordinating efforts to scale up energy access in developing countries.

Following Yasemin, we will hear from Stéphane Tromilin. Stéphane has been project manager at AFD’s headquarters in Paris for 3 years and is in charge of energy projects financing in India, Sri Lanka, Bangladesh, Lebanon, Burkina Faso, Dominican Republic and Ecuador.

Our third presenters today will be a team. It will be Yao Zhao and Chitra Narayanswamy from the International Renewable Energy Agency. Yao Zhao works at IRENA as a Junior Professional Associate (JPA). His work primarily focuses on helping Small Island Developing States (SIDS) develop renewable energy projects under the Global Renewable Energy Islands Networks (GREIN). Presenting along with Yao will be Chitra Narayanswamy. Chitra works with IRENA, in Abu Dhabi as a Programme Officer for Technology Support and Partnerships.

Then our final presenter today Stewart Craine and Stewart is a Founder and Managing Director of Village Infrastructure Angels. Stewart's experience includes project design and development in micro/mini hydropower design, large-scale wind farms, off-grid hybrid systems and engineering software development.

With those brief introductions, please join me in welcoming Yasemin to the webinar.

Yasemin

Thank you very much Sean and thank you everyone for joining our webinar this morning, or this afternoon, depending on your time zone. At the UN

Foundation, we have been wanting to host a webinar on energy access for islands for a very long time, so I'm very happy to be here with you today. I would like to provide a very quick overview on the Sustainable Energy for All initiative and our Energy Access Practitioner Network, for those of you joining us for the first time, before we get to the main presentations. Next slide please.

So, the Sustainable Energy for All initiative was established by the UN Secretary-General in 2011 to accomplish three objectives by 2030. These are ensuring universal access to modern energy services, doubling the global rate of improvement in energy efficiency and doubling the share of renewable energy in the global energy mix. 2014 through 2024 was also declared as the Decade for Sustainable Energy for All, which provides us a great platform for integrating energy into the upcoming sustainable development goals as well. Next slide please.

So far, 80 countries and a very large number of organizations have made commitments to support the Sustainable Energy for All initiative and a number of these commitments, on the energy access side, are from members of our practitioner network. Next slide please.

I also just wanted to point out that our webinar today, focusing on islands, falls within the broader Sustainable Energy for All and UN framework as 2014 was established as the International Year of Small Island Developing States [SIDS] and SIDS is considered a priority within the Sustainable Energy for All initiative as well. Next slide please.

The Energy Access Practitioner Network is the UN Foundation's contribution to the energy access objective of Sustainable Energy for All. We bring together a wide range of stakeholders. These are mainly small and medium enterprises and practitioners working on the ground, but we also have a large number of civil society organizations, larger corporations, government agencies, academics, basically anybody who is working on scaling decentralized energy solutions for remote or developing countries settings, are welcome to join our membership. We now have close to 2,000 members from 170 countries and we basically provide a number of doorstep services, one of which is today's webinar to convene this large range of stakeholders, communicate their successes and ongoing needs in the sector, and to catalyze action and scale up energy access efforts via partnership building and promoting new technologies and business models. Next slide please.

Just a few more words on sort of setting up the context of today's webinar, as many of you may know, the International Energy Agency estimates that decentralized energy solutions will provide electricity access for roughly 60% of the people currently living without. Islands have probably the most significant issues with energy access with the number of specific challenges. 70% of households in Pacific islands, for example, lack access to electricity. However, islands also have some of the most ambitious renewable energy targets with some island states aiming to generate anywhere from 15–100% of their energy needs via renewable solutions by the time from of 2020 through 2030. Within the context of our Energy Access Practitioner Network,

over 280 of our member organizations report operating in either Caribbean or the Pacific Islands with solutions ranging from anywhere from large micro-grids to a small scale solutions like solar lanterns.

I would now like to turn over to Stéphane to begin the conversation on the current work and challenges around clean energy efforts in island settings. Thank you all very much.

Stéphane

Hi everybody. I'm Stéphane Tromilin. I work as project manager for the French Development Agency, the AFD. I will briefly present you the public policies that have been set up in the French overseas territories. Next slide please.

First off a few words about the French Development Agency, we are developed by donor and the public bank in charge of the French ODA. We've been created in 1941 and we started our operations in French overseas territories and in Africa. Since then we extended our operations in Mediterranean countries, in Asia, and most recently in Latin America. We use mainly loans and technical assistance in order to support implementation of the project requirements and last year we committed 7.8 billion Euros in more than 90 countries. Next slide please.

Regarding islands, as you may see in the area on the left, we operate in foreign states mainly in the Caribbean and in the Indian Ocean. At the same time in the French overseas territories we are really reactive in these different islands and they are spread in the Atlantic Ocean, Pacific one, and in Indian as well. It's important to mention that for the French government the islands are considered as laboratories, you may say, in order to develop renewable energy. That's really a punier side of the French public policies' renewable aspects. Next slide please.

Okay, so we are looking at characteristics of tariffs of French islands. We have to underline that all French citizens have to pay the same price, meaning that the price in mainland and islands are the same. As the cost of generation is almost 5 times higher in islands, there is a financial transfer from the tariffs collected in the mainland in order to support the difference in the islands. At a certain point the average cost of power production in the islands has substantially increased in the past years, mainly due to the fossil fuel prices, even that most of the installed capacity in the islands relies on heating fuel and diesel. That's what you can see in the graph, which is the top right. From something around 10 Euro cents spent per kilowatt-hour in 2002, we moved to 22 cents in 2013. Regarding the evolution of the compensation that comes from mainland, that's the other graph on the bottom left, you can see the green line, which represents the state of electricity of the islands. The red one, which represents the cost of power generation...so basically it is the gray bars that you can see in between represents the financial transfer coming from mainland. It has increased a lot in the past year. The French government considers that it is really important and relevant to foster the development of renewable energy in our islands. Next slide please.

I will here focus on the PV projects, photovoltaic system, and what have been the public policies that have been set up. First of all, in the first phase, a feed-in-tariff has been set. In 2011 something like 12 Euro cents per kilowatt-hour and it has since then decreased up to 7 in 2014. Basically it depends on when you signed your PPA, your power purchase agreement. If you signed it in the second quarter of 2011 you'll have a tariff, which is guaranteed for 20 years at 12 cents. If you signed it in the last quarter of 2014 you will get 7 cents of Euros per kilowatt-hour for the 20 years to come. It resulted in a huge increase of the installed capacity of solar PV in islands, up to almost 600 megawatt in 2012. Actually, it increased so quickly that we reached the theoretical limit of 30% of renewable energy installed capacity in the local mix that has been set by the agreed operator for technical reasons, because basically the operator did not accept to bring more power than 30% for this first phase. From a feed-in-tariff we moved to a call for proposals, as all the new projects have to propose some storage. Given that it's more technically complicated, it had to be more discussed so that's why we moved to a call for proposals. It concluded to a selection of 17 projects, or almost 60 megawatts, with an average cost, which is way higher—something like 40 Euro cents, with storage that could be proposed up to six hours. Next slide please.

Regarding AFD's own experience, we financed a lot of projects in islands either with projects that signed a PPA feed-in-tariff or with projects that have been selected through the request for proposals. Given that the off-taker, which is EDF, Electricity de France, is a really strong institution, we have confidence that prices will be paid for each kilowatt-hour generated. We made direct loans to the special proposed vehicles. Generally speaking, there is one SPV project and so we financed this SPV because we are quite confident in their business model. All of these SPVs are generally set by the private sector. You get below the bottom of the slide a picture of one of the last projects we financed in la Reunion, which is an island in the Indian Ocean, which is a really interesting project as it combines PV and all electricity production and they do tables production as well. So we have really an issue in la Reunion regarding land availability and so these projects allow the combination of two different activities—electricity production and agriculture. So that's something we would definitely try replicate, duplicate, in other islands. Next slide please.

A few conclusions we could draw from our experience that we had in the different islands we operate in. First of all, is that small to medium size projects that are developed by the private sector come in really quickly. You see we reached the 30% limit within two to three years. If the feed-in-tariff is correctly set, you have really a huge interest from private companies to invest in renewable energy in the islands. In France, or in French islands I should say, it has been allowed because a lot of takers or EDF is really strong and brings confidence in the fact that all of the PPAs will be respected. If you have a strong off-taker you can definitely give up all these projects by special proposed vehicle in which the private company will take some equity but doesn't bring its own guarantee on the loads for simple technologies, like PV, because now it's definitely a major one, or for wind farms, a feed-in-tariff is definitely suitable. You will be able to attract a lot of investors but the issue is

that it's more difficult to calculate exactly the installed capacities of adequate install. As I mentioned previously, because we reached 30% limit, we had to stop the feed-in-tariff after only two years and actually that's not what was expected. There was way more, higher let's say, interest from the private companies than what we expected. So that's one of the risks of the feed-in-tariff because if you have room for only 100 megawatts, and you've got subscriptions for 1,000, it's quite complicated to say to one company—yes, you will be able to sign a PPA and say no to another one that proposed exactly the same kind of projects. For the reverse buildings, that's another way of selecting projects that is what has been developed, for example, in South Africa or in India. You just analyze the quantity of megawatts you want to be installed and then you select the project that proposes the price per kilowatt-hour that's cheaper. In India that's how it works now for solar. In South Africa that's the same and that's definitely easier using this way to sell it to others an exact idea of the installed capacity. It is that you will add on your grid.

For technically innovative projects we chose the last one that had been developed in the French islands because they include some storage and storage is not a major technology. There are different options, different equipment, that could be used. In this case we upped it for a call for projects in order to be able to compare and take into consideration different aspects. This one has been a success but actually it required a lot of work in order to select the projects as some time they were really different, one from each other.

What we have used in the French islands is net metering, which is a scheme that is developed in other countries—in Sri Lanka, Burkina Faso, or Dominican Republic—where basically you install PV panels on your roof and you will inject it in the grid and at the end of the day your electricity bill will be decreased by the quantity of electricity you injected on the grid. This scheme works if you have a high tariff of electricity. Fortunately in the French islands it's not the case because you buy or you pay for your electricity something like 6–7 cents per kilowatt-hour and it's rather complicated to produce electricity on your rooftop at a cheaper price, which is the case, for example, in the Dominican Republic where the price is around 15 Euro cents per kilowatt-hour. It's definitely worthwhile and it works quite well.

The last point and not the least is that the development of smart grids is compulsory to reach higher renewable energy integration rates. In the different islands where there's a 30% threshold that has been already reached there are a really lot of works currently undergoing in order to act on the consumption of electricity, not only on the input, but on the consumption as well, in order to increase this integration rate. So far the first results is that for la Reunion, for example, expects to be able to reach 50% of installed capacity based on renewable energy by 2020 and the ultimate objective would be to be able to reach 100% renewable energy on our grid. That's it for me. Thank you very much.

Yao

Hello? Yes. Hello. Good morning, good afternoon, and good evening. My name is Yao Zhao. I am working at IRENA International Renewable Energy Agency in Abu Dhabi. IRENA is an international organization that is dedicated to renewable energy development and IRENA was established in 2009. Now it has about 140 member countries. My work at IRENA is especially focused on small island renewable energy development. Next slide please.

As Yasemin mentioned earlier, the year 2014 was a significant year for small island states. The international community put a lot of attention on SIDS, for example, the SIDS Summit was held in Samoa in the summer. Clearly, clean energy is a big focus acknowledged by world leaders. It does make social and economic sense to develop more clean energy. The rationale for IRENA to work islands is several. The first one is the high electricity price. As you can see in the graph compared to the average electricity price in Europe, which is about 19.1 US cents per kilowatt-hours, small islands face a much higher electricity retail price. High electricity price results from expensive fuel imports and uncertainties of the future fuel prices. Most of island governments actually subsidize consumers. This is such a heavy burden on islands, governments, budgets.

The second rationale that we found was small islands spend a larger portion of their GDP on fuel imports. Again, you can see on the graph that compared to the average spending on fuel imports islands, which is about 4.7%. Islands spend about two to four times higher and that amount is actually very vulnerable to the fuel price volatility.

Sean

Yao, just to interrupt real quick. Can you go to the slide show view? We can see right now you're in the minimized view. We can see the side bar and everything.

Yao

Is this better.

Sean

Yes, much better. Thank you.

Yao

Thank you so much. Back to the presentation. As you can see, a lot of the GDP actually can be better spent on economic development, especially on those small islands that is less developed.

Lastly, as we may have all known, that islands are actually blessed with an abundance of renewable resource potentials. This is just an example that the solar resource measured in selected small islands in the Pacific. We measured the solar potential in kilowatt-hours per square meters per day and general we think 3.5 kilowatt-hours per square meter per day is classified as good potential for solar development. All the Pacific islands and other islands are well above this threshold.

I think you will see in the GREIN that we also did, IRENA, we also did a wind resource assessment that linked the potential development for wind development for several islands and you can also see the wind potential on islands is also very good. It's all those rationales and also waste received.

We've received huge demands and huge interest from our member countries, especially those small island countries, to help them develop more renewable energy systems in their countries. Therefore, at IRENA we formed two initiatives—one is GREIN, Global Renewable Energy Islands Network. It is a platform to share experiences and best practices. Six clusters have been identified from our member countries that most need from the ground: one is tourism, one is resource assessment, Islands renewable desalination, roadmaps, and waste to energy, and grid stability, and grid integration. GREIN is a platform to share experiences.

The other initiative is the SIDS lighthouses. It's more of implementing initiative. It's a holistic approach to deploy renewable energy systems on the ground. We pledge a 5-year time frame to deploy 100-megawatt solar PV and 20 megawatt wind and other renewable energy technologies.

Besides those two initiatives, today I think I'll go a little bit further with the capacity building activities we're conducting at IRENA in small islands. The capacity building is a very important pillar of our work on islands. The capacity building, we designed the capacity building program into 3 components—three major components. One is to strengthen the policy environment to train the policy makers in the small islands how to set up the targets, how to implement the targets, how to implement the right policies. The second is on the technical part—to build the technical capacities in small islands. That includes to train the local engineers, to develop the training programs for the local engineers, and to certify them. The third one, very importantly, is to facilitate the access to finance and to empower the local entrepreneurs in the small islands.

The design of the program is actually demand driven. We collect interest. We collect interest from the surveys we did with all the islands. We believe that's actually a reflection of the voices on the ground. On the policy side we have done several workshops with the small islands. One is last year in Tokyo. One is last year in Fiji, which is where we handpicked the relevant people from [inaudible 32:50] the Pacific islands, focusing on the target setting, the methodologies and best practices to set renewable energy targets. Also, we hold the options for renewable energy procurement in islands with the training on that I've mentioned—feed-in-tariff and utility led models for renewable energy deployment. The second part is that on, as I said, the technical part we provided qualified local skilled technical force to support the growth of PV. Through the training of the local engineers, our aim is to increase the confidence of the consumers and the end users of solar PV to inform them, to ensure the good quality of properly installed solar PV systems. Also, we are increasing the local job market through renewable energy on islands. Lastly, we facilitate the access to finance and empower entrepreneurs through two aspects. One is on-grid and one is off-grid. Today we are going to focus on the off-grid example. One example IRENA facilitated in Vanuatu on the solar lighting and solar at work processing systems. My colleague Chitra will take over the floor and go into details.

Chitra

Thank you Yao. Welcome everybody in joining me on this platform to talk to you. In continuing to what Yao has been explaining about our mandate on capacity building, I will talk about one specific case in Vanuatu where it's been one of the more impactful business models, which we have worked with and also our partnership with the VIA, the Village Infrastructure Angels, to support in the capacity building activities of this energy provision.

Here the initial project was to do with provision of lighting and wire charging, which, you know, supported 200 households. Subsequently in looking at the demand of the local communities there was also the livelihood that was at risk to provisions—solar, agro—systems for their domestic needs.

With regard to the capacity building, you can get capacity building if it's done in a very structured environment with methodology—one is, of course, the scoping to really see what is the kind of capacities that need to be built and also in addressing each stakeholder in the supply chain right from the PV panel confidence and manufacturers to the local importers and key to the islanders on how the local distribution will happen, and then the local operators themselves who would help in installation of the panels in each household, the power sockets and then subsequently the maintenance. We follow up and work with the technical issues and so forth. Then, of course you know, in really for the foreseeable future we look at what is the enterprise development. This strengthening of locals as entrepreneurs who can then subsequently upscale the existing project and also spread it to other villages, who once having seen this provision, are keen to have lighting and this kind of energy provision for their villages too.

The trainings were done in four sequential modules. The initial one of course was looking at the local village operators and teaching them how to operate the charging stations. Primarily a charging situation was where a local consumer would bring in his battery to charge and looking at simple trouble shooting activities. The key to the entire thing was bookkeeping because it involved payments; it involved monetary payments of so many numbers of consumers. Then if consumers wanted a higher loan or higher energy provision then they would work with the payment sequences, who are defaulting, and so forth. Then the district managers themselves, to give them an overview of what these products were and strengthen their capacities on the renewable products themselves and work with the methods to ship, invoicing and so forth.

Then, in [inaudible 38:33] in two or three months based on what was happening in the field. A local community, which included these operators and the district managers, on—how do you trouble shoot; what are problems, technical and others even in the administration that's rising; once again, strengthening of the bookkeeping education, giving them printed receipt books, how to keep logs, so forth? Then it also comes to larger system installations. Once people have lighting, if they want higher loads, let's say an icebox or they want power for their television, then what is the installation procedure? Rather than not limiting, saying it's just in this region and so many numbers of households, to see where is really the demand. Once its demand

driven then, you know, these kinds of projects are sustainable. Of course it has to have some kind of initial support recap and investment and so forth, but at least once it's demand driven then you know that there is potential and what's to be done can be done.

Then to telling them the Kiva campaign, through the crowd funding methods, and what it means to get an interest, get a loan from Kiva, the crowd funding, you know, the interest-free loans and so forth. Module 3 was in continuum. What is important is this whole kind of schedule training is to constantly take feedback into what's happening in the field, come back with a structure, training that follows the previous training, and do what the field or the stakeholders needed. So, in this it also looked at spare part management and how to procure spare parts and further on a kind of upscaling of the existing project. That's where this led to looking at also projects for livelihoods, you know, domestic needs where they looked at how this agro could be brought into replace some of the manual labor, say in coconut grating or threshing of rice or rice milling or other kinds of local needs for the island. That has been a huge success.

The final module was of course with the larger systems and deep market penetration. The entire capacity building is seen on a whole strengthens the local as an entrepreneur. It's not just about helping in a power socket or install a solar panel in a rooftop, but to kind of strengthen them as an entrepreneur by himself that tomorrow he can do the needed in putting up a business plan and becoming a local energy provider.

In terms of how many benefit. Over 200 households benefited and then 20 entrepreneurs. This was project one where solar lighting was the initiated.

Then we looked at project phase two part, which extended into solar agro-processing. The details of the business model and how it all came about will be given in detail by Stewart following me next. They also looked at from local partners to expand to other regions of the island.

With solar agro-processing these agro-machines were installed in six of them and quite a number of customers; 62 customers benefited who would use these mills for a small fee and it had become quite popular. They were also, this gave them the scope to find what were the opportunities for which this kind of solar agro-machines could be designed and used. The small film, if you take on this link, is very informative and well taken as to showing how this whole solar processing, solar agro-processing, has helped the local community. We also have a case study put up on our GREIN website at IRENA.

From IRENA's perspective, given that capacity building is one of our key approaches to strengthening and bringing about available energy into these developing and small islands, is to look at capacity building. As we take these type of projects forward, the capacity building also has to be scaled up and it would mean to us that we strength the local communities with the entrepreneurship approach and also in design, where they look at products themselves and design or customize it to their needs. That's minimized the

cost also. Finally, nothing really happens if there is no financing. How do these entrepreneurs and developers really approach small banks and financing institutions to get these small investment demands that they can be an energy provider for their local communities? Thank you.

Sean

Thank you Yao and Chitra. Now we'll turn over to Stewart.

Stewart

Good morning, good afternoon, and good evening to everybody who's on and thank you very much also for the hosts for allowing this opportunity. So I'll go into some of the grassroots details of the Vanuatu project here, how we're trying to plan Sustainable Energy for All for the one island and the whole country of Vanuatu using ideas and processes that can be replicated in any small island developing study and larger countries as well. My favorite slide for entrepreneurship in energy access in any country is just trying to survive. I don't think too many people have made huge amounts of money out of this business yet and just trying to survive through this process is quite difficult. Scaling up small projects like this to larger full scale projects that can be commercially viable is a very painful process and we welcome anyone listening to help with that scale up because I think we all know that that is one of the most difficult parts of all of this.

A quick summary of what is coming up and I'll be moving very quickly because of limited time. Apologies if I'm talking too quickly. We'll summarize the projects that we're doing, getting to the details of Vanuatu, share some of our design philosophies, tools and innovations that we've come up with that we have found a need for that no service provided or no products provided. Some of our results, to date and in the near future, plan for scaling things up.

A quick introduction on ourselves. Village Infrastructure is a not-for-profit company based in the UK, focusing on making 3–5 year loans of micro-infrastructure of villages in developing countries. We have experience over the last 15 years of helping about two million people in 30 developing countries, mostly from using barefoot power to help people get access to modest amounts of electricity and we're trying to move those models beyond what we started back in 2005. The VIA network includes quite a range of experts—investors, institutions, supply side, technology entrepreneurs, capital raising consultants, funding managers, and many others. It's not just about the direct staff. It's about a whole network that we can reach out to, which we do on a regular basis.

Sorry, I'm having a little trouble going to the next slide here. Ahh, there we go and now it jumps. (laughter) Okay, here we go.

A summary of SIDS-related projects, or our projects in general, we're working in Ghana, Vanuatu, Indonesia, Honduras, and an upcoming project in Liberia. Not all of those are small island developer stakeholders but, for example, on Honduras we are working on an island as well as on the mainland. These involve charging stations, mini-grids, and agro-processing mills next to lighting systems. We also have technical assistance projects that have helped the Asian Development Bank, World Bank, and others, helped to

plan investment, mapping of households, mass design, and mini-grids for master plans. I'm also the Working Group Chair for the UN Foundation's Sustainable Energy for All, which is why you see some mapping things happening here. I'm currently in India giving advice on water pumping using solar and Sierra Club has given some high level directives for the Sustainable Energy for All program. We thank IRENA very much for their support in bringing the idea of solar agro-processing to market.

One of the innovative tools of this report is a mapping tool to essentially know where households are located at very low cost and we can offer a free service for up to 1,000 households for anybody listening. We can map where households are actually located. So that really helps to know what the local population density is, how far are people from roads, where's the closest micro-finance network, or how to design a mini-grid for these households once, at low cost, you actually know where they are.

The Vanuatu lighting project location is on Tanna Island. You can see that relative to Australia, with one project in the central north of the island and out to the west. We mapped every single household on this island. The pilot project was only 200 households but we've mapped 4,000 households on the island with a big empty space down at the bottom right because that's a big active volcano spewing smoke into the air. Not too many people live on that but once we had all of the locations of every single house and building we were able to use big data programming languages, like R programming language, to generate minimum spanning grids to connect all of those households into potential mini-grids or stand-alone solar home systems. You can see the results of that mapping technique here, which can be applied in any country at less than 0.1 percent of the cost of actually getting them electricity. So it's a true feasibility tool.

After reviewing the lighting technologies available, we found that the Sun King Pro and a 3-lamp kit from Betta Lights were quality approved and seemed the best value for money. We added an extra battery to these kits so that one battery would be charged at the charging station where all the solar panels were kept and the second battery would be used at home to run the lights every two or three days as they interchange the battery. Households don't necessarily have the solar panel on their house unless they've already established it with payment record.

The agro-processing project location was both in Tanna Island in Vanuatu in Port Villa in the capital and also in PNG. About six or seven mills are spread across those areas. There is a variety of core agro-processing—agro-processes—that mostly women undertake in the developing countries, including threshing, pounding or grinding, winnowing, grating, grinding flour, and grating coconut.

Between these six processes, and the foods involved of those 3 or 4 major crops of rice, cassava, and corn (maize), as well as coconut in the islands that represents about 65% of all food that the poor eat. It covers a lot with just a few machines. What we're looking at doing is helping to displace the diesel engines that are being used for this process but above and beyond that to

reach in to villages where there are no diesel mills with smaller mills than 2 kilowatt, counting down to maybe 500/700 watts and building small agro-processing mills so people don't have to go long distances to transport their crops and pay an extra dollar for the transport on top of the dollar for processing, increasing their costs.

So we put 3 mills in Vanuatu—coconut grater and a flour grinder. We even installed real-time energy metering that allowed us to see the energy consumption online from the Port Villa based coconut grater, which was exciting and we believe we can do that in a remote setting as well. Out in Tanna Island we put a cassava grater, which was met with great enthusiasm by the women. During a ceremony women will spend 26 hours grating about 500 kilos of cassava for a big village ceremony. So, they don't like it and this kind of machine could help them save that. They priced that product as something they could rent very quickly.

Four mills were also installed in PNG, where staff and industry workers in a semi-urban slum and nearby off-grid villages were able to use it. These were fairly controlled conditions, not always remote. To get some feedback and visibility by key stakeholders now we want to push it out into remote areas.

The UN target for Energy Access for All is 2030 and access to energy cannot just mean lighting and phone charging, which I think there is pretty broad agreement on. That's a starting point but not an end point. We're thinking that an access to energy package may be the Tier-2 collection as in some of the papers as I'll mention later, but it also has to include community and business scales and uses, such as refrigeration, better communication to get these villages online and their products seen, and also to get the data back to the machines to see how they're operating and productive power for processing crops so that women aren't smashing up their crops with sticks and stones for the next 15 years. In other words, a Tier-2+ service package, which we believe can be delivered for less than 50 watts per household, maybe less than 150 kilowatt-hours per year, well under what the IAA believe, of 250 to 500 kilowatt-hours per year per house.

A few of you might have seen these tier based systems. It's very consumer focused at the moment. That's talking about lighting and televisions and fans for TV, but it doesn't account for the community scale stuff. So we think the Tier-2+ is what access to energy actually means.

There's a great opportunity in agro-processing and solar water pumping and other forms of improved productivity, particularly for women. If we could save one hour per day, which in agro-processing all by itself could do, let alone water pumping. You would save 100 billion hours per year of productivity, which is equivalent to the entire workforce output of the UK or France. We really believe that solar has now come down to a price where it can do that and the French Aid Agency recently recognized solar agro-processing being one of top twelve leading global innovations in agriculture, which is great but it does need a bit more patient loans financing than just the 6–8 month payback produce we see for lighting. We need to push it out 2–5 years and seeing best who is willing to take that risk.

A few quick photos to speed things along. This is what agro-processing manually looks like. This is cassava being grated on Vanuatu and this is the mill, very small scale as you can see. That turned that same job from a few minutes for a piece of cassava to a few seconds. The looks kind of explain the reaction that we had. They were very happy to be out of process that quickly. We also did coconut grating. You can see our field partner there from active assisting one of the entrepreneurs to understand how to do that and the solar panel in the background. That grated coconut was put in the local market to sell.

The lighting has helped with studying and you can see some of the basket weaving that's happening at night now under improved lighting conditions. There would be more hours available with the cassava processing to help that.

There is a bit of history here about the lighting project. I won't go into it in detail but highlight the IRENA support there for capacity building, mobilizing the first \$40,000 of investment, and now we're preparing to scale it up about 10 fold if we can find the investment to help support that and get electricity to about half the island.

The back of the envelope financial model sees a \$200 installed cost by construction investors and then separate lending investors may take the risk after the project is built, providing an exit for construction investors in a fairly innovative model. At \$3 per week the project brings in \$450 over three years, giving a gross profit that's shared between the people collecting money, people making Kiva profiles to put these projects online, VIA, and the investors. So, we believe there is enough there to withstand substantial default rights as well. If we can get up to 1,000 on 2,000 households, then we can actually get a break of even scale of a small team fully engaged to manage those assets. This is one of the dangers of pilot projects as they get stuck at the pilot level and they don't scale up.

What's an access to energy power station look like? It looks like the pay-as-you-go sort of lighting systems that we're seeing at the moment, but we're adding on milling. It's not a lot extra. It's maybe 25% extra budget. It is a longer payback period for that component but combined it may not be that much of an extra-long payback period. It's maybe a 1-year payback for lighting and 4 years for mill and might be 2 years all together for the project. It's still quite viable. If you take a global look at that, how much energy is going to be needed? We did a paper with Sierra Club and Laurence Berkley Laboratories, who is key in identifying kerosene lighting expenditure, which was huge in the early days of the LED lighting industry. This is a model that we've developed that we think can show how the growth of Energy Access for All, including grid extension—mini-grids and solar home systems—can grow to 2030 and achieve the goal that we require, including the sort of capital mobilization, most of which is lending capital. There are stepping-stones along the way to say how much we need and most of it is not about equity. We need to start lending and making these products affordable over 3–5 years instead of selling for cash, which I think we're already seeing the big wave of that change happening with pay-as-you-go solar.

We have not had any technical problems. The products have moved very nicely. We've seen almost a dip in solar lantern demand as everybody wanted 5–10 watt kits because there was very little upfront cost. That's interesting that we can actually help people get to more power sooner and the lanterns that were popular really no longer are. There are some repayment issues but it's mostly actually with the regional managers and not the households or the entrepreneurs at the village level. So we're looking at pay-as-you-go technology to maybe eliminate the regional managers from the equation or at least make them a little bit more accountable.

We put these projects on Kiva as well and got crowd funding involved and we got the first \$10,000 of projects refinanced on Kiva in less than 4 hours, which was really fantastic. I believe there's huge potential for crowds to take these 3–5 year lending risks but also impacted investors should be able to match that dollar for dollar at least to help mobilize both institutional and crowd or angel money together.

You can see a little bit here about the Kiva profiles. You've got the proof of the pudding there and some of the profiles that we organize and the repayment strategy that's coming through. We also appreciate a 25% risk guarantee from Rotary Melvin for that project. There are some details here about the scale up of what we're trying to do. The installed cost is about twice the cost of the FOB cost from China. Because the importer doesn't have to actually sell the product themselves, they just freight forward it to the village, it's in and out of their warehouse very quickly and so you can probably exist on smaller margins from the importer as well and get things out more efficiently. We make about 10% during the project management of the construction of these projects and another 10% managing the assets. It's more than a normal fund manager because we're out there on-the-ground training entrepreneurs and things like that. So to cover say \$150,000 a year of costs we need to mobilize a \$1.5 million asset portfolio before we can stop doing consulting and do full-time project management. That's really the challenge in front of us now for the scale up and for a larger team you need about \$5–\$10 million, still less than a venture capital fund model. They need, say, \$30 million for breakeven.

A few key web links here, which I won't dwell on too much, but feel free to have a look through them. There's a house mapping service. There's a free atlas there with 500 layers of useful data and 2 million data points. There's a mini-grid mapping example, the agro-processing video example, the white paper on how to get to Sustainable Energy for All by 2030, and the project reports from the IRENA capacity build.

That's my email for any questions. I'm more than happy to hear from you. Thank you very much. Over and out from here.

Sean

Great, thank you very much Stewart and thank you very much to the panelists for your presentations. We do have a number of questions that came in from the audience so we'll move right on to that. Just a reminder to our attendees today that if you do have any questions for the panelists you can submit those through the questions pane in the GoToWebinar window.

Going back to the first question we received. This question is for AFD for Stéphane. They ask—how do the PV power plants in la Reunion perform when exposed to the storms? Do they have a good survival rate or perhaps, if not in Reunion, if there's any similar situation that you can discuss?

Stéphane

Yes, thank you for all the questions. Actually for PV power plants on ground there isn't too much trouble as they are fixed on an iron structure. For example, the greenhouse that I showed in one of the last slides it's an anti-cyclonic greenhouse. So, there are some structures, which are particularly designed for storms but that's for PV where it's not that much trouble. That's a really good point for wind farms actually. There are some in la Reunion and Guadalupe as well with some windmills that you could, you can bend particularly or dis-install within one hour. So that's something you can erect or lay down in one hour, so when a storm is announced. All the wind farms on the French islands could just be laid on the ground. That is a particular technology that has been developed by a French company called Vernier.

Sean

Great, thank you Stéphane. We'll actually stick with you for the next question. Just a general question from one of our attendees that asks—why are fossil fuels so expensive in small islands and what are the reasons for the high transfer costs of power?

Stéphane

Actually there is no, obviously no, petrol or oil generation on the island. On top of that there is no, how do you call it...to transform basically the oil in a refinery. There isn't any on the island so basically you need to import directly some fuels, which are ready to be used. So directly diesel or EV fuel or EV fuel oil and that needs to be brought by tankers and actually that's why it's so expensive on the islands.

Sean

Great, thanks again Stéphane. Moving on now the next question is going to be for IRENA. It asks about your three capacity building pillars that you discussed. They're wondering how are those managed? Is the technical capacity building done by separate teams and a separate team for policy and then another separate team for finance etc. and how much do those teams work in concert with one another?

Yao

Thanks for the question. Actually, those three pillars—policy, technical training, and also finance and entrepreneurs are all done by the IRENA capacity building team under the country support and partnership division. It's done by one team but we also reach out to other divisions at IRENA because IRENA has divisions focused on technology and also one division focused on finance and policy. So we basically got country requests from small islands—their demands, what their interests are—and then we design the training. In the process of designing the training and asset-building program, the CSP or Country Support Partnership division will consult with other divisions to deliver the products.

Sean

Great, thank you Yao and another question for IRENA for Yao and Chitra—what is the zero subsidy energy-lending model that you discussed? Can you elaborate just a little bit more on that?

Chitra This is primarily what I think Stewart has a better handle on because he's the one who's been working with the financing. I'll let Stewart answer this question.

Stewart Sure, the lending model offers a one-lamp system to households with phone charging capability for \$1.50 per week per house. In Indonesia we're doing something similar over 5 years instead of 3 and can bring that down to \$.75 per week, so we're really trying to make it as affordable as possible, or a three lamp system for \$3 per week for 3 years or maybe closer to \$1.50 per week or \$2 over 5 years. The cost can come down and be more affordable if the lending term goes out. We're starting to see batteries that can actually last 5–10 years as well with lithium ion phosphate and similar. The only thing that doesn't last at the moment for 5 or 10 years are the bankers. Basically that's the pitch that we give and we find that 80–100% of households go for the larger 5 watt kits. Over time we collect those funds. We leave 10–30% of the gross revenue with local partners for collecting the money and bringing back 80% or 90% or maybe as low as 70% of that gross revenue to the investors, of which we need a little bit too to help us manage the assets. I hope that makes that clear. For the agro-processing, again, it's similar—3–5 years and the cost of the service from the solar mills is typically around 2–4 cents per kilogram or \$1 per bag.

Sean Great, thank you Stewart. The next question states that Stéphane mentioned successful feed-in-tariffs in his presentation. This attendee is concerned about the poor. Can you, Stéphane, maybe to start with and then maybe we can open that up to other panelists? Can you comment on the implied inequity of richer citizens who can afford solar receiving subsidies from the poor who cannot? I can repeat that real quick. Can you comment on the implied inequity of richer citizens who can afford solar receiving subsidies from the poor who cannot? You are still muted.

Stéphane My bad, excuse me. Thank you for the question. Actually it's considered that it should be that electricity is a basic need, basically, and that everybody is allowed to accept it at the same rate. So it's considered that you need equality and that's how it's perceived in France. Everybody has to pay the same price for electricity. There are no subsidies between rich and poor, but actually there are more subsidies from mainland where the tariff or the production costs are low, because we have a lot of nuclear power plants, to highlands where the cost of production is high. The idea is to have more equality between citizens instead of subsidies between rich and poor.

Sean Thank you Stéphane. For the sake of time I'll move on to the next question now. This attendee states that IRENA has funding possibilities through the ADFD for large renewable energy projects. Is there any possibility that IRENA can assist in financing of smaller scale renewable energy projects below 100,000? Remember that for small islands such figures, even though small can go a long way in creating livelihood for a large part of the relatively small populations. Are there any funding possibilities from IRENA for projects smaller than 100k?

Yao I'll address this question. That's actually a good question. IRENA has been facilitating ADFD, Abu Dhabi Fund for Development, to develop, as you said, large projects on islands, in Africa, and other places. In terms of small projects, IRENA is not an implementing agency so we don't actually get into direct financing of small projects. What IRENA can do is to facilitate and try to find donors who are interested in those projects to put those projects into perspective with private sector and donor countries. I think that's IRENA's role. Unfortunately IRENA doesn't get into direct financing into small projects.

Sean Thank you Yao. The next question is for Stewart concerning VIA. What is the scale model from electrifying individual homes to having an electricity network? Why did you choose to look at a network model versus solar for individual homes and who will be the utility that will manage that network?

Stewart Thanks a lot. One of the things about solar home systems and pay-as-you-go solar is its okay for lighting and phone charging but you can't run the mill off it. So there is a need to get hundreds of watts and kilowatts of solar in a centralized location so that we're able to run more advanced productive end uses. Now that doesn't necessarily mean that we have an end grid and in Vanuatu we don't. We've got a charging station. People can bring batteries back and forth to that larger charging station. As investor's confidence increases, we can go back to that village later with mini-grid networks and as the confidence increases again we can start inter-connecting those networks. In a way I call that reversing rural electrification, building the networks, getting lights in first, then putting in house wiring, house-to-house mini-grid wiring, and then village to village interconnections using similar, sort of, interconnection inverters that you might need for connecting a house in Australia to the grid that would be enough for a whole village in these other countries. Investors are not ready to put down that money in one go right from the start and it's a bit risky because you don't know which of a hundred villages is going to default. So you want to find that out first with a small, shorter-term investment before you start bringing in the larger long-term financing. Also, it comes down to house-to-house distances. You don't want to build a mini-grid for houses that are 300 meters apart. It's better if they're just 50 meters apart. It's always going to be a mix of solar home systems and mini-grids, in my opinion. That's why we do the mapping to work out how.

Sean Great, thank you Stewart. This question is for all the panelists. It asks—how is the education sector integrated? On small islands maintenance is often a problem. How do you separate training for technicians as well as policy makers in these small island settings?

Stewart I can start with this one. We do monthly collections from the villages, which gives us an opportunity to do technical checks and technical skills and advances. It's not all about financial and bookkeeping. There're also technical possibilities there if you've got a regular plan to visit, similar to a loan officer from a micro-finance organization going out and visiting the entrepreneurs every two to four weeks. There's not a lot of difference in the way that we've designed this. For the policy makers we try to alert them of the different

innovations, like solar agro-processing, like mapping the households of low costs and things like that to keep them abreast of what's happening out there in the industry and letting them know maybe if ADFD funds are available for large scale stuff. We do seem to be missing some options for policy makers to tap into off-grid funding as well but maybe that's something that can be worked on a little. So, with regular visits, both from VIA to our field partners and from our field partners to the entrepreneurs and households then we think there's a continual communication path there to help support into the future as well.

Stéphane

Right regarding, so, Stéphane speaking from AFD regarding the French islands some particular studies have been set up in the different universities in order to train some engineers dedicated to the renewable energy sector and at the same time there are some centers of expertise, which have been created by [Inaudible 1:18:09], which is the French public institution in charge of promotion of renewable energy and energy efficiency and where they train some technical staff basically to maintain and install all the different plans.

Sean

Great, thank you both. We'll move on now to the next question. One of our attendees states that they're working on a loan guarantee program in Barbados, which can be used to leverage investment by SMEs for renewable energy investment. Are there any such guarantee schemes currently going on in the South Pacific?

Stewart

To the best of my knowledge there are no risk guarantees happening. There's lighting PNG coming in but that's really focused on small, less than 5 watt, lanterns, which we believe if households have access to lending capital, of maybe one or two or three years, the demand for such lanterns would drop out completely and we'd be able to get more people larger systems as well, but there's an additional risk in lending to the poor, particularly in the South Pacific. It's not a strong micro-finance area and so risk guarantees are something that are needed. I've brought this up with multiple agencies—ADB, UN Foundation, and World Bank and whatever, but the South Pacific is very much off the radar for a lot of people. A lot of these funds are just focused on India or Africa where the big numbers are and these seats often get left behind with not being eligible for about 80% of the money that's on the table.

Sean

Great, thanks again Stewart. Next question asks—taking the example of milling, the milling systems that were implemented, can fishing communities also be involved. For example, refrigeration on boats, and for storage and ice making on shore and are there any examples of this that you know of?

Stewart

The short answer is yes, absolutely. I see that as a key part of the access to energy Tier-2+ package to get, not necessarily refrigeration into every house, particularly because small-scale refrigeration is highly inefficient compared to larger scale refrigeration. Getting community level refrigeration and also making sure the health clinics can benefit from that, for their vaccines, is a big part of the equation I think. We do get repeated demands for fishing solutions and ice making solutions on boats to extend their time out on the water and we're actively working on that, but at a very slow pace with not a

lot of investment interest for that, but certainly the market is there in every island we've ever been to.

Sean Thanks again Stewart. Next question again is for all the panelists, so feel free to jump in. It asks—is there potential for securitization type transactions on the islands given the challenge of size and scaling in financing?

Stéphane I'm not too sure I understood.

Stewart Want me to jump in again. There we go. You go Stéphane.

Stéphane I was just asking to rephrase or hear again the question because I'm not too sure I understood it correctly.

Sean It just asked—is there potential for securitization type transactions on the islands given the challenge of size and scaling in financing?

Stéphane Yeah, that's actually a really good point particularly on the donor side and for the main investing banks. Let's say that we can make some loans from say from 1–10 million Euros. It's quite easy to do so. If you're below 100,000 Euros you can, more or less, find grants from different international organizations. The funding gap would be between 100,000 Euros and 1 million. That's where, basically, the need investments is more important for islands as you are looking for installations of 1 megawatt or between 100 kilo and 1 mega. Actually, I have to say that on the donor side that's a target quite difficult to reach as we've got some costs, quite important ones. We're like big boats and it's not really easy to change from one direction to the other so it takes some time and of course money to appraise a loan and I think that donors in this case will not be able to meet this kind of requirement. That's one of the major financing issues that needs to be addressed for islands but I know that some donors are working on a kind of, not a trust, but a platform where a number of money would be committed on aggregated projects. That's maybe the way to go in order to be able to access funding—to aggregate different projects in order to have or require financing, which would be above 1 million Euros.

Stewart To complement those good notes and noting the titanic nature of some of these fund managers.

Stéphane (laughter) Not that many. Like the France.

Stewart Queen Mary perhaps. This is why the Angels compliment the funds quite well, and I mobilized both in the barefoot power days and we could see a direct correlation that no start up would be surprised about. Angels move faster, even though they're smaller. They can do smaller, more nimble deals, which can complement and give a rich pipeline of deals for the larger funds to then take up and stay once things have been worked out. I don't see them as competitive but it's complimentary and, when it comes to securitization, solar grid connected on households has already happened in the USA and Australia. About 10% of Australian households have solar if not more. This is pretty much an accepted situation and an accepted deal. It can be replicated

for the villages, take Vanuatu one of the smallest markets on the planet, 30,000 households off-grid, \$200 each. You could do the whole lot for \$6 million dollars. Each individual village or even each individual household could be done for either a \$200 ticket or a \$10,000 ticket, but aggregated together it's a \$6 million deal, which becomes interesting. At the smaller level entities like Kiva are making available 0% interest for 5–10 years. That is allowing micro-securitization very affordably at rates you can't even get from the World Bank, even if you're lucky enough to get them. It's not just about large-scale securitization. In my opinion, I think micro-securitization can also happen if you can rinse and repeat your projects in a very quick and efficient and reliable matter. Some of them are not going to work out because if you spread the risk across 1,000 little projects then you're going to be able to work out what that is. I think the pay-as-you-go solar guys are already demonstrating that with \$100 million raised in the last 80 months.

Sean

Great, thank you Stewart. We have time for just one more question. I just have to keep the responses a little brief, maybe 30–40 seconds each. The first part of this question is for Stewart and then the second part I think applies to everyone. The first part—how is the competition on the ground to capture the market with solar lamps and mobile chargers as well as competition on the fund to do the renewable energy services? Then the second part of the question—how would you all like to rationalize approaches in the market and funding to maximize benefits to the remote communities?

Stewart

Well, for part one, competition; Vanuatu is a big cash sale promotion system with outside support back in 2010–2012, which got a lot of people lanterns. That didn't mean that there wasn't demand for larger systems. In fact, a good number of those lanterns eventually died after 3 or 4 years. The solar panels are fine but there are either loose connections or the batteries died or whatever. Particularly as those were the days before lithium ion phosphate really took off. In Indonesia, not much competition other than from government giveaway programs. That's one of the biggest competitors that we have to deal with.

Sean

Great, would anyone else like to add on to that response on how to rationalize the markets?

Chitra

Rationalizing the market really is all about going through this transition period where at these projects and these energy access initiatives have to happen, which is as much grant based as much as there is some amount of private investment. Energy access right now, though the focus is really just on domestic lighting by charging, that needs to translate, as the others were saying, to a Tier-2+ level where also livelihoods are seen as potential, which in itself I think will bring the market into sustaining itself where livelihoods includes income generation and helps these poorer communities to pay for their electricity service and sustain these kinds of energy provisions. The first step has to be taken where investments are more forthcoming. There is a larger giving through grants. A set of these projects can kick start the whole thing so that that market builds.

Sean

Great, thank you. We do have to wrap up now as we're running out of time. I'm sorry if we weren't able to get to all of the questions. What I will do is I'll take those questions that we weren't able to address and email the panelists following the webinar so that they may respond through email.

Now we just ask attendees if you could please just help us evaluate our webinar by participating in a very quick survey. It's just three questions that we have for you. The first question is—the webinar content provided me with useful information and insight. The second question is—the webinar's presenters were effective. And, the final question is—overall the webinar met my expectations.

Great, thank you for answering our survey. On behalf of the Clean Energy Solutions Center, I would like to, once again, thank all of the panelists for their presentations today, and also to our attendees for participating in the webinar. We very much appreciate everyone's time and I do invite the attendees to check the Solutions Center web site if you'd like to download the slides or listen to a recording of today's presentations, as well as any previously held webinars. Additionally, you will find information on upcoming webinars and other training events. Just a reminder, we are now posting webinar recordings to the Clean Energy Solutions Center YouTube channel. Please allow about one week for the recording to be posted. We also invite you to inform your colleagues and those in your networks about Solutions Center resources and services, including no-cost Ask-an-Expert policy support. With that, I hope everyone has a great rest of your day and we hope to see you again at future Clean Energy Solutions Center events. This concludes our webinar.