

# Empowering Livelihoods: New Research on Off-grid Appliances and Equipment

—Transcript of a webinar offered by the Clean Energy Solutions Center on 23 October 2018—  
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## Webinar Panelists

**Jem Porcaro**  
**Erboy Ruff**  
**Elisa Lai**  
**Michael Kuntz**

## This Transcript

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## Katie

Today's webinar is focused on empowering livelihood, new research on off-grid appliances and equipment. Before we begin, I'll quickly go over some of the webinar features. For audio, you have two options. You may either listen through your computer or over your telephone.

If you choose to listen through your computer, please select the "Mic and Speakers" option in the Audio pane. Doing so will eliminate the possibility of feedback and echo. If you choose to dial in by phone, please select the "Telephone" option, and a box on the right side will display the telephone number and audio PIN you should use to dial in. If anyone is having any technical difficulties with the webinar, you may contact the GoToWebinar's Help Desk at 888-259-3826 for assistance.

If you'd like to ask a question, we ask that you use the "Questions" pane where you may type it in. Also, the audio recording and presentations will be posted to the Solutions Center training page within a few days of the webinar broadcast and will be added to the [Solutions Center YouTube channel](#) where you'll find other informative webinars as well as video interviews with thought leaders on clean energy policy topics. Finally, one important note 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 resource library as one of many best practices' resources reviewed and selected by technical experts. Today's webinar agenda is centered around the presentations from our guest panelists, Yasemin Erboy Ruff, Elisa Lai, and

Michael Kuntz, who have joined us to discuss the role of off-grid appliances and equipment in power resource constrained communities.

Before we jump into the presentations, I'll provide a quick overview of the Clean Energy Solutions Center, and Jem Porcaro, from the United Nations Foundation, will provide an overview of the Energy Access Practitioner Network. Then, following the panelists' presentation, we'll have a question and answer session where panelists will address questions submitted by the audience. At the end of the webinar, you'll automatically prompted to fill out a brief survey as well, so thank you in advance for taking time to respond. The Solutions Center was launched in 2011 under the Clean Energy Ministerial. The Clean Energy Ministerial is a high-level global forum to promote policies and programs that advance clean energy technologies, to share lessons learned and best practices, and to encourage the transition to a global clean energy economy.

Twenty-four countries in the European Commission are members, covering 90 percent of clean energy investment and responsible for 75 percent of global greenhouse gas emissions. This webinar is provided by the Clean Energy Solutions Center, which focuses on helping government policy makers design and adopt policies and programs that support the deployment of clean energy technologies. This is accomplished through the support in crafting and implementing policies relating to energy access, no-cost expert policy assistance, and peer to peer learning and training tools, such as this webinar. The Clean Energy Solutions Center is co-sponsored by the governments of Australia, Sweden, and the United States, with in-kind support from the governments of Chile. The Solutions Center provides several clean energy policy programs and services, including a team of over 60 global experts that can provide remote and in-person technical assistance to governments and government supported institutions; no-cost virtual webinar trainings on a variety of clean energy policy topics; partnership building with development agencies, and regional and global organizations to deliver support; and an online library containing over 5500 energy policy related publications, tools, videos, and other resources.

Our primary audience is made up of energy policy makers, and analysts from governments and technical organizations in all countries, but we also strive to engage with the private sectors, NGOs, and civil society. The Solutions Center is an international initiative that works with more than 35 international partners across its suite of different programs. Several of the partners are listed above in the slide, and include research organizations like IRENA and IEA, and programs like SeforAll, and regional focused entities such as ECOWAS, the Center for Renewable Energy and Energy Efficiency. A marquee feature of the Solutions Center provides is the no-cost expert policy assistance known as Ask an Expert. The Ask an Expert service matches policy makers with more than 60 global experts selected as authoritative leaders on specific clean energy finance and policy topics.

For example, in the area of appliances and equipment, we are very pleased to have Christine Eagan, executive director of CLASP, serving as one of our

experts. If you have a need for policy assistance in appliances and equipment, or any other clean energy sector, we do encourage you to use this valuable service. Again, this assistance is provided free of charge. If you have a question for our experts, please submit it through our simple online form at [cleanenergysolutions.org/expert](https://cleanenergysolutions.org/expert), and you can see the link on the slide above. And we also invite you to spread the word about this service to those in your networks and organizations.

Today's webinar is co-moderated by Jem Porcaro, who is the UNF senior director for energy access. He oversees the foundation's work to expand access to modern energy services and build synergies with UN agencies and other key multilateral partners, especially Sustainable Energy for All. And now, I'd like to introduce our panelists for today. First up is Yasemin Erboy Ruff, who manages the efficiency for Access Coalition, and oversees associated communications activities around the coalition as well as UK aid-funded low energy inclusive programs. Following Yasemin, we'll hear from Elisa Lai, who is the leading technical expert on off-grid appliances and managing the global leap off-grid appliance data platform in much of CLASP's related test methods of development and quality assurance work.

And our final speaker today is Michael Kuntz, who's the president and CEO of Simusolar, a financier and distributor of off-grid agriculture and fishing equipment in Tanzania. And I apologize—we are having some technical difficulties. And now, with those brief introductions, I'd like to welcome Jem to the webinar.

**Jem** Thanks, Katie. Much appreciated. I'm gonna just pull up my screen here. Let me know if you can see this. Can you all hear me?

**Katie** Yes, we can hear you and we can see your screen. If you just want to put it in slide show mode—

**Jem** Perfect.

**Katie** Perfect. Wonderful, Jem. Welcome.

**Jem** Thank you, Katie. Pleasure to be here, again, co-moderating this exciting webinar. Again, my name is Jem Porcaro. I manage the UN Foundation's Energy Access program and, as Katie said, my role really is just co-moderator, so I'm gonna try to say as little as possible, get out of the way, and let our speakers have some time to present. And then, I will help facilitate a little bit of discussion on the back end.

But, before I do that, just a quick word about the Energy Access Practitioner Network for those of you who may not be familiar with it. We, too, were established in 2011, really, for the purposes of helping catalyze and grow kind of a more thriving, global, distributed energy access sector. We do that principally by connecting our membership, which now includes about 2,500 individuals who are working in about 170 countries around the world to news and information, industry insights, market intelligence—like what we're gonna hear a little bit more about later today—and most importantly, to

themselves. So, we facilitate a lot of peer to peer learning, brokering partnerships. So, over the years, we kind of started out about 20 members; as I said, we're about now up to 2,500, making us one of the largest networks of its kinds, really, for kind of providing an unparalleled platform for better understanding the opportunities and challenges that we all face in the energy access sector.

So, a little bit about the webinar itself. I think most of you on this webinar probably would agree with me in that the appliance market often receives less attention than typically the solar home system and mini-grid markets. And yet, it remains a critical and growing part of the overall energy access value chain. In fact, I think it's fair to say that in order to reach its full potential, the global off-grid clean energy market really needs a complimentary market for high quality [Inaudible due to technical difficulties] meet off-grid consumers' needs. And so, it was really with that in mind that we decided to put this webinar together, really to examine how underserved communities can tangibly benefit from the development of highly efficient off-grid appropriate products.

And we wanted to draw on two recent pieces of market intelligence, at least one of which the Energy Access Practitioner Network partnered on, and that first one is the 2018 Off-Grid Appliance Market Survey Report, which I know Yasemin will delve into a little bit more in detail. But that really examines the evolving perceived demand for an impact of different products within the off-grid appliance market. The other piece of market intelligence that I think we're gonna touch on today is the Appliance Data Trends report, which examines, in more detail, the market trends for those appliances most in demand by un or under-electrified consumers. And that specifically means off-grid appropriate TVs, fans, and refrigerators. And these two products are really the product of the Efficiency for Access Coalition, which again, Yasemin and Elisa will talk more about.

So, our hope for today is that our panelists, our speakers, will react to some of the findings from these two reports, specifically touching on issues that relate to productive uses, income generation, gender, consumer protection, quality assurance, and impact. So, with that, I'm gonna hand it over to Yasemin. Obviously, I encourage all of you to follow us on social media. I've included our social media kind of handle and with that, I'm gonna hand it over to Yasemin.

**Yasemin** Thank you very much. [Loud echo] Sorry about that. Hopefully, you can hear us okay now.

**Katie** Yes. We can hear you loud and clear.

**Yasemin** Hello, everyone. Can you hear us okay?

**Jem** Great. Yes, we can.

**Katie** You should have the pop-up on your screen. Can you see it?

**Yasemin** Yes. Are you able to see our screen now?

**Katie** No, we are not.

**Yasemin** Okay. One second. How about now?

**Katie** Yes. If you want to put it in presentation mode...

**Yasemin** Is that good now?

**Katie** No. We're still seeing the slides.

[Crosstalk]

**Yasemin** Okay. I think there is just a little bit of delay. Let me see if we can change anything on here. How about now?

**Katie** No, I'm sorry, we're just still seeing the same frozen screen.

**Yasemin** Okay. Katie, could you take the presenter back and give it back to me again? Maybe we can just try?

**Katie** Yeah. Absolutely.

**Yasemin** Sorry about that everybody.

**Katie** All right. You should be [Inaudible due to lots of echo] on your screen again.

**Jem** Perhaps as we wait for this [Echo] up, I'll just introduce Yasemin's presentation in terms of what she's gonna be [Inaudible due to poor audio], provide a little bit of review of the survey report that I mentioned, and we'll kind of close touching up with us—[Inaudible due echo and poor audio] that I mentioned earlier, including gender [Inaudible due to poor audio].

**Katie** And I'm sorry—we're having a lot of feedback and echo. Yasemin, did you join on two different connections? Are you joined on two different computers or called in and on a mic?

**Yasemin** No, we are only on one computer, but we have been having technical difficulties. Katie, why don't—would it be possible for you to share the screen and then, I can just speak through the slides.

**Katie** Yes. We will happily do that.

**Yasemin** Let's do that so that we don't waste anybody's time. But I can get started on just introducing myself and saying, "Thank you" to everyone. Apologies. Thank you for your patience and we're very happy to be here today as part of our joint collaboration with the Energy Access Practitioner Network as well as Power for All on our productive use month. Throughout October, we have been using the hashtag #ProductiveUseMonth and talking about the role of efficient appliances from a productive use \_\_\_\_\_ as well as customer perspective.

So, we're looking forward to talking about some of that with you today. Katie, do we have the slides ready?

**Katie** We are pulling them up right now.

**Yasemin** Perfect.

**Katie** All right. We have them up on the screen. Once again, welcome to the webinar and for our attendees, my apologies for the technical difficulties, and we'll continue on.

**Yasemin** Yes. Thank you so much. Katie, could we move on to the second slide, please? Great. Thank you so much. I want to kick things off by looking at the broader picture and give everybody a little bit of context around our theory of change.

As you know, and as most of you are a part of, the off-grid solar market continues to grow rapidly, and a key driver of this growth is the increasing uptake of solar home systems and similar off-grid systems that are large enough to power household appliances, as well as an increasing awareness of the transformative potential for such distributed renewable energy systems to power productive use appliances. So, our theory of change looks at the energy efficient appliances as a catalyst in scaling energy access. Next slide, please. As you can imagine, many people think that appliances still consume too much energy to be compatible with something like a solar home system. Here, we show, in green, the amount of PV and battery capacity that is needed to run off-grid appropriate refrigerator, along with four LED lights, a radio, a phone charger, a fan, and a TV.

The orange icons, in contrast, show the amount of PV and battery capacity you would need to run the same system with an average conventional on-grid refrigerator. So, to power the on-grid product, you would need almost nine times the amount of PV and more than eight times the battery capacity. As you can imagine, the cost of such a system also, at this size, would be prohibitive for a lot of off-grid customers. So, if products are designed and developed explicitly for use in off-grid and weak grid resource constrained settings the market opportunity grows considerably. Next slide, please.

**Katie** Just one moment. We're switching presenter mode. We're having some technical difficulties on our end as well today so, just one moment and we'll get it back up on to the next slide.

**Yasemin** No problem. I can still start talking about it. You will soon see a similar diagram to what we just showed, but going a step further, will be you want to be looking at appliances outside of a vacuum, too, beyond the individual pieces of just household level appliance use to holistic ecosystems powering and scaling energy access. There are positive signals from energy access professionals as well as development and finance institutions and other funders engaged in this sector, including our Efficiency for Access Coalition's donor roundtable, which I will get to in a just a second, towards a more holistic approach to electrification. Now that we have the slide up, you will be

able to see what we're talking about, as we mean that there's a growing interest in enabling and scaling higher levels of energy access, but that go beyond household electrification to powering appliances for productive use as well as for public institutions such as schools and health clinics.

Here, we show that the same size energy system that's required to power an inefficient \_\_\_\_\_ refrigerator could actually power a far more expensive load when a super-efficient refrigerator is used alongside a suite of other efficient appliances and medical devices. However, very little market data exists, in general, to inform potential investment business and design decisions for market actors looking to expand to new product areas, whether they're household, productive use, or health care use. The work we will present today hopefully will be a key input to informing this prioritization. Next slide, please. Before getting into the insights from the two research reports that Jem mentioned, I also want to briefly introduce our Efficiency for Access Coalition.

You might have heard of the Efficiency for Access framework, which began as the global campaign to harness the game-changing power of energy efficiency to drive universal energy access and enhance energy services beyond lighting by 2030. It was re-launched in late 2017 with the support of UK government's DFID and current coalition members—or, I should say, current donor roundtable members, include UKAID, Power Africa, ESMAP, IFC, the World Bank, Shell Foundation, Rockefeller Foundation, Good Energy Foundation, GIZ/EnDev, and, most recently, we're very happy to welcome DOEN Foundation, also, to be coalition family. CLASP, alongside the Energy Saving Trust—or EST—serve as the secretariat of the coalition, and we also manage the LEIA program, which I will get to in a second. Next slide, please. This slide quickly shows you the breadth of our coalition members' current activities across different technologies and geographies.

You can see the little icons representing the technologies and the dots representing different donors. So, it's quickly—you can see, for example, that refrigeration is on top of every coalition member's mind. And our goal is to grow this footprint in future years. You can visit our website, [EfficiencyForAccess.org](http://EfficiencyForAccess.org), to learn more about each donor organization as well as the work that they do on different technologies. Next slide, please.

And since I had just mentioned the LEIA program—or Low Energy Inclusive Appliances—just want to mention that it is the flagship program under Efficiency for Access and is funded by DFID for five years as a research and innovation program. Next slide, please. LEIA's goal is to help halve the cost and double the efficiency of our range of off and weak-grid appliances in least developed countries. Here, you can see the different technologies that focus currently under LEIA. They're divided into near-to-market technologies, as you can imagine—such as televisions, fans, solar water pumps, and refrigerators, which is mainly what we'll be talking about today, but also, other horizon enabling technologies, that as you see on the right side. Next slide, please.

I won't spend too much time on this slide, but you're more than welcome to take a look at it after the presentations. This is just a quick snapshot into how LEIA's different works streams, which are shown on the left as activity types—are leading various threads of work development to different technologies. We are expanding the scope of this diagram more and more every day, especially under our research work, and we would be more than happy to give you more details if there are any questions after the webinar. Next slide, please. So, now, we get to dive into our first report.

This will be a broader outlook across all relevant appliances and technologies for off-grid use, and then, when Elisa takes over, we'll be looking at specific technologies under these. Next slide, please. So, Efficiency for Access, in collaboration with the Energy Access Practitioner Network, earlier this year conducted an online survey of energy access professionals to assess their demand and impact potential of 46 off-grid appliances and this was done across 3 different segments—appliances that are relevant for household use, productive use, and health care or clinic use. The survey received 135 respondents from participants around the world. If you participated in the survey, thank you very much for doing so.

And we definitely got an overwhelming response from energy services providers that are active across Sub-Saharan Africa, and a lot of the results are a result of that also. I want to mention that this was the third time this survey was done in collaboration with the practitioner network, and this gave us a great opportunity to continue and expand on regional, sectoral, and yearly comparisons, so that we could plot changing signals in terms of market readiness and customer interest in different appliances. Next slide, please. I want to take a few minutes just to discuss some of the key takeaways that we took out of the report. As you can imagine, we found that since 2014, LED room lighting continues to be the highest ranked household appliance in terms of both perceived customer demand and impact potential.

This underscores the fact that basic energy access needs continue to remain out of reach for many households and communities across the globe. An interesting finding was that fans were ranked first in terms of demand in South Asia alone, and similarly, air conditioning units only made it into the top rankings in South Asia. So, such regional differences suggest that while customer demand for off-grid appliances remain broadly similar across regions, as we can expect, regional preferences are still important and should be taken into consideration. There is an increasing demand for—and a growing commercial opportunity around—refrigeration technologies at all scales. Whether it was household use, agricultural processing coal chain use or for businesses and productive uses, any kind of refrigeration technology consistently ranked in the top rankings.

And more work is definitely needed to unlock the affordability of refrigeration technologies, as well as their off-grid appropriateness, so that we can reach true scale for this near-to-market technology. Solar water pumps emerged as the top near-to-market appliance of note, for the first time ever, being ranked above many other appliances. Off-grid customers are also

showing interest in a wider range of appliances, as evidence by high rankings for many of the newly introduced categories, such as electric cook stoves, as well as internet or connectivity equipment. In terms of health care, there were unclear patterns of rankings for specific medical equipment, which I will unpack a little bit more in a few slides, but this underscores the needs for additional resources to scope out region and clinic-dependent nuances. We are actually working on an Efficiency for Health concept with the UN Foundation's Powering Health Care, as well as the Clinton Health Access Initiative—or CHAI.

We are very excited to see where this work in research may take us in terms of discovering which medical appliances, for example, have the highest potential for efficiency measures. In terms of gender results, household appliances that support labor intensive activities seem to showcase significant difference between gender perspectives, and I will, again, explain this in a bit more detail shortly. And finally, many of the appliances that ranked highly in terms of perceived demand or impact—which you will see in a second—actually had little to no reported sales when we asked for sales information in 2017, which shows that there's a continued lack of commercial availability and viability as many of these appliances that are showing high-impact potential. Next slide, please. So, now, we want to showcase some of the most interesting findings from the report.

Here, we are showing the 2018 household appliance demand and impact rankings. The orange or yellow bars are the impact potential, and the blue ones show the perceived consumer demand for each of these technologies. As you can see, LED room lighting—as I mentioned just now—is ranked highest. What is interesting is that television's ranked second highest in terms of consumer demand, but only fifth in terms of potential impact. While TVs are among the main inspirational products in high demand by off-grid consumers across the globe, their impact beyond simple entertainment generally is less discussed and socioeconomic benefits of using TVs—whether it's for women's empowerment and education, information sharing—this has not been fully explored or documented, which may explain why they're viewed as a lower impact product.

Other interesting findings include the fact that respondents ranked items such as modems, web routers, and internet equipment—which was a new appliance category, actually, that was introduced in the 2018 survey—fourth in terms of potential impact, even before TVs and tablets. Electric cook stoves, which was also introduced this year—and, as you saw earlier—is one of the horizon technologies of interest under the LEIA program, actually ranked relatively highly both in terms of demand and impact. Even though this technology's not necessarily viable yet, due to its relatively high load requirement—which is currently only achievable with a very large-scale micro-grid, this ranking underlines its importance. Next slide, please. And here, we're showing a similar graph that now looks at productive use appliances both in terms of demand and impact.

Again, as we mentioned, solar water pumps rank first, followed by refrigeration. What was interesting to us was that LED room lighting, phones, and televisions, were ranked consistently lower compared to household demands and impact rankings, however, they still made it into the top 10 products. In terms of, again, newly added categories, milk-chilling units and food drying units made it into the top 10 ranking in terms of consumer demand, and milk-chilling units actually received quite a high ranking in terms of impact. So, there's definitely a technology that we will continue to keep an eye on. And the appliance that showed a significant difference between demand and impact, was solar sewing machines, which were ranked quite low in terms of demand, but received a much higher impact ranking. Next slide, please.

As I mentioned earlier, one of the more interesting aspects of this year's results is that now that we have three versions of these survey results, we are able to do temporal comparisons to see how consumer demand and impact perceptions may have changed over time. We looked at changes through time for productive uses. This was one of the more interesting results and they've showed a significant change across time. In 2018, as I mentioned, solar water pumps ranked highest in terms of both consumer demand and potential impact, but this was the first time ever of this happening, especially being ranked above refrigeration and LED lighting appliances. The rankings for small business appliances—in particular, LED lighting, mobile or smart phones, mobile charging banks—dropped much lower compared to the 2014 and 2016 findings.

The biggest change, actually, was seen with mobile and smart phones, which dropped from being ranked 2nd in 2016—as you can see in this graph—to 10th in 2018 in terms of potential impact. So, that is a very significant change. It was also interesting that fans didn't make it to the top 10 rankings in 2018 only. Next slide, please. Now, we come to the health care results, and in 2018, we actually divided health care appliances into two categories under infrastructure and medical equipment, to be able to have a more granular look into demand—or importance, I should say—rankings of different products that are relevant for health care use.

We actually had a larger respondent pool than last year for the health care results, but interestingly, none of the survey respondents who answered these questions on health care rankings were actually health care professionals. They were all energy access stakeholders and service providers. So, that is something that we should keep in mind—that these results reflect the sort of energy access side of things rather than the health care perspectives, perhaps. But, unsurprisingly, many of the results remained similar consistent across the board. Refrigeration, LED room lighting appliances were ranked as top two in terms of perceived demand by respondents in 2016 also, which you can see also happens in 2018, and many of the other appliances received similar rankings across 2016 and 2018.

So, there is definitely a continued need for even the most basic appliances for health care—especially refrigeration and LED lighting—but then, when we

look at medical equipment, there's also some interesting results that surface. Next slide, please. Here's a bit of a closer look at the gender differentials. This question was asked for household use only. Basically, survey respondents who answered the ranking question for household use were then asked the follow-up question of, "Would you change their rankings that you just gave us based on the gender of the end user?" And basically, those that said that their rankings would change gave a new ranking for male and female consumer perspectives.

Gender, actually, is a focused theme for Efficiency for Access, as well as LEIA, as we continue to weave it into our research office, especially consumer impacts going forward. Here, we show that the results show that the LED room lighting, mobile phone, charging banks, refrigerator/freezer units, didn't show much of a change between female and male user perspectives, but some products definitely did, and you can see those here in terms of hand power tools, clothes washers, sewing machines, and electric cook stoves. Next slide, please. And finally, as I mentioned earlier, we did ask a follow-up question of—following the rankings of actual reported sales in 2017, and you can see in the pie chart here that the sales data did not match the high-impact perceptions that we discovered in the survey.

Almost half of the sales reported were radios, about a quarter of solar water pumps, and then, smaller percentages of televisions, fans, and ICT equipment. Other technologies that you'll remember ranked extremely highly such as refrigeration units, milk chillers. These did not have any reported sales, basically. This sales data that was collected through this survey is, of course, limited, but it's still a useful benchmark give the lack of data for this \_\_\_\_\_ market. And we will be using these first insights under the Efficiency for Access Coalition to collect, verify, and continue to publish data on sales and market potential for off-grid appliances.

Now that we've covered the sector's perception of consumer needs and impact, let's move into a more technical review of the off-grid appropriateness of a number of the most in demand appliances that surfaced from this report and ways in which we can build in quality assurance as well as customer protection. And for that, I will turn it over to my colleague, Elisa. Next slide, please.

**Elisa**

Great. Thank you. Excited to be here today to share some of the high-level findings from the off-grid appliance \_\_\_\_\_. Next slide, please. Before we dive into the report, I would just like to start with the current state of off-grid appliances market.

There is very little information available regarding the performance and quality of appliances designed specifically for off-grid and weak-grid environment. This barrier is inhibiting of stakeholder across the supply chain from making informed decisions. For example—manufacturer and distributors often have very little information regarding the potential cost, quality, and service delivery tradeoff when sourcing between high efficient product versus the generic baseline product. Investors and lenders—they perceive investments in appliance sector very risky, so it's like, as pay-as-

you-go company are increasingly attracting more investment access for financing for appliance manufacture remain like, very little. A policymaker often do not have sufficient resources and testing capacity to collect comprehensive market data to really defy and classify off-grid appliances based on their performance and potential to deliver energy access benefits. So, all these different barriers is really inhibiting the growth of the off-grid appliances market as a whole. Next slide, please.

To fill the significant knowledge gap, the Efficiency for Access Coalition has been building technical foundation through a program called Off-Grid Appliance Data Platform. The platform is supported by the Clean Energy Foundation, and it's got this LEIA program, which Yasemin introduced earlier. On the highest level, the data platform's a program that generates and collects and share information about appliance performance and pricing, but there is actually a lot technical foundation that are built to enable the generation in sharing of tests performance data. We start at the very bottom, which is the test method development. Most currently available test method are not designed specifically to ability of appliances used by off-grid consumer.

For example, appliances that are used with off-grid energy system must be able to sustain voltage fluctuation, but most of the test method for grid power domestic appliances are not written in this particular factor in mind. To enable consistent product comparison, we developed standardized test method to able a product design, quality, and energy performance. Test lab network—there were many national commercial test lab around the world, but very few of them have experienced in testing off-grid appropriate appliances. We identify test lab partners and work with them to enhance their capacity of conducting off-grid appliance testing based on the test method we just described. And to understand what product model are being sold to off-grid consumers, we conduct survey in retail marketplaces to collect basic product information such as the product brand, model names, size, the client energy consumption value warranty, and retail price.

The data we collected from the market informed the sampling process and we collect the sample and test them in the test laboratory. Currently, we're conducting these type of market survey in eight different countries—in Kenya, Uganda, Tanzania, and also in East Africa with Sierra Leone, Nigeria, but also in South Asia, which is India, Pakistan, and Myanmar. Today, the program has identified more than 1,500 television, fans, refrigerator models around the world, and tests about 300 products in a laboratory setting. Next slide, please. The data generated through the data platform enabled us to develop pretty interesting analysis and insight—particularly around efficiency and pricing trends.

In terms of approach, data trends report focus on three most demanded appliances, which Yasemin also mentioned earlier—TV, fans, and refrigerator. Our approach is to really map out the performance and price of each individual models tested through the data platform, create year by year baselines, and compare off-grid appliance performance with on-grid products

that are similar in sizes. It's also important to note that the test data we are referencing here are collected from two different sources. By saying "baseline product"—we're referring to the generic AC or DC appliances we procure from the market, and a lot of those are generic Chinese imported appliances. The awards product that we're referring to is the product submitted by manufacturers and distributor for the global \_\_\_\_\_ awards competition, which is the international competition that identifies high performing off-grid appliances in various categories.

The awards product are also randomly selected and tested from manufacturer warehouses. All these products are tested in test laboratory based on these different parameter that you're seeing on the slide—so, energy performance efficiency, surface delivery, durability and safety, and quality and workmanship. And all these test methods you can actually find on the Efficiency for Access Coalition website. Next slide. For the sake of time, in the following slides, we're using refrigerator analysis as an example, but please do check out the data trends report for more fans and TV data.

Refrigerator, as mentioned, is one of the highest consumer demand product, but it's also one of the most challenge of off-grid appliances to design and develop. The global market for off-grid refrigerator is actually still in the very early stage of development. Between 2016 to '17, we test about 57 refrigerator models. For the purpose of the study, the refrigerator energy efficiency index, as you can see on the left side, is defined as the unit surface area per daily energy consumed. So, meter square per kilowatt hour per day.

As you can see, the arrow is pointing up. The higher the EEI, the more efficient the refrigerator is. The graph is showing the efficiency value of these 57 refrigerator model tested and the average efficiency value of 2017 awards winners, finalists, and baseline products. What we can see from this graph is that there's significant gap between baseline awards product. If we take one of the highest point in the chart compared to one of the lowest point here, the worst performing refrigerator in 2017 data set used 19 times more energy per unit surface area than the most efficient refrigerator tested.

But also, on the average, the efficiency of awards finalists and winner product are close to two to three times more efficient that the baseline products. This chart also tells us that the daily energy required to operate a typical off-grid refrigerator is high. The average refrigerator requires about .7 kilowatt per day to operate in ambient temperature of 72 Celsius. They're the optimal conditions. This would require a solar \_\_\_\_\_ system with at least 200-watt peaks solar panel and a 160 an hour battery. This is still like, too big for most of the off-grid consumer to be able to afford. Next slide.

In terms of pricing trend, the high price of refrigerator is a critical barrier to consumer adoption. Off-grid and weak-grid consumer are very price sensitive, especially for large investment appliances such as refrigerator. The price of refrigerator range roughly from \$300.00 to—on the low end—to roughly about \$2,000.00 on high end. What we can see is that there are increasingly more specialized off-grid refrigerator that use new technology such as space change material technology to really improve the thermal

performance, but these product also comes with a much higher price tag. The other factor that we're seeing in this chart is that the high price is not always associated with better energy or performance or equality.

Because of the inconsistency in refrigerator pricing, we conduct additional analysis to kind of look at the correlation between energy performance and pricing. The data indicate that among the product that perform similarly in terms of energy efficiency, the retail price ranged from roughly \$360.00 to \$1,300.00. That's like, 3.6 times difference. So, without the proper performance data, distributors and consumer can only make decision based on price, but higher price product does not necessarily mean it's higher quality or efficiency. Next slide, please.

We look at the off-grid refrigerators and compare the performance of these product with the most efficient off-grid refrigerator—basically, the product that carry A++ or A++ European energy weight goals. The data that you're seeing here indicates that most efficient off-grid refrigerator in the European market are still a lot more efficient than off-grid products. There's significant potential to improve efficiency for off-grid refrigerator so they can catch up with the on-grid public market, but we are also seeing that for refrigerator, and here, we're referring to the product that only have fresh fruit compartment. We can see the gap between the most efficient off-grid refrigerator and the on-grid refrigerator model. It's closing up for the refrigerator and freezer combination unit.

The difference in terms of efficiency—it's so pretty significant. Certain design improvements such as using higher efficiency compressor or better insulated technology can really help off-grid refrigerator/freezer to be more efficient. Next slide. So, here are some additional insight and I'll be quick and brief about these. One thing that I really want to highlight is actually the importance of field testing.

Field testing is one of the growing topic and it's really important for the off-grid appliance development. In contrast to laboratory testing—which is like, controlled and conducted to ensure reliability and repeatability—field testing deliver different set of insight to appliance performance, quality, durability, and consumer experience. And this is especially important for off-grid appliance, since, in many cases, consumer usage and preference is not very well documented and understood. We're also seeing that assessing product accurbility and quality—it's really critical to consumer protection. Many rural consumer living in remote area where accessing maintenance and warranty—it's extremely difficult.

Our tests has found that two-third of fan fails during the aspect of the drop test. Sometimes, it's a malfunction of the motor. Sometimes, just shelter—the motor casing or damage the fan guard. But, regardless, product failures impact user experience and quickly erode consumer confidence in appliances and their brands. So, having appropriate quality assurance framework in place to look at the broader quality issue—such as choosing advertising warranty more holistically—would be a very important part of market development to inform stakeholder and champion quality products. Next slide, please.

And just to put a very quick plug in, Efficiency for Access Coalition's planning to launch a public facing user friendly web database in the first quarter of 2019. This will be an open platform for a user to access most up-to-date product information and performance data. We can compare and filter data based on a variety of different attributes, such as market availability, efficiency, and pricing. So, please, stay tuned and sign up for Efficiency for Access newsletter to receive more information about things.

**Jem** Thank you, Elisa. Is that your last slide?

**Elisa** Yeah. That's it.

**Jem** Perfect. All right. A lot to unpack here, but we have one more speaker. Michael, are you still with us?

**Michael** I am, indeed.

**Jem** Perfect. So, Michael's gonna talk a little bit about—from a practitioner perspective—some emerging research that they're leading with support from LEIA, in fact, on solar water pumping, which was something that certainly Yasemin mentioned. So, Michael, the floor's yours.

**Michael** Great. Thank you. So, this is regarding a solar water pumping market research study that LEIA and CLASP sponsored in Tanzania and Simusolar's a distributor, financier, and after-market servicer of a lot of different productive use equipment, including solar water pumps. So, we were keenly interested to support them in this and learn more about the marketplace, since there's not a lot of information on there about these applications. So, the research is focused specifically on solar water pumps from an energy efficiency standpoint, and we start off with a number of key questions that we sought out to answer.

One was better segmentation. Who are these potential users of solar water pumps and how might we identify them? What are the use cases for solar water pumping? What's the potential impact—with a specific focus on income, but then, also some further inquiry into some of these social impacts? What is the value proposition?

What drives clients to seek out or adopt solar water pumping technology once they're aware of it? And how do they afford it? We did this by surveying about 400 farmers, 81 focus groups, and 67 key informants—actually, in reverse order there—to get some different perspectives of the market, speaking with experts as well as adopters of the technology. And this was covering several different regions of Tanzania—basically, the Northern Highlands, central region in Morogoro to South. These are all—they're very different regions—both geographically, climate wise, and in terms of the kinds of agriculture that goes on there and other activities, so, we thought it would give a good perspective and some interesting counterpoints.

So, first, to put these segmentation in context. There are a number of different ways that you can think about farmers as a client base, and one of the things

we wanted to do at the outset was try to reduce the number of variables that we were considering and try to get down to what are the main factors? And these are just an example of some of them. I'll get a bit into what we focused on. As further context—76 percent of the farmers we surveyed only irrigated two acres or less and half of the farmers are irrigating less than an acre.

So, half the farmers are truly one-acre small holder farmers, and the takeaway there is that much of that limitation is due to mechanization. It's very hard to extend the amount of land you can farm if you don't have a means of spreading the water around. Financing is, also, of course, a factor. 90 percent of the farmers were seasonal in their farming—grain fed, waiting for the periods when the water was available to farm. And that means that there's significant gains they can gain if they adopt some sort of pumping technology where, all of a sudden, they can now farm year-round and benefit from bringing crops to harvest during the dry season when prices are highest. And interesting—40 percent of the surveyants used a fuel pump at some point in the year—either owning one or renting one—which really tells us that pumping technology is available and there may be some early adopters on the substitution front versus fresh first-time users.

Looking at these factors and looking at it across the data, this is a work in progress, but we are—we've converged on these four factors—whether someone's currently using a pump—be it a fuel pump or a mechanical pump—whether—what is the level of their total expenditure in ongoing operating [Break in audio], what their market orientation is and what that means as they commercial farmer, are they a farmer who is selling to markets when convenient, or are they a [Break in audio] farmer that really isn't selling [Break in audio] for a market. And I think someone is off mute, so if you don't mind getting back on mute. The last factor is the water source. It's very important, obviously, for irrigation technology whether you have a canal nearby, a lake, a river, a well, or none of the above. So, here, the size of the circle on this map of Tanzania represent the ongoing operating expenditure.

It's a weekly operating expenditure. Those are presented in Tanzanian shillings for about \$2,002.00 USD just for order of magnitude. And the coloring is whether there's a canal system present. And canal systems, essentially, are government or co-ops or group developed systems that distribute water free of charge to people in the community. And you'll see—what's interesting here is where you see more orange on the screen, you also tend to see smaller circles.

That's because there's less motivation or need to pay for water pumping technology where you have free water or water's gravity fed and more readily available. [Inaudible] is a bit of an exception there due to economic position of many of the farmers there, as we'll see on this next slide. So, here, if you take a look—the darker the blue you see here in the number is the higher percentage of commercial farmers in that region. And you'll see in Morogoro, there's a decent number, but there are also quite a few that are more market oriented. Singida, where we saw the smaller circles, you see, is probably

among the group a bit lower in terms of the breakout and the presence of subsistence-oriented farming.

So, this gives also some insight into where there could be potential adopters. So, it's probably clear, at this point, that our focus was very much on horticulture. There are certainly opportunities in aquaculture, animal husbandry, and other areas, but we did not pursue those as those are not as visible a market and we figured this is something where there's a very large need on the farming front in Tanzania and that's where we started. Certainly, there's room for further research on those fronts. Segmentation for solar water pumping is very localized and that sort of falls with the subsequent statement that clustering and trying to make any broad conclusions requires a lot of judgment and discretion, because nuances from the closeness to market, soil quality—a number of different factors—can affect local adoption and what would work in a market.

So, the clustering that we have come up with, at this point, is first, to group those who would be substituting a pump. So, there's many people using fuel currently and a key pain point for them is the cost of fuel and having to spend out on a regular basis. They already have the practice. Their income's generally a little bit higher, and so, they're better positioned to adopt to solar water pump. And some of these are actually mechanical pump users as well, so, it's not just fuel substitution.

Secondly, there are those who have free water. They're part of a canal scheme and yet, they could improve the scale of their farming if they were able to distribute that water more broadly with pump technology. But, the motivation's a bit less than some of the other groups. Third would be the first-time irrigators, and these are those who may have been doing bucket irrigation or simply waiting for the rains to come.

And they're a bit more of a—they're a high impact group if they adopt, but they're challenging because there's some behavioral change a lot of support that's needed in them adopting the technology, which I'll touch on a bit later. And lastly, the itinerant farmers, as we fondly refer to them, and these are really professionals who are working in nearby cities, but own land and will hire people to work their land and maybe come out weekends to check up and do part-time farming. It's generally higher income, greater ability to pay, less need of financing, but maybe less impact than some of the other. So, in terms of impact, one of the challenges was we found zero solar water pump users among the 400 people we surveyed. It is not a technology that's widely known or adopted, requires a high capital, upfront cost—so, it's not something you've really seen in the marketplace.

So, when we start talking impact, at least from the survey, it's very much \_\_\_\_\_—very hypothetical. And we did do—based on current yields of farmers, working with some of the agronomic models, estimated what would happen if they farmed year round and adopted solar water pumping technology and calculated what the cost benefit would be, and we saw that on average, farmers in horticulture—that's vegetables, fruits—could pay off the pump in under 18 months and that's using any number of different irrigation

technologies. We excluded drip irrigation from the study for a number of reasons. And just to add to a bit of insight outside of the study with Acumen Lean Data to some surveys of Simusolar clients in the past and we saw that 94 percent of those surveyed experienced higher yields and 100 percent experienced an increase in income. So, that's just to say that while we not have actual data on experiences for the broader survey, when customers have adopted this technology, we've seen good results.

Further analysis, of course, is required and I think that would be a great follow-up study. So, what's the value proposition to these users of solar water pumps? Why did they adopt? What are they looking for when they go and they decide to purchase a pump from you? Well, one is servicing.

There's a limit of quality providers that service. Many informal service providers, but they don't necessarily know this technology and often can do more damage than good. Likewise, spare parts are hard to come by, so, these are big concerns that were brought up by that surveyed—the farmers. Secondly, it's a package. The farmers are not looking just to get a pump and go off and apply it on their own.

They know that they're taking on some new practices. They know they're using new technology and, as evidence of that, when asked what some of their challenges were or what some of their needs were, the number two need was—"knowledge" was the answer—and referring to agronomic knowledge and irrigation knowledge. Similarly, irrigation technology was number four in the listing. So, clearly, there's self-awareness of the need for support. And we believe as well to say that more on working in a value chain with partners is really key to providing that.

And this is just to round out the data. We found that 71 percent of users listed cost and time efficiency as a reason for adoption, and 41 percent listed reduced fuel expense, which, of course, implies that many of them had fuel pumps prior. And 100 percent purchased on credit. So, speaking of servicing—financing of pumps is one of the services that is needed for the market to really develop. Most purchases, interestingly, in the survey group—and this, again, a group with no solar water pumping option—were cash purchases—meaning there was zero financing utilized in that.

And the answers upon further exploration in focus groups included they borrowed from family, they had other savings in their groups. There were different ways they purchased it. They didn't necessarily have all the money themselves, but they didn't go to a formal financial lender. And, when asked what their challenges were, financing was listed as the number one challenge. The largest percent of farmers indicated that was their main pain point.

And some of that's due to land title situation here. [Break in audio] There are many other structural challenges, but financing is [Inaudible] marketplace. And we do not explore payment terms, specifically, but we did find that through capex and opex, you'd get a sense of what farmers might be able to afford and pay on a regular basis. And we also read into some of the complaints that we heard that farmers had about input suppliers who provided

financing and how expensive that financing was. And taking that and taking the lack of use of credit to date, it really gives us a sense that these are very much interest rate sensitive buyers and they are real averse to—it'd have to be an attractive package for them to adopt it.

So, in conclusion, we believe that to develop this market, a great deal of market awareness is required. People are really are not familiar with solar water pumping technology. There's disbelief that solar can do this. They really have to see the pumps in action to believe that they can serve their needs. Similarly, clients who already have experience with pumping technology are more likely to appreciate and get the value proposition of these and be early adopters and then, they become champions in their community and examples that others can follow.

And lastly, customers need lots of support. Service-based models, we believe, will develop the market, not distribution—not sole-based distribution models. Customers need ways to get information. They need after-market support. It really takes more than just getting equipment to them.

And so, that would be our counsel for a number of different product categories. That is the end of my slides. Thank you.

**Jem**

Thank you, Michael. That was really great, and I think that sets us up very well for a bit of Q&A, which I will probably get started by just asking maybe one or two questions of the three of you and the, I will probably hand it over to Katie to field questions from our participants. So, let's not waste time. I'd love to kind of stay on this thread—this topic of solar water pumps and maybe ask a question of both Michael and Yasemin—and Elisa, for that matter, too—one of the things that I found really interesting from the survey report was the fact that solar water pumps kind of rose to the top of the productive use ranking for the first time ever, eclipsing LED lighting and other appliances. And clearly, it's interesting to hear from Michael, some of the dynamics around what's driving that—at least in the context of one country or one region.

But I wanted to kind of unpack that a little bit more and better understand what you all thought was driving at least this perceived increase in demand for and the perceived impact of the impact of solar water pumps. Michael, you—and you had it on one of your slides in terms of some of these drivers. You mentioned cost, time savings, economics, but can we talk a little bit more about what you all think is driving this seemingly new demand for solar water pumps? Is it, in fact, economics? Is it the differential in terms of the cost of fuel?

I don't know. Michael, Yasemin, Elisa—do you want to kind of weigh on this? I'd love to see if you all see this similarly or if you have different points of view on this.

**Michael**

I'm happy to just share a brief \_\_\_\_\_ and that's—it's really interesting to hear—I forget it if was Yasemin or Elisa, earlier, who pointed out that the solar water pump demand or potential impact, as reported by industry players,

is very high, but then, when you actually showed the pie chart in terms of adoption, it was like around 25 percent. And I think that gets at what we see as a giant opportunity and a real need for water in an environment of climate change and where farming is increasingly important. At the same time, it's very challenging on the distribution front. It is not a plug and play, "build it and they will come" kind of product. You really have to be there, engaged, in these regions.

You have to develop partnerships and you have to provide ongoing servicing. And so, I think you'll see that adoption will be slow and take time. All the excitement around it from the industry will rightly be high, but there is so much—there's a large farmer base that really would benefit [Break in audio].

**Jem**

Yas and Elisa, do either of you want to chime in on this—kind of this idea that clearly, the sector is beginning to understand and appreciate the potential, but yet, kind of clearly, from a distribution, kind of building it out—building out the infrastructure the sector needs, but from a distribution and after sales service point of view, it's still trying to catch up. Any thoughts on that?

**Yasemin**

Sure. Yeah. I agree with everything Michael said and we do definitely see that, as he said, in terms of the offset between impact and potential demand rankings, but the lack of sales. I think this new interest in larger appliances like solar water pumps comes from a few different places. Obviously, we saw that LED lighting continues to be top of mind for everybody, so there's still a very large energy access problem.

But, more and more, I think the energy access sector is maturing. Those of us who have been in the sector for more than five or seven years have seen it grow from just arguing for the importance of a solar lantern, even, to talking about larger solar home systems, those becoming affordable, adding on appliances. Now, we're talking about all these larger scale appliances being able to be powered by smaller and smaller systems. There's a—in addition to this growing maturity and interest—and competitiveness, also, in the energy access sector—different DES cos and energy service providers trying to provide their customers with more and more services to stay ahead. There's also a really growing interest, I think, from the donor side in terms of larger appliance, more holistic ecosystems, and definitely, productive use.

If you ask any one of our Efficiency for Access Coalition donor members what are their focus areas, productive use will be definitely one for each and every one of them. But we do agree that solar water pumps are a different beast within the sort of near-to-market technologies that we discussed earlier. You can imagine a TV—a TV is a TV, right? I mean, it might change in terms of sizes and in terms of lumens, but it's generally the same kind of thing. When it comes to solar water pumps, Michael would have much more insight into this than I do, but I know there are submersible ones, there's surface ones—there are different types that work with different batteries.

Some do require batteries; some don't. So, it is definitely a much more complicated system. And I also want to provide a little plug here and say that in 2019, the Global Leap Awards will be, for the first time, focusing on not

just refrigeration but also solar water pumps. So, we will be having nominations open within a month, I believe, so this is a little teaser for that.

We are definitely very much focused on test methods for solar water pumps use cases, as Michael said, for solar water pumps, just seeing how this sector grows, really.

**Jem**

Thanks, Yasemin. I want to ask Elisa a question. Before I get to that, I want to stay on this thread and maybe, back to you, Michael. You touched on financing and kind of the critical barrier that access to financing plays in the adoption of solar water pumps. Can you say a little bit more about what sort of financing are you seeing farmers actually use currently for those that have adopted solar water pumps?

Are they depending on local financing providers, banks, MFIs? Say a little bit more about that and maybe, as a comparison, how are farmers who are using traditional pumps financing those assets?

**Michael**

So, there's not a lot of equipment financing available in the marketplace period. Banks, generally—there's no equipment financial sector that's developed here. Banks generally want a lot of collateral the people aren't comfortable giving out. So, we have not seen solar water pumping technology adopted through bank loans at all. And we haven't, obviously, canvassed the entire marketplace, but it doesn't seem to be like that is an active means of financing your pump—or an attractive one, at least.

We have seen that, among our own client base, I believe it's about 70 percent are using financing—using our financing—to purchase the pumps. And the other either simply have the money and can afford it and are very—they're either interest-sensitive or they simply are loan averse. And there's certainly that market, which is maybe the higher—the mid to higher end market. But, as you get into really the mass market of farmers, financing is absolutely critical. And fuel pumps are a different beast, because the entry price point is low, and you pay for it over time.

You pay for it in fuel costs, which are high, and you pay for it in maintenance, 'cause fuel pumps break down a lot and the maintenance costs are very high. So, when we speak with farmers and they do the economic comparison, if they have a fuel pump, the solar pump almost always wins with even a one-year time horizon because often, they are over equipped with their fuel pump above their needs and burning a lot of fuel on it, and the economics—the solar water pump works, so as long as you have the financing.

**Jem**

Okay. I would love to continue that discussion, but I also want to give Elisa an opportunity. And I have a question—I'm gonna switch gears a little bit. Elisa, you mentioned—you touched on the issue of quality and the need for perhaps a quality assurance framework. And I'd love to hear your thoughts on whether or not you think this sector is ready for such a framework.

Clearly, the development and growing adoption of a quality assurance framework for PICO and solar home systems has clearly been an important driver for the growth and maturity that we're seeing in the off-grid kind of lighting electricity sector. Can you say a little bit more about kind of your thoughts on where things stand with regards to quality assurance?

**Elisa**

Of course. Thanks, Jem. From what we can see, there are certainly a lot of generic, low-quality products that are currently on the market and so, we think that well-designed quality assurance framework can certainly send the right signal to the market that product quality and durability and truth in advertising are actually really important for protecting of your consumers. All the technical foundation that we just discussed and laid out by the data platform is actually paving the way towards the same way toward quality assurance for your off-grid appliances already. With all the data generated, it's certainly informing how an off-grid appliance \_\_\_\_\_ structure or criteria could look like.

And this is actually a question that we've been discussing and partnering with our colleagues on a \_\_\_\_\_ global side to really explore if there's a certain demand for the off-grid appliances quality assurance framework. And so, this is definitely forthcoming and we definitely welcome feedback from industry stakeholder on this issue. It's going to be a continued discussion.

**Jem**

Okay. So, it sounds like we're gonna hear more about that. All right. I'm cognoscente of time. It's—I think we have about 15 minutes left, and we certainly want to leave some time for the audience to ask questions. At this point, I'm gonna hand things back to Katie, 'cause she controls—so, she can see questions that are coming in. Katie, over to you.

**Katie**

Wonderful. Thank you so much, Jem, for that wonderful discussion. As we shift to the live Q&A with the audience, I just would like to remind our attendees to please submit the questions through the question pane at any time, and we're also keeping up several links on the screen throughout for quick reference that points to information on upcoming webinars and previously held webinars and how to take advantage of the Ask An Expert program. We've had lots and lots of questions from the audience. We won't get to them all today, but we will definitely follow-up with those attendees afterwards.

Our first question for Elisa and Yasemin is—how is the commercial viability of efficient productive use appliances being currently measured through your study?

**Yasemin**

That is a very interesting question. I don't actually know how to answer that because we—I should say, obviously, the reports that we talked about today were just two small parts of a very large, forward moving system of different activities under the LEIA program. There's a lot being done on their research, one of which Michael presented, but there's going to be more and more, obviously, work on this. One good example that I can give that might kind of speak to this question about how do we measure affordability or sales is a partnership that we have cultivated with goGLOW that will start next year

where goGLOW will, for the first time, be measuring through their members, not just sales of solar pump systems and solar products, but also, appliances. So, that is something to look forward to.

And, as you know, goGLOW puts out this research, I believe, on a yearly basis as well as quarterly sales reports as well. So, that is a first step into us being able to measure different milestones and different KPIs really around sort of progress towards making efficient appliances more available and more viable in the market. We also are working on refreshing the state of the off-grid market report which was put out, I believe, a few years ago, and Elisa would have more background on that than I do, but we are working with a number of partners, including IFC, on scoping the market and also sizing the market a little bit better and obviously, including more of the appliances that we are seeing as near-to-market at the moment. So, that is a bit of a vague answer, but the general point is that there will more and more data coming from us in the coming years.

**Katie**

Wonderful. Thank you so much. Now, I'm gonna go to Michael for a question about your work in Tanzania. Was there any insights on efficiency of solar water pumps? And do you think the higher efficiency pumps result in lower costs to drive greater adoption?

**Michael**

So, it depends a bit on—I guess "it depends" is the refrain in this. If you're talking about portable pumps, surface pumps, things that people will take out in the field, then, efficiency becomes important, because a smaller panel's easier [Break in audio]. And that would be the driver there. From a [Break in audio] the cost of solar has gone down so much that in most of the solar systems we sell [Inaudible due to break in audio]. So, not a big driver of cost in having more efficient equipment allows you to downsize [Break in audio].

It's not the major savings. The savings is on [Inaudible due to break in audio]. So, while [Break in audio] additional efficiency certainly is important, I think, maybe for being into grid, there might be [Inaudible] if you have larger [Inaudible] equipment into grids. For off-grid solar water pumping, [Inaudible] on a portable type, you don't see [Inaudible].

**Katie**

Okay, Michael, and thank you. And we are having a little bit of audio difficulties with you. You seem to be cutting out a little bit. So, maybe we can resolve that as we go to our next question to Yasemin and Elisa. Our next question is—how is the tradeoff between price and quality changing for different kinds of efficient appliances over time?

**Elisa**

Yeah. That's a great question. And from the data set that we're seeing, we actually—a lot of times, it's really hard to find that correlation. Basically, because the appliance market's not fully mature yet, we're just seeing the prices jump up and down regardless like, what's the efficiency and quality of the product and we're expecting that once the market gets a little bit more mature and get more organized. We might be able to start seeing a trend.

Actually, like, for TV, for example—this is a slightly more mature market where we're able to see that more efficient TVs are correlated with like,

higher price tag now. But, for fans and refrigerator, I think these two product market's still really early in terms of development, and so, not seeing that much correlation.

**Katie** Okay. Great. And a quick follow-up question—do you have global figures for the future demand of—for domestic and small commercial off-grid refrigerators?

**Yasemin** Katie, could you repeat the question?

**Katie** Yes. I'm very sorry. Do you have global figures for the future demand for domestic and small commercial off-grid refrigerators?

**Elisa** Now, I would say that in the previous market research that we put out through Global Leap, there's some estimate of like, how much the global market can grow in terms of TV, fans, and refrigerator. I can't quote the number on the top of my head.

**Yasemin** I almost want to say—this may not be very accurate, but we do have this information on our website, but I almost want to say that the global market would grow to over a billion dollars, I believe, if off-grid appropriate refrigerators were more available and at a price that customers could afford. I believe that's like, at least a two times growth if not more. Possibly three. And this is, again, something that we will be re-visiting and re-scoping the state of the market report that I mentioned, which will be coming, hopefully, next year.

**Katie** Great. Thank you so much. Going back to Michael. Michael, regarding the solar pumps, are there different designs and brands and are there any particular brands that are more preferred? And also, is the distribution limited to Tanzania and East Africa?

**Michael** So, our distribution—Simusolar operates in Tanzania, but certainly, solar water pumping—or I should say water pumping as a category—electric water pumps and those powered by solar—are broad and adopted around the globe. It's just the degree of penetration and the level of the market it's reached is quite limited. There's certainly a number of different quality manufacturers out there. We've got some great partners. And we believe that there's a benefit in working with different manufacturers that have different areas of focus.

Some are really focused on efficient surface pumps and others are delving into the larger well pumps, \_\_\_\_\_ pumps that can produce larger volumes of water. It's quite diverse in terms of the manufacturers and frankly, the—it's not—if you have the right electrical engineering on your team, designing a system that can work with any electric pump and that you sell as a solar water pumping package is possible. And so, you're not limited to those who are exclusively selling a package of a solar panel with a pump. You can buy the panel separately and have your own packages. But, just to list some of our partners—Ennos is great.

\_\_\_\_\_ culture has been a great partner to us. Aqua Royale—there's a whole list of different manufacturers that we rely on and provide us good products and good warranties.

**Katie**

Great. Thank you. And an attendee would like to know a little bit more. Can you mind explaining a bit more into detail about service-based models for the solar water pump supply?

**Michael**

Is that directed to me?

**Katie**

Yes. Yes, it is, Michael.

**Michael**

Yes. So, service-based model is really tied up in the financing. So, as I mentioned before about 70 percent of our clients rely on financing, and even those who don't have a 2-year warranty with us and a commitment that we'll service their equipment for a fee thereafter. So, the one part of the servicing is obviously just making sure the equipment keeps working. If there's any issues, you can provide some remote support or actually send your own person out to make a repair/replacement and that gives a lot of confidence to people to make this investment and adopt this—what is a very new technology to them.

But it goes beyond that, because when we surveyed farmers—and in the surveys from this report—we've seen that farmers are looking for, as I mentioned before, knowledge, agronomic support—some go so far as to say links to market. They're really underserved in a number of fronts in the value chain and looking for that front—the, I guess, companies they engage with, and they don't really engage with many. We're probably one of the few formal counterparties or servicers/supporters of many of these clients. So, what that looks like is us engaging with quality seed suppliers, evaluating who are the quality seed suppliers, and which see suppliers provide training and service, and linking up with their networks and linking our farmers with them involves working with capacity builders. There's a number of different great horticultural associations and groups operating in Tanzania and many farmers aren't aware of them.

And so, when you do come across a farmer needing support, you can make that introduction and that can really help them improve their practice. So, I'd say, the full servicer model is—we certainly have a \_\_\_\_\_ staff. We support our clients that way, too. But I really want to encourage people to think about being a team player in the value chain and focusing on partnerships more than trying to do it all yourself.

**Katie**

Great. Thank you so much, Michael. And we're running out of time, and, like I said, we had wonderful questions from the audience. So, any questions that we don't get to, we'll follow-up with attendees afterwards. I think we have time for one more question with Elisa and Yasemin.

As we discuss appliances—especially if we're looking at off-grid solar PV mini-grids, how do we plan for additional energy loads and do we size the

mini-grids for current load profile and add more later? Or, do we oversize the system from the beginning?

**Yasemin**

That is a great question. It's a bit of a chicken and egg problem, isn't it? I think one thing we could say is in a lot of cases, especially for public institutions such as health clinics in Sierra Leone, for example, which is something we're scoping for the Efficiency for Health work that I mentioned earlier—it was they basically found that the mini-grids have such a high load already that it's not being used effectively with just a few lights and maybe one vaccine refrigerator that's available. So, in some cases, there's a lot of room for your additional appliances to be used. It's just a question of finding the right ones and making sure they're as efficient as possible so you can make the most out of the load that you have.

The same is true for smaller mini-grids that might be for communities or a few households. I'm not a technical expert, so I don't know about adding extra loads to the existing micro-grids. Obviously, they all have their limits, but, as we showed earlier at the beginning of my presentation, you can do a lot with very little when you have a lot of efficiency in play. So, it's really a question of making sure you source and use the most appropriate and efficient appliances in such a configuration that you're not overloading the system.

**Elisa**

And I will also add that having accurate performance data for appliances would be very important in terms of sizing mini-grid systems. Like, through the data platform, what we were trying to provide is this type of information so that mini-grid operator or solar home system can kind of like, use this type of data and to estimate it how much load they need to plan and decide for. And so, this is like, definitely one of the resources that we would love to provide to mini-grid operators around the world. And there's some scenario in modeling that we can run here to kind of provide that additional support, but I would say that's one of the resources that people can reference.

**Yasemin**

Yeah. And it's definitely, again, to reiterate something Elisa said earlier, it's also very important to do field testing and make sure there's truth in advertising, because sometimes, even laboratory testing can't account for all of the real-life conditions that you might be experiencing. I mean, you've seen many case studies in which an appliance would use maybe three times the energy load that it was supposed to for various reasons so it's very, very important to source appliances appropriately and also, for there to be enough testing of different kinds—both laboratory and field—to ensure that we have accurate data, like Elisa said.

**Katie**

Wonderful. Thank you so much. And on behalf of the Clean Energy Solutions Center, I'd like to extend a "Thank you" to all of our expert panelists and to our attendees for participating in today's webinar and for all the wonderful questions that you submitted. We very much appreciate your time and hope that there's some valuable insights that you can take back to your ministries, departments, and organizations. We also invite you to inform your colleagues and to those in your networks about the Solutions Center resources and services, including our no-cost policy support through our Ask an Expert service.

I invite you to check the Solutions Center website if you'd like to view the slides and listen to the recording of today's presentation as well as previously held webinars. In addition, you'll find information on upcoming webinars and other training events. We will also post recordings to the [Clean Energy Solutions Center's YouTube channel](#). Please, allow about one week for that posting to occur. Finally, I'd like to kindly ask you to take a moment to complete the short survey that will appear when we conclude the webinar.

Please, enjoy the rest of your day and we hope to see you again at future Clean Energy Solutions Center events. This concludes our webinar.

DRAFT