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Puerto Rico Clean and Resilient Energy Solutions

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Webinar Panelists

Ferdinand Ramos-Soegaard
Asa Hopkins
Janine Migden-Ostrander
Megan O'Reilly

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Kamyria Hello, everyone. I'm Kamyria Coney, and welcome to today's webinar, which is hosted by the Clean Energy Solutions Center in partnership the Regulatory Assistant Project—RAP. Today's webinar's focused on the Puerto Rico Clean and Resilient Energy Solutions. 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 technical difficulties with this webinar, please contact the Go-to Webinar's help desk at 888-259-3826 for assistance.

If you would like to ask a question, we ask that you use the "Questions" pane where you may type in your question. The audio recording and presentations will be posted to the Solutions Center's training page at cleanenergysolutions.org/training within a few days of the broadcast—and will be adding the Solutions Center YouTube channel as well, where you'll find 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's resource library as one of many best practice resources reviewed and selected by technical experts. Today's webinar agenda is centered around the presentations from our guest panelists, Commissioner Ramos, Doctor Asa Hopkins, and Janine Migden-Ostrander, who have joined us today to discuss issues relating to the building of resilient energy system in Puerto Rico after devastation of Hurricane Maria.

The presentation will provide an overview of the actions taken by the Puerto Rican government, focusing on the proceedings and activities of the energy bureau. Key topics covered will also include a discussion of the PREPA's integrated resource plan, energy efficiency demand response, and microgrids regulation. Before we jump into the presentation, I will provide a quick overview of the Clean Energy Solutions Center. Then, following the panelist's presentations, we will have a question and answer session where the panelists will address questions submitted by the audience. And, at the end of the webinar, you will be automatically prompted to fill out a brief survey, so, thank you, in advance, for taking a moment to respond.

The Solutions Center was launched in 2011 under the Clean Energy Ministerial. The Clean Energy Ministerial's the high-level global forum to promote policies and programs that advance clean energy technology, to share lessons learned and best practices, and encourage the transition to global energy economy. 24 countries in the European Commission are members contributing 90 per cent of clean energy investment, and responsible for 75 per cent of global green gas emissions. This webinar is provided by the Clean Energy Solutions Center, which is an initiative of the Clean Energy Ministerial. The Solutions Center focuses on helping government makers design and adopt policy and programs that support the deployment of clean energy technologies.

This is accomplished through access to no-cost expert policy assistance in capacity building activities such as this webinar. The Clean Energy Solutions Center is co-sponsored by the governments of Australia and the United States. 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 topics, partnership building with development agencies, and regional and global organizations to deliver support, an online resource library containing over 3,500 clean 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 private sector, 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 and include research organizations like IRENA and IEA programs lies SEforAll and regionally focused entities such as ECOWAS, Center for Renewable Energy and Energy Efficiency.

A marquee feature the Solutions Center provides is the no-cost expert policy assistance service known as Ask an Expert. The Ask an Expert service matches policy makers with one of the more than 60 global experts selected as authoritative leaders on specific clean energy finance and policy topics. For example, in this area of—where we are pleased to have—I'm so sorry. Excuse me.

Again, this is provided free of charge. If you have a question for our experts, please submit it through our simple online forum at cleanenergysolutions.org/expert. We also invite you to spread the word about this valuable service to those in your networks and organizations. At this time, I will have our moderator, Megan O'Rielly from RAP, introduce the presenters.

Megan

Good morning. My name is Megan O'Rielly. I'm an associate at the regulatory assistance project, and I'll be your moderator for today's webinar. At this time, I'd like to provide brief introductions for today's panelists. First, we have Commissioner Ferdinand Ramos-Soegaard.

Prior to his appointment in the Puerto Energy Bureau, Commissioner Ramos was involved in various aspects of the electrical industry, including design, construction, and maintenance of power distribution systems, as well as high-voltage transmission lines and interconnections of renewable energy resources to the Puerto Rico grid. Commissioner Ramos holds a bachelor's degree in electrical engineering from the Georgia Institute of Technology and is a licensed professional engineer in the state of Florida and Puerto Rico. Next, following Commissioner Ramos, we will hear from doctor Asa Hopkins. He is an expert in the development and analysis of public policy and regulation regarding energy and greenhouse gas emissions, including cost benefit analysis, stakeholder engagement, state energy planning and utility planning, providing analysis and testimony in both legislative and regulatory context. As vice president of Synapse Energy Economics, Doctor Hopkins main focus is on utility and demand site issues including demand response in Quebec, energy and economic development in Ohio, as well as many other projects. And our final speaker today is Janine Migden-Ostrander, a principal with the Regulatory Assistance Project.

Ms. Migden-Ostrander has worked in public utility law for more than 35 years and has worked on numerous projects with the energy bureau of Puerto Rico on subjects such as integrated resource planning and microgrids. She has served as a lecturer and educator on regulatory issues in a variety of forums, including work with numerous commissions and facilitating meetings, providing workshops and writing reports on issues related to power sector transformation. And with those introductions, I'd like to welcome Commissioner Ramos to the webinar. Commissioner Ramos, I'll turn it over to you.

Ferdinand

Okay. Thank you. Good morning. Sorry about this. I need to share my screen.

There you go. Thank you for the introduction, Megan. Good morning, everyone. I'm not sure if you can see my screen yet.

Megan We can see it. There we go. Now, it's great.

Ferdinand I'm sorry about that. Good morning, everyone, and welcome to the Puerto Rico Clean and Resilient Energy Solutions webinar. I'm Commissioner Ramos from the Puerto Rico Energy Bureau and I want to take this opportunity to talk to you a little bit about the Energy Bureau of Puerto Rico in general, give you a little background about our electric utility and its recovery post-Hurricane Maria. Puerto Rico Energy Bureau's a specialized independent entity in charge of regulating, supervising, and enforcing the energy public policy of the government of Puerto Rico. It was created by back Act 57-2014 and consequently renamed and reorganized by virtue of Act 211-2018.

It was formerly known as the Puerto Rico Energy Commission. Puerto Rico has a land area of 100 by 35 miles. It's smaller than 48 states. Only Delaware and Rhode Island are smaller. The island is so small, you can drive around it in roughly six hours. Although small, Puerto Rico has a population of 3.195 million.

It's estimated there are approximately 156,000 residents fled the island during the aftermath of the hurricanes. Its population density of 1,046 people per square mile than that of 49 states. Only Jersey and District of Columbia have more people per square mile. Another interesting fact about Puerto Rico is its impressive GDP of $104 billion, which ranks 38 amongst the 50 states and D.C. Although Puerto Rico's GDP has been steadily increasing for the past couple of decades, this forecasted to somewhat flatten during the next couple of years.

In the beginning, since 1893, the commercial power production _____ in Puerto Rico was in the hands of multiple private companies. The Puerto Rican government, in the effort to strengthen and further develop the agricultural sector, built a series of dams and hydroelectric power plants, the first of which was inaugurated in 1915. Today, there are around 100 megawatts of installed hydro capacity in Puerto Rico. In 1937, the government started the nationalization of the power system with the purchase of the Ponce Electric Company. In 1941, what is today the Puerto Rico Electric Power Authoritative—or PREPA—was created with a goal of electrifying the island which, by the mid '40s, only 12 per cent of the rural communities had electricity.

Between 1950 and 2000, PREPA built approximately 3,500 megawatts of thermal generation. The latest editions to the fossil generation fleet were independent power producers that interconnected with the grid early in the early 2000s. PREPA is a vertically integrated government owned utility with a 1.5 million customers and an annual revenue of approximately $3.4 billion, which makes it one of the largest government owned utilities in the whole United States. It is ranked 14th in the nation in terms of number of customers. The winding roads and mountainous terrain, coupled with the density of population in Puerto Rico, make for a grid which is quite complex.

PREPA is ranked 37 out of 1,961 utilities across the entire United States in quantity of distribution circuits. To put that in context, let's compare PREPA to the utilities in the rest of the United States. There are approximately 2,074 power distribution utilities serving the United States. Government owned are at the top of the list with 948 entities, followed by cooperative with 862, and lastly, 264 are investor owned utilities. The largest government owned utility in the US is Los Angeles Department of Water and Power.

It has 1.4 million customer and $3.59 billion in annual revenues, which is really similar to PREPA. The largest cooperative in the US is Pedernales Electric Co-op operating in Texas Hill Country near San Antonio. It has 333,000 customers and $563 million in annual revenues. And the largest investor owned utility in the United States—for the largest IOU in the United States, there's a close battle between PE&E—which has the largest revenue with $12.4 billion—and Southern California Edison, which has the most customers with 4.97 billion. Now, to the impact of Maria.

On September 20, 2017 at 6:00 AM, Maria arrived in Puerto Rico as a category four hurricane with 150 mile-per-hour winds. Some areas reported up to 35 inches of rain. This was the last radar I—this was actually the last radar image I saw on my cell phone that morning. The hurricane plowed through Puerto Rico, leaving a wake of destruction in its path. The days following the storm were chaos.

The majority of the roads were either obstructed or destroyed by the hurricane. There was no water, no communication, and no electricity. Nobody had power. The traffic lights were out everywhere, and it was like that for months. According to PREPA, it took roughly 11 months for power to be restored to 100 per cent of the customers able to receive power service safely.

Total electricity sales returned to pre-Maria levels as of April and May of 2018. I'm sorry. These are just some images I thought might be helpful for you to understand them—the devastation. Although PREPA's crews started working immediately, the destruction was so widespread, it was obvious they needed help. The sheer size and complexity of the system made restoring power in Puerto Rico an unprecedented task.

PREPA and local contractors, FEMA, the Unite States, Army Corps of Engineers, and DOE stepped up to the plate and started tackling the challenge. In the next couple of months following the disaster, the United States Army Corps of Engineers and FEMA installed upwards of 1,600 generators to supply the critical infrastructure—mainly water and sanitary pump stations. I was one of the fortunate ones. About three weeks after Maria, FEMA installed a generator in the water pump that serves my house. Before that, I would just gather rainwater with my kids to be able to take baths.

Thanks for that, FEMA. Over here, there's an interesting fact. The previous record for generators installed was 310 in response to Hurricane Katrina, compared to 1,600 plus for Hurricane Maria in Puerto Rico. As of December 11, 2018, almost 1 year and 3 months after the hurricane, the United States

Army Corps of Engineers was still re-fueling and maintained 24 generators, 7 out of which were supporting microgrids in the islands of municipalities of Vieques and Culebra. But why?

Why did it take so long to power back Puerto Rico? Well, there are four main reasons. The first are the logistical challenges. Everything had to be shipped in. It was much more difficult and time consuming to bring in crews, equipment, and materials than doing the same in the mainland.

Second, availability of materials. Three hurricanes affected the US in 2017. Texas and Florida were also acquiring materials which made it more difficult to get materials shipped in a timely manner. Also, PREPA sometimes uses components that are not standard in US and required special orders. Third—PREPA's financial problems.

When the hurricane struck, PREPA was already in bankruptcy under Title III of PROMESA. At the time, it had approximately $9 billion in debt. This _____ led to lack of maintenance and contributed to the destruction of the transmission distribution systems. And fourth—the incredible magnitude of the disaster. What about solutions?

The best thing we can do is rebuild to prepare for the next hurricane because, at some point, it will happen. FEMA plans to establish a standing inter-agency power task force to coordinate with DOE and US Army Corps of Engineers and state and local governments and provide a crisis planning for the energy sector emergency support function to support the restoration of power during future disasters. Also, PREPA is proposing to segment the grid into eight distinct mini grids that could operate independently during the emergency. This proposed project forms part of the new IRP, which is currently under review of the bureau. Also, a plan to establish preventive maintenance and vegetation-controlled programs to be reviewed and enforced by the bureau.

This is something really simple that can go a long way. And the extensive damage to the grid infrastructure and the length of restoration and recovery demonstrated the need to incorporate resilience and hardening into the restoration recovery mitigation planning and execution. Where do we stand now? Here we are, almost two years after the hurricane, armed with two things that we didn't have before. One is what people are calling the most important bipartisan bill this governments' administration, which was signed by our governor into law April 11th this year, becoming Act 17-2019.

And secondly, the political will to restructure the entire Puerto Rico electric system. These are some of the initiatives being tackled by the bureau right now. Like you all might know, the bureau is working on vetting and improving PREPA's new IRP. If PREPA's last submission, filed by June 14th, is found in compliance, we should be issuing procedural calendar in July, which would put us in a position having an approved IRP by the end of the year. In August, the bureau will start a series of workshops meant to start exploring the distribution system planning in an effort to integrate more renewable energy into the system.

The bureau is also about to issue a propose regulations on all the following topics—microgrid interconnection; wheeling; performance incentive mechanisms; energy efficiency; demand response; electric cooperatives; and renewable energy credit market. That's it for me, Megan. Thank you.

Megan Thank you very much, Commissioner Ramos. And next, I'll turn it over to Doctor Asa Hopkins from Synapse Energy Economics. Go ahead, Asa.

Asa Thanks, Megan. I got my slides up there. Great. You can go to the next slide. Just sort of—a little context of who I am and who we are at Synapse. We are a consultancy _____ in Cambridge, Massachusetts.

We've been working alongside RAP for the Puerto Rican Energy Commission—now bureau—for a number of years, including both the first integrated resource plan and the utility's first regulated rate case. So, I'm trying to put the resource planning challenges that PREPA faces now, in phases now into that longer context with a few slides here at the beginning, and then, talk about the hurricane's impact on the approaches to resource planning that the island is considering and the direction it's taking. A little bit about the impact of the electric sector transformation processes that are under way, and then, I'll dive into describing integrated resource planning in a little more detail, talk about sort of how that process is supposed to work, what some best practices are, and then, what that context means in Puerto Rico in terms of how each of those different pieces of an IRP are shaped and reflect what's going on on the ground on the island, and then, put that back in the context of the actual filed IRP that the commissioner just mentioned. Next slide. This is the—a little bit of Synapse.

I just mentioned that we work for public interest and government clients all over the country and elsewhere. Next slide. So, as of 2015—so, I recall a timeline that hurricanes that the commissioner was just talking about is in the fall of 2017, but the bureau was created in 2014 and sort of got really up and running shortly thereafter. And, at that point, when PREPA conducted its first integrated resource planning exercise, this is where it was starting. So, you know, over 70 per cent oil, electric generation; a little less than 20 per cent natural gas; one large coal facility; and a little bit of hydro wind and solar.

The dominant resource concerns had to do with dependence on very expensive imported oil and inefficient and polluting oil, concerns about air quality compliance, and whether it made sense to expand natural gas import. Next slide. Just a little sense of the geography. It matters for some of the resilience conversations. The generation on the island is—most of the capacity and energy is on the South coast.

You can see two areas of generation in the Southeast and Southwest where there's natural gas import in the southwest and a coal plant in the Southeast and oil facilities in both those areas as well. Meanwhile, most of the load and population is in the San Juan area, which is in the more Northeasterly areas there where you see there are, in fact, a couple of generators in the San Juan area. But the gray lines here are the transmission lines, and you can see that, in the context of a hurricane moving roughly right to left across the island, the

connectivity between the generation resources and the population centers was challenged by that sort of topology [Break in audio]. Next slide. The other real challenge that PREPA was facing in the pre-hurricane era was—you know, and this is compounded by the fiscal difficulties that the commissioner mentioned—is that PREPA had been deferring maintenance on its infrastructure and [inaudible] capital spending in its power plants, which contributed to high and rising forced outage rates.

So, the five generators shown here—two in the San Juan area—or three in the San Juan area and two in the South Coast—Coast Estero and Aguirre—had pretty high and rising forced outage rates, particularly in the latter half of 2015 and 2016. Again, this is two years or a year and a half pre-hurricane. So, there were stability issues. There were power outages. PREPA felt like they had to maintain quite a high reserve margin—a lot of sort of backup generation that was ready to come on at any time—because the existing generators could trip off and fail at any time and they had to be ready. So, it was a challenging environment to think about doing resource planning again, even before the hurricanes hit.

Next slide. So, the large fossil generators on the island were actually relatively unscathed by the hurricanes. They would have been able to come back up online quickly, except that the wires connecting them to the load that they would be serving were severely damaged. And so, when thinking about doing resource planning in a post-hurricane environment, you have a generation fleet that was relatively unscathed—but not a highly performing on in the first place, as we just saw in the previous slide—but increased focus on resilience, on being able to recover quickly from a storm like Maria, an interest in locating generation closer to load. We talked about that geography where the generation is on the South coast, across the side of the mountains, for most of the load.

There's also a real, I think, _____ change in customer attitudes towards self-generation and storage. The folks have somewhat less confidence in the utility to restore them quickly, having seen that it could take months. And so, increased customer interest in generators, in storage, in developing microgrids—both for critical loads and for individual households and neighborhoods. And Janine, from RAP, will talk about reflecting that in the microgrid's role once I'm done here. Oh, the aspect on resource planning is that one of the—the economic shock of the hurricanes—which essentially compounds roughly a decade long economic flattening stagnation on the island—that's the demographic projections.

They vary, but generally projects flat to falling population over the 20 years planning horizon, and GDP staying basically flat throughout that period, which just shapes what kind of electric load the island needs to be planning for. Next slide. So, on the transformation front—so, the two big energy bills that the commissioner mentioned that have particular impacts that passed in 2018 and '19 have particular impacts on resource planning questions for the island. So, first, Act 120, passed 2018, set in motion the transition in ownership and control of PREPA's assets. The generation fleet—the

generation fleet that's not set to be retired is set to be sold or transferred to independent [Break in audio] who will run it, and that's something potentially a little bit more like a market context, or at least a little bit more independently than it's run today.

And separately, the wire system, the transmission distribution system on the island, will be operated by a concession [Break in audio] and there's a [Inaudible] ongoing this year to identify who will come in and operate the wire system on PREPA's behalf. That entity would be the entity that would take on resource planning going forward. And then, ACT 17, that passed this year, is a more policy focused act setting goals and direction and particular relevance for resource planning is that it established 100 per cent renewable energy requirement for 2050 with mile posts along the way—20 per cent by 2022, 40 per cent by 2025, and 60 per cent by 2040. Those are minimums. And so, that obviously has a real impact on what kinds of resources the utility could be planning for to be able to meet those targets.

It also requires that all electric suppliers develop demand response plans to try to get more flexibility onto the grid, and also, re-establishes and put a little more detail on an existing target for a 30 per cent energy efficiency by 2040 and explicitly allows for programs to be run by a third-party administrator. One thing I'll just mention about resources—I didn't dwell on this before—but when thinking about the existing resources, many of them—the larger plants—are steam plants, which are really inflexible. They tend to want to just ramp up to some level and stay there—more sort of, "traditionally baseload" generators, the oil plants. And that is a challenging resource to plan around in the context of increasing amounts of variable renewables—so, both customers and also utility interested in more solar in particular. So, if you think about what that resource—just the grid operation challenge of say, having a 60 per cent renewable grid by 2040—if you also have a bunch of generators that just at a technical level have a hard time ramping up and down, that could be a particular challenge for just straight up grid operations.

Most of those steam plants are also the old and dirty ones with high forced outage rates that might, for example, be prime for retirement and be replaced by more flexible resources going forward in the resource planning process. Next slide. So, to just tell [inaudible] here and get the sort of grounding for everybody on integrated resource planning. So, the Integrated Resource Plan—or IRP—is a utility plan for meeting forecasted annual peak and energy demand plus some reserve margin through a combination of supplies and demand site resources over a specified future period. So, this is generally an optimization type process, so, you're trying to find the lowest practical costs to deliver energy service to customers over a longer time horizon.

The intention is to try to get away from piecemeal "Well, this seems like a good idea" type planning to a long-term, coherent picture. So, the IRP usually involves modeling, using analytical tools that can model forward, say, "Okay. Well, the best overall/least cost thing over the next 20 years is to retire this plan, and that plan can build these other ones and be able to—and will do sensitivities and compare, you know, what if the cost of natural gas were to

rise? What if it were to fall? What if load were higher or lower? And be able to fairly compare both demand and supply side resources in that sort of coherent optimization framework. Next slide.

This slide takes sort of a flow chart through how an IRP is conducted. The IRP rule that is established in Puerto Rico that tells PREPA how to conduct an IRP basically follows this structure. The rule is quite prescriptive. We discovered in the first IRP that laying out a general structure in a context in which the utility had never undertaken a planning exercise like that—results had been some misalignments between how the utility interpreted that structure and what best practice would be. And so, the new rule lays that structure our in much more detail, and that's the rule that the currently filed IRP is being evaluated under.

So, general idea for an IRP is you start with a load forecast. You start with your goals and what resources you have, and you say, "Okay. Well, given that load forecast and what resources I have, their expected _____ of life and maybe the goals that I have, what is my need for new resources?" So, you identify a gap, a need to fill that gap, and then, you evaluate supply side, demand side, resources that could fill that gap. You look at what the impacts of the transmission and distribution system are on that, what the impacts on rates would be, and recognize that rates have an impact on the load forecast.

If rates fall, the load might go up. If rates rise, the load might go down as customers either self-generate or they simply change their consumption because of the cost of electricity. If you look at all those different potential resources and bring various social or environmental factors in if they [inaudible] come back—relate to goals—for example, being compliant with air quality requirements or meeting an RPS—bring those pieces together to define potential resources mixes, evaluate them, figure out which ones their least cost, what their pros and cons are—one may be least cost, but is really sensitive to the cost of a fuel input, for example. And so, you need to check and make sure how much risk to fuel price are we willing to take? Maybe we choose another portfolio that, in its base case, is slightly more expensive—maybe it's a little more robust to change a refuel price, for example.

So, then, you go through a regulatory approval process and develop an action plan and actually execute, and then, it's a rinse and repeat process. Typically, the IRP would be done every three to five years, monitor how things are going, and see whether maybe the load is higher or lower than you expected or different resources are available than you expected, and put those pieces back around together into a coherent picture. So, just for context of some of the things, what does it mean to go through this process in Puerto Rico—so, starting back up from the top, the load forecast, as I mentioned—the projections are for load to be falling, even before you incorporate any sort of energy efficiency. Meanwhile, we have a goal of 30 per cent energy efficiency improvement, and so, the net load forecast that PREPA's actually planning for in the IRP they just filed has load, by the end of the period, being something like a third lower than it is at the beginning. So, it's a particular context that shapes what that need picture looks like.

On the global front, obviously, there's 100 per cent renewable goal for 2050, and so, fossil fuel assets—if you build a new fossil fuel power plant, say, in 2035, you gotta be planning to retire it within 15 years and so, that changes the context when thinking about capital costs. We're also—obviously, had goals around resilience, goals around meeting that compliance with their quality, and also, recognizing that context of PREPA's fiscal challenges and the island's fiscal challenge of access to capital. And so, what does that mean about how the resources would actually be acquired? The existing resource fleet, obviously, matters a lot in Puerto Rico. I talked about the high forced outage rate, the expensive oil resources, the inflexible resources, and so, that really has a strong impact on what this looks like going forward.

There have been—looking at the new resources front, obviously, the falling cost of solar power generally, the falling cost of batteries, have big impacts on what kinds of resources the island has at its disposal. Also, we're working in a context where there have been [Break in audio] no energy efficiency programs, so, the demand side management—whether it's demand response or energy efficiency—is almost—it has been almost non-existent but could be quite substantial and matter quite a lot for them in going forward. Also, whether you want to think of this as being on the demand side or maybe an impact of rates, customers are really interested in self-generation. And so, the question of how do you plan in a context where if you do it wrong, you might lose a lot of your customers, is a particular thing that they island will have to take into its consideration. The T&D system obviously is being rebuilt as you saw from the pictures that Commissioner Ramos showed.

It took a lot of physical damage. And there's this mini grid proposal to develop a new topology for that system. So, pull all that together, you can see how this is a particular interesting and complex event, but potentially, a very impactful planning process for the island to undertake in the next six months or so. Next slide. One of the key contexts for IRP in Puerto Rico is that both the commonwealth laws and US federal laws—the PROMESA Act—established consistency with an approved IRP as a key threshold for both utility and third-party actions in Puerto Rico.

And so, it's very important that the island have an approved IRP. [Break in audio] IRP was approved in 2016. It's still officially the controlling document, although it was developed in, as you know by now, quite a different context. As I mentioned, the bureau did issue a new IRP role that's more explicit about following that kind of process that I just described, and the new IRP is developed in the context where both the bureau and the utility recognized that a new IRP is necessary sooner, rather than later, to align with the transformation that the island is planning for an undertaking, and also, for a post-hurricane environment. Next slide.

So, we're in the process now of evaluating a 2019 resource plan. PREPA filed a version in February that the bureau ruled was not in compliance with the regulation. And PREPA filed a new version on June 14th, and the bureau is now evaluating it for compliance. We would expect examination of that IRP to take place over the second half of this year, with the goal of having an

approved IRP that is high quality and reflects the island's needs as soon as practicable so that we can use that consistency with the IRP framework. The bureau can use that to judge actions against an up-to-date plan of where the island is trying to go.

The June draft evaluates options that are consistent with Act 17 that was [Break in audio] passed between the February version and the June version, so, it's good to have an update version that reflects the renewable energy and energy efficiency policies that are in that bill. PREPA proposes allowing segmentation of the grid into eight mini grids, as the commissioner mentioned, and then, the critical and priority loads within each of those mini grids would have, essentially, microgrids or something like that to serve them, so, they would get power even faster, and try to have it as resilient of a local energy supply in the event of a catastrophic hurricane, if possible. And the evaluation of that mini grid proposal will be part of what the bureau looks like in the course of IRP for the rest of the year. Next slide. In concert with the IRP process, just to mention that the load forecast in the IRP assumes that the island follows through on its energy efficiency and demand response objectives, so, the bureau is developing roles that would implement that's act's policy on energy efficiency and demand response.

The IRP role's already described a third-party administrator approach and Act 17 codified that that is an acceptable path forward, so, sometime in the next—over the summer, the bureau expects to release rules and an implementation approach with the objective of having robust energy efficiency programs in place starting next year to be able to capture that low-cost resource for the island. Next slide. That concludes my quick summary of what's going on on a resource planning front in Puerto Rico. I look forward to your questions at the end and I'll pass the baton to Janine to dive a little deeper into microgrids.

Megan And this is Megan. Before I turn it over to you, Janine—just a reminder for our attendees that if you'd like to ask questions, please go ahead and do that in the question pane any time and we'll have a Q&A after your presentation, Janine. So, with that, thank you very much, Asa, and over to you, Janine.

Janine Thank you. Thank you, Megan. You can go to the next slide. So, just to give you a little bit of background on the Regulatory Assistance Project. We provide technical and policy support at federal, state, and regional levels to advise commissions and governments and their staffs.

We advise legislators and governors and other national organizations on clean energy policy, which encompasses a whole lot of categories, many of which are being covered today, and encompass a lot of the work that we are currently engaged in in Puerto Rico. Next slide, please. And RAP has been involved in—you can skip to the next slide—RAP has been involved in working with the Puerto Rico Energy Commission—which is now the Energy Bureau—in advising them on a number of policies to—since the passage of Act 57. And we've been doing that along with Synapse as well. So, the context is—for the microgrid rules—is that this is the first set of comprehensive rules.

When we were asked to put these together, we started to look and see, well, what other rules are out there to sort of get an idea, and there just weren't any. So, this is really the model. It's our best effort and we think what we came up with will work well, but that's not to say that in the future—because it is the very first—there may not be refinements down the way. But the reason for these rules—and these rules were passed in record time—was to address the problem of large swaths of the population being without any power for months, especially in the rural areas. The tendency is, when you have a widespread outage, you restore power first to emergency areas like hospitals, government authorities, police, and other institutions, and then, you go to the large population areas for the biggest bang for the buck.

So, what ends up getting left toward the end are the remote rural areas that are very difficult to access and will take a lot of time. So, the idea behind the microgrids—and these are islanded microgrids—was to be able to provide a source of power for people who were without power for a period of time and may remain without power for a while as the cleanup and restoration efforts expanded. So, as you can see—and as has been discussed—there was widespread discussion of PREPA's transmission and distribution system. Next side, please. And this is basically a photo of some of the wreckage from the distribution system.

This is Las Marías in Puerto Rico on October 23, 2017. Next slide, please. To give you an overview of the microgrid rules—and then, we'll dive deeper—it—as I said earlier, it was focused on islanded microgrids. The rules for interconnection are being drafted by the energy bureau and will be released for comment shortly, and this will enable microgrids to interconnect with PREPA's grid, use power from the grid, provide power to the grid, and then, island, in the event of another storm. It was based on Act 133 in Puerto Rico and we used—which required renewable energy—and what we did was we used a renewable standard similar to that in the public utility regulatory policy act otherwise known as PREPA.

So, the microgrids have to use 75 per cent renewable energy or can be combined heat and power or a hybrid combination of the two. The rules also call for—well, separately, there are proposed performance and incentive metrics that may address cooperation with microgrid operators by PREPA in order to ensure that the interconnections and everything else that needs to take place takes place well. And as has been mentioned earlier—performance incentive metrics—there was some work done on it—a proceeding opened by the bureau prior to the storm where PREPA was asked to report on key performance indicators. That proceeding will be re-visited and there'll be more to come in the near future on this proceeding. Next slide, please.

So, here are—the microgrid rules consisted of Article 1, which is your standard legal information on what is the purpose, the application, and provisions of other regulations. Next slide, please. It also includes the definitions, which is very important section. And you'll find that these sections exist in most of the rules promulgated by the Energy Bureau, with the definitions changing—definitions being consistent from regulation to

regulation, but different definitions being employed based upon the subject matter. Also, information on confidentiality of information and also, on penalties.

Next slide, please. So, one of the key factors is the microgrid categories and how we're classifying microgrids. Next slide, please. So, microgrids are being classified by their operational structure, by their size, and whether or not they engage in off-system sales of energy or other grid services to entities other than PREPA—and we'll get into that last piece a little bit more as we go further on. Next slide, please.

So, microgrids are being classified according to whether they are operated by one or two natural persons, customer owned cooperative of at least three or more cooperative members; whether it's a non-profit or for-profit entity such as a corporation, limited liability company, or a partnership; whether it's a single municipality, a group of municipalities, or any other administrative division of the commonwealth; or whether it's PREPA operating it; and any other arrangement that are submitted to the bureau for review. So, that's sort of a catch-all. We felt we pretty much covered the waterfront with those categories, but if there's some other kind of structure that someone comes up with, they can submit it to the bureau for review and approval. Next slide, please. So, microgrids were also classified on the basis of size.

So, we have individual sized microgrids of one or two customers or customer/owners where at least one of the customers is operating it. Small microgrids we categorize as between 3 or 10 customers for cooperative members, and no more than 250 kilowatts in size, and then, we had large microgrids of more than 10 customers or cooperative members with a generated capacity of over 250 customers. And—next slide, please. And one point to make is that the requirements for microgrids owned by PREPA are outside the scope of this regulation and are covered elsewhere within other regulations. So, section three are the technical requirements for a microgrid.

And the microgrid composition consists of generation assets, the load that is to be served, and the distribution infrastructure. So, it's like a little mini self-contained utility. The renewable energy microgrids must have—75 per cent of the energy output must be renewable energy. The combined heat and power specifies annual useful thermal energy output and fuel input so that the thermal energy output of the system is no less than 50 per cent of the total energy output. And the fuel input minus the useful thermal output is no more than 7,000 Btu per kwh of generator output.

The hybrids must be—to be a hybrid, it must meet the renewable energy and the combined heat and power standards above and explain how they're planning to operate between the two components. Section 303 requires that the microgrid owners submit forms demonstrating compliance and that they are going to be in compliance as well with any codes and standards in Puerto Rico that would be relevant to them. Next slide, please. So, Article 4 was the requirements for the cooperative microgrids and the small cooperatives, remember, are 250 kilowatts or less and large cooperatives are greater than

250. The requirement is that no single member of a microgrid may possess or control more than 35 per cent ownership stake.

For small cooperatives, the cost per share is determined by the members. They can ask for deposits, and rates for service must be based on consumption, peak load, or another metric at the discretion of the members, provided the rates are just and reasonable and non-discriminatory. And these are the same requirements for large cooperatives, however, in addition, large cooperatives must submit an annual report every year to the bureau as to their operations over the years. Next slide, please. The requirements for third-party microgrid are the most complex and most involved.

The law in Puerto Rico was somewhat unique in that it allowed—even though there is no retail competition or wheeling in place at this time—although that is in progress and being developed—at the time this law was passed, this was not the case. And so, allowing a third-party to provide power was sort of an exception to standard practice where PREPA provided all the power. And so, they're viewed, a little bit, analogous to being an energy service company, and so, the thinking was that there needed to be tighter regulations in order to ensure that the public and consumers are protected. So, there are—under this section, the microgrid owner—the third-party microgrid owner—may sell energy and grid services to customers and PREPA. So, once the interconnections are in place, that provides an opportunity to sell power back to PREPA when there's excess power.

That might be helpful to the grid. There are certification requirements, and those are referenced. If the load is greater than one megawatt, they must comply with the standard bureau regulation 87-01. There is also registration in addition to the certification, and the registration would require information on location, number of customers, type of generation, system resources, equipment vendor, and certification of design. Also required is the submission of a model contract or a sample bill and that is to ensure that all customers—similarly situated customers are getting the same contract. So, you don't have different contract requirements and different rates depending upon the sophistication of the customer.

There is also a requirement that the microgrid shall bill their customers on a per kwh basis. Section—there's also a section that says that the rate structure must be non-discriminatory. And this is because you want to avoid a situation where you have a microgrid providing service to a group of customers but excluding one or two customers for various reasons—and I'll get into that a little bit more later. There's also the ability for deposits and the requirement of billing in regular intervals with 30-day payments, similar to what PREPA is required to do. So, in other words, we're looking at this supplier to be somewhat analogous to what a typical utility might be, because it is a third-party provider.

And unlike with co-ops or some of the other structures where customers have more of a say in how it's operated, here, they would have less so, so we need more customer protections. Next slide. Oh, and also, I want to mention that for non-metered microgrids, those would be billed on a kw basis. There's also

added other provisions such as if there's an objection to the bill—if the customer has an objection—or their service is being suspended, the regulations under 88-63 for customer protection would comply. There is also a complaint procedure.

The goal with the complaint procedure is to try to resolve complaints internally, but if the customer remains unsatisfied, they can take the matter to the energy bureau under regulation 85-43. Again, the standard contract, again, the non-discrimination—for non-discrimination, microgrid owners must submit of the proposed microgrid boundaries if there are more loads to be interconnected. And to exclude an area, it must be based on cost or technical feasibility. So, if there's a group that's being offered and there's one customer that, for some reason, is not well-liked, you can't just exclude them. You have to have a legitimate basis for excluding that customer.

One of the tricky issues was that we wrestled with was the contract length and the exit requirements. The microgrid operator has to have a sufficient amount of assurance that they're going to get paid if they're sizing a microgrid to serve a certain number of customers and then a group of those customers leave—maybe go to Florida or they move to another part of the island. If the microgrid owner cannot have sufficient revenues to cover its debt, it's not gonna get the financing in the first place. So, we had to balance being able to come up with sufficient amount of revenues—or revenue assurance—for the microgrid owner, with also customer protection and customer ability to leave and move on. So, what the bureau decided to do was have a contract with a maximum length of 20 years.

There's a 30-day termination notice and exit fees can apply during the first 5 years that a customer is gone, and those exit fees would be set by the bureau—be set forth in the contract as approved by the bureau. But there is a requirement for the third-party microgrid owner to try to secure a replacement, and once that replacement is in place, then the customer who has exited would no longer be required to pay the exit fee. So, the exit fees are merely designed to help assure that the microgrid owner has sufficient revenues. It is not designed as any kind of a penalty. So, that's a really important thing.

And very often, if somebody leaves, the persons purchasing their dwelling or moving into their dwelling—renting it or whatever—would most likely take up that contract. But if not, they could find somebody else. Rate review—on the issue of—there's also a fee for use of PREPA's infrastructure. And on rate review, the rates that are established in the contract will be in place for the first three years with no review by the energy bureau. But thereafter, the energy bureau may review the rates if a customer request it.

And part of this was—so, if a contract is for 10-15-20 years and it's based on a rate that is a favorable rate, but then, PREPA's rates go down—as is hoped for under Act 17—you don't want a situation where customers with microgrids are paying much more than customers who are customers of PREPA. And so, if there is an opportunity for more efficiency and to do reduce the rates under the microgrid contract, that would be explored under

a rate review. Next slide, please. This section, Article 6, addresses registration form, commission review, and filing fees, which are $50.00 for a small co-op, $100.00 for a large co-op. And the registration forms would be available at the bureau and, at a minimum, would include information that's in Section 403 and 503 that we've discussed previously.

Article 7. Next slide, please. So, because this was the first of a kind rule—and we got a lot of comments and feedback during the comment period about various aspects such as what if there is a period of lots of rain with no sun, not much wind, and the microgrid—let's say it's a microgrid—relying on solar needs to exceed the fuel requirements of using more fossil fuel because of the unavailable of renewable energy. Can it file for an exemption? What would happen then—other things that we may not have anticipated that we will not fully discover until this is in operation.

The bureau decided to enact a broad exemption category that would allow any microgrid operator to file a request for exemption of modification of any of the requirements under these regulations, and they have to be specific and describe what they're seeking, and it may occur at any time during the process of seeking approval for the microgrid or at a later date such as a change of circumstances—like the one I described with a lot of—for example, there's another hurricane and there's no sun and you need to be able to maybe exceed your fossil fuel requirements. Could you do it to keep people having power during that time period? But this is a process that is available to any microgrid owner to catch whatever in these regulations, because they are first of a kind, that may have been missed, but may need to be addressed to make the system work. So, those can be submitted for the bureau for the bureau's review and ruling as to whether the waiver should be granted, if there's good cause. Next slide, please.

Any decision by the bureau with regard to the microgrid rules—they can be subject of a request for reconsideration. And if still not satisfied, there is the opportunity for judicial review. Next slide. And that does it on microgrids. Thank you.

Megan Well, thank you very much to all of our presenters, and we'll now turn it over to a Q&A session for all of you. So, first—and as noted before—please submit your questions in the question pane if you have those, and we already have a bunch here. So, we'll go ahead now. Following up on your presentation, Janine—but please weight in, Asa and Commissioner Ramos, the first question we had was just about the distinction between microgrids and mini grids. Can you lay that out a little bit for us?

Janine Sure. A microgrid is small confined structure which includes distribution generation and load that is—it's sort of like a mini utility, but it's serving a very, very small number of customers that are signed up to receive service from that entity. A mini grid is the division of the PREPA grid into various smaller contained areas that can be operated independently, and I believe, Asa, there's like, eight. Is that correct, Asa?

Maybe you want to jump in on that or Commissioner Ramos. But that's the distinction. One is a small little controlled area for a discreet number of customers versus a mini grid, which is a larger, regional section of PREPA.

[Crosstalk]

Asa I think there is a proposal of eight mini grids. Think of mini grids as the larger grid cut up into pieces and mini grids as more composed of individual sort of built up from the bottom up—composed of individual loads and the generation design to meet that. So, it's a little sort of—maybe think of it as sort of top-down versus bottom up about how you get to some construction. A mini grid might have thousands of customers that reflect one-eighth of the island whereas a microgrid might have, you know, 3 or 20 customers.

Megan And following up on that—maybe Asa, this one you can expand on a little more. We had a question about the potential benefits of PREPA's proposal for the eight mini grids and how that could integrate with many community led microgrid efforts now occurring on the island.

Asa So, PREPA has identified, within each of the mini grids, particular priority or critical loads that would then be served by microgrids—so, there's some sort of continuity of idea here. And so, I think community level engagement to identify where those particular areas are that would be priority loads from a community standpoint is—and community actions to develop those microgrids—and then, the idea of the mini grid is, in part, that the microgrids don't necessarily need to be able to support themselves for quite as long or have—they're more likely to have some sort of support from the broader grid sooner rather than later.

Megan Thank you. And then, following up on that even a little more—we got a lot of questions about this interaction between the two—are there incentives that exist or will be created to encourage cooperation between PREPA and a microgrid owner? How does that relationship work?

Janine There will be some. The bureau is in the process of developing rules on performance incentive metrics, and there are potential—what we've looked—there are potential performance incentive metrics that could deal with things like the cooperation. If you look at the quick key performance indicators that were put into place before the hurricane, what they basically contained was what was the issue that wanted to be addressed? How were you going to measure it? And what would be the target?

So, one of the issues might be the speed of time to—and there were general ones for just general interconnections of distributed generation, solar, but it might be applicable or analogous. Things like, how much time does it take from the time an application for interconnection is submitted and the amount of time it takes PREPA to actually review it and then, actually get the interconnection taken? So, those might be some examples of some of the performance incentive metrics that might be put in place in order to ensure and monitor and make sure that PREPA is making this a priority and

responding to microgrid owners. And there may be others, but that's just one by way of example.

Megan Great. Thank you. The next couple of questions—and these, I think, are—then, we'll turn into a broader topic—but the last couple of questions on the microgrids and mini grids were some technical ones, and I'm gonna try and combine these a little bit. The first was with regard to microgrids. Does PREPA assert a monopoly on crossing public ways with wires that might pose a barrier to microgrid creation?

And then, another kind of specific question on inverter operation and design standards that might preclude a solar only EC microgrid from running on islanded mode. So, are there any challenges that you see—including these—that might prevent the creation of microgrids in Puerto Rico?

Megan On the second question—I'll take that one, 'cause that one's a little bit easier—on the inverter issue, the microgrid owner can design anyway they so choose and would submit that to the bureau for approval. If the microgrid owner does not want to interconnect with PREPA, there's no requirement that they do so; that's an option for the microgrid owner. So, they would—the benefit of interconnecting is, of course, if you don't have sufficient power and PREPA can sell you the additional power so that you make sure, it's sort of a supplemental power provision that's always useful to ensure greater reliability. But it's not necessarily required. With regard to the monopoly on wires, that's a really good question.

Basically, the thinking is that the wires from the microgrid to the—that there microgrid itself would have its own wires from its generation source to its customer. If they are interconnecting and using PREPA's system, some of that may be covered in interconnection rules that may be released soon, and I don't know if Commissioner Ramos would like to supplement that response.

Ferdinand Well, as far as PERPA having a monopoly on the right of ways, it's not that way. We definitely don't want two parallel energy systems to be running on the same right of way because of security reasons. But there will be a case by case, I guess, review of anybody that wants to use a right of way for a microgrid purpose that's either crossing or that needs, for any particular reason, to run parallel with PREPA. I guess they could probably go underground or something to that respect. But there definitely would be opportunities to use the right of ways. It would just be on a case by case issue.

Megan Thank you. And actually, this is taking a fairly big step back, but following up on that a little bit, how is the IRP process reflecting the proposed privatization of generation assets in Puerto Rico? Maybe Asa, if you want to touch on that one.

Asa Sure. An interesting thing about the IRP process to date is actually that it's really focused on what assets would be the—what generation assets would be the best ones for the island, rather than necessarily on who's owning and operating them. They're basically sort of modeled as though there were a single entity in charge and until PREPA actually goes about selling assets and

such, they are effectively that entity. But then, like he said, the plan is that the IRP will identify which resources are necessary and then, PREPA, or it's the Concessionaire or whoever they are—the Public and Private Partnerships Authority or other entities on the island—can go about the process of actually procuring from independent providers the different resources that have been identified as being the ones that are part of the approved action plan. One of PREPA's proposed paths forward builds on some proposals that independent power producers have put on the table, and this is part of the IRP being shaped by PREPA's fiscal situation as some preference for resources that are sort of known to be able to build and finance-able.

So, it's sort of—it's impacting things in that way, although I think the bureau, I think, will take a pretty sort of _____ principles, optimal approach rather than necessarily being too colored by that. But, like they said, that's up to the Commissioner and his colleagues.

Megan Commissioner Ramos, any follow-up on that or I can go to the next one as well?

Ferdinand Yeah. Like Asa said, the IRP doesn't really go into the ownership of the plants; it's just modeling the actual generation. So, basically—yeah, you can go to the next one. I'm sorry.

Megan No. That's great. Thank you. And maybe this is another one specific to the IRP—so, for you Asa. It is—how can the IRP—or how can an IRP like the one in Puerto Rico—take account of uncertainty around future electric load as that process is moving forward? And I know you mentioned this a little bit in your presentation, but if you can maybe expand on that issue.

Asa Sure. Yeah. So, [inaudible] particular context is particularly relevant because there's this potential—you know, there's—our base case for planning is for something like a one-third load reduction. But if the island's economy were to rapidly recover, if there's less energy efficiency potential on the island than you might think, then, maybe the load will be substantially higher than that. And so, one of the key things to do in an IRP is to do high and low load sensitivities and have them be sort of conducted an appropriate amount different from the base case.

PREPA has a high load case where a load is 15 or 20 per cent higher than in the low load case, but you can see in that—that gives you a chance to run that optimization in the high load case and figure out, okay, so, if load looks like it's not actually changing the way we thought, maybe it means we need to lay the groundwork for this other generator or put RFP out for more solar or more storage than we might have otherwise. And sort of, as part of this monitoring process in doing an IRP, every three or five years—in Puerto Rico, it's every three years—so that you have a chance to see, "Okay. What is load actually doing? What's the current state of the economy?" And be able to actually adapt for that before you've locked in a resource decision or walked away from something—that it turns out that actually, load is higher, and you needed to go and acquire those resources to make sure you have them for the long haul.

Megan Great. Thank you. And Commissioner Ramos, the next one for you. Given such an aggressive goal that's been set of 100 per cent RPS by 2050, what will the bureau's role be in ensuring that Puerto Rico reaches that goal in the coming years?

Ferdinand Okay. Well, right now, there's roughly three per cent renewable energy in Puerto Rico's energy portfolios, and we have a long way to go. The first amounts of 20 per cent for 2022, which is 17 per cent away. So, as in any jurisdiction, trying to reach a goal 100 per cent renewable generation—I think energy efficiency and energy conservation will be key. Like, Asa has mentioned a couple instances.

We have a, I guess, ideal goal of 30 per cent energy efficiency, which is a really aggressive goal also. But in able to get to the 100 per cent renewable energy, we must reduce the energy we consume to make the goal closer and easier to reach. The bureau was—it's gonna start soon—the implementation of aggressive energy efficiency and demand response program that's gonna be catered to all customer classes, but that's one of the things that the bureau will be working on to help reach that goal. The interesting thing—that energy use per capita in Puerto Rico's about a third of what it is in the 50 states, which makes energy efficiency in Puerto Rico a lot harder and there's less opportunities to exploit on the island than the mainland. We're gonna focus on municipal and government dependencies to be able to maximize on the opportunities of efficiency, and also, there's a really aggressive initiative to replace all street lighting to LED lights in the short term.

And also, the Energy Bureau's gonna engage in a massive energy conservation and education campaign. So, I guess these initiatives will start getting us at least on the right path to 100 per cent renewable energy.

Megan And out of those initiatives—this is a good follow-up—do you see some or one as the most important? It sounds like energy efficiency is high on your list. Are there others that you see as at the top of that list of all that the bureau's doing?

Ferdinand Well, actually, I didn't mention the renewable energy credits. So, the renewable energy credit—I'm sorry, the renewable energy market—it's not really a thing yet in Puerto Rico. And it's one of those things that has helped the other jurisdictions in implementing or just pushing the renewable energy. So, that's one of the things that the bureau's gonna be working on in the next couple of months. I think that's gonna help also to have that market and be able to trade the credits.

Megan That makes sense. Thank you. So, one interesting question that we just got is—are there any opportunities to establish an underwater electric _____ to Puerto Rico? What are some of the economics of a solution like that to expand the area of opportunity for resources?

Ferdinand Do you have anything on that, Asa?

Megan To anybody who wants to answer.

Asa Yeah. I don't know of anybody who has done that analysis and I think—as Puerto Rico shifts towards more—wanting more of its generation to be more local to its mode, you know, expanding that building a line and then, maybe a redundant line to some other island—other than serving Vieques—but, if you're trying to connect internationally, that would be a whole different level of analysis. You'd have to be shifting more towards local supply and self-reliance and solar and batteries rather than going the other way. But I suppose someone could make a pitch.

Ferdinand Yeah. That would be like, an old-world solution. Definitely. We could probably sell electricity to some neighboring islands.

Megan Well, for generation more close to home—you mentioned, Commissioner Ramos, a large amount of hydro generation. What is the status of that after the hurricane? Maybe for both you and Asa.

Ferdinand Yeah. There's about 100 megawatts of installed capacity. Not 100 per cent of it—it's in working condition. Some are, but part of the IRP, and just part of the policy in Puerto Rico is to have those up and running 100 per cent. There's actually a private/public partnership RFQ in process to have those refurbished and operating soon in the next year.

Asa From a planning standpoint and a modeling standpoint in the IRP PREPA models, those are sort of ramping back up to their full capacity over the course of the few years, basically—assuming that that P3 process is successful and somebody is able to come in and refurb those plants and get them back up to capacity.

Ferdinand Yeah. So, 100 megawatts of generation in the center of the island—which is pretty much where most of the hydro plants are located—goes a long way. So, I know that—I'm sure that having these online would contribute a lot to resiliency in the center of the island, given another hurricane.

Megan And that was the question I was kind of saving for last. Do you think PREPA, specifically, is ready for an event similar to Hurricane Maria this time? What is the status of the system at present?

Ferdinand Well, to be honest with you, no one can be ready for a disaster of that magnitude. But what we must do is prepare the best we can. The bureau recently opened dockets and actively overseeing PREPA's emergency and vegetation control protocols, and so far, PREPA's complying with bureau's orders, and they also assure they have an aggressive vegetation control program in place. Also, the majority of the power lines that were damaged by the hurricane—they've been rebuilt back to pre-hurricane conditions, which, in the majority of the cases, it turns out to be better than what they were before. So, if there were another hurricane—sure.

They're probably—I mean, there will be destruction and a lot of people without power, but most certainly, I'm sure that the recovery time will be greatly improved than what happened last time in 11 months. So, hopefully.

Megan Yes. Definitely. We'll all hope. Well, with that, maybe I'll turn it back over to you, Kamyria. Those were the last of our questions. And thank you to all of our presenters very much. Those were really interesting for me as well.

Kamyria Yes. Thank you, Megan, for hosting that Q&A session. So, for the questions that we didn't have time to get to today, we'll connect with those attendees offline after the webinar. For now, I would just like to give the panelists an opportunity to say any last-minute closing remarks.

Ferdinand Well, thank you for tuning in and having/showing interest in Puerto Rico and our planning initiatives, and have a good day. This is Commissioner Ramos.

Asa From my standpoint, thanks everybody. And to the extent that there are follow-up questions, please feel free to send them. I'm looking forward to trying to execute best practices with the bureau in Puerto Rico on resource planning, and perhaps set models for how other islands can think about doing transitions like this.

Janine And I would also like to thank everybody for attending and the interest in this webinar. And for those who are—have a direct interest in what's going on in Puerto Rico, to remind you to keep an eye on the commission, on the bureau's dockets. There are a whole lot of cases and opportunities to file comments on regulations and the comments from participants is extremely welcome. So, keep that in mind and thank you.

Kamyria Great. Thank you again. On behalf of the Clean Energy Solutions Center, I'd like to extend a "Thank you" to all our expert panelists and to our attendees for participating in today's webinar. We very much appreciate your time and hope, in return, that there are valuable insights that you can take back to your ministries, departments, or organizations. We also invite you to inform your colleagues and those in your networks about Solutions Center resources and services, including 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 a recording of today's presentation, as well as previously held webinars. Additionally, you will find information on upcoming webinars and other training events. We are also now posting webinar recordings to the Clean Energy Solutions Center YouTube channel. Please allow for about a week for the audio recording to be posted. Finally, I would 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.