# PR100 Six-Month Progress Update (Text Version)

This is the text version of the video PR100 Six-Month Progress Update.

This video is a webinar that discusses the progress updates of the Puerto Rico Grid Resilience and Transitions to 100% Renewable Energy Study, also known as the PR100.

[Link to YouTube video: <https://www.youtube.com/watch?v=JsSVJQq6Vac> ]

*>>***Charlotte Gossett Navarro***:* Good morning, and welcome to all who are joining us today for this 6-month progress update of the Puerto Rico Grid Resilience and Transitions to 100% Renewable Energy Study, also known as the PR100. *[Language other than English spoken, 0:00:40.]*  
  
Before starting, I would like to also mention that American Sign Language interpretation is available. Should you have trouble accessing either the Spanish or ASL interpretation, please alert the panelists in the chat.  
  
My name is Charlotte Gossett Navarro, and I am the chief director for the Hispanic Federation in Puerto Rico. Hispanic Federation is a national nonprofit organization working with Latino communities across the United States, and since 2017, here in the archipelago of Puerto Rico, to promote a just and sustainable recovery. For us, that includes reaching Puerto Rico's 100% renewable energy goals.   
  
Accomplishing that is no easy feat, and it will require the input, collaboration, and participation of many, especially those of us who reside in Puerto Rico. Recently, Hispanic Federation partnered with the PR100 project team to support their stakeholder engagement in the study, including events such as today's. For that reason, I am looking forward to moderating today's webinar, learning from the project team, and hearing feedback from you, the participants.   
  
Our agenda today is tight. Let's take a look. There we go.

Agenda  
So first, we will hear opening remarks from each of the federal and Puerto Rico agency partners in the study. Next, we will hear a brief overview and timeline of the study, and then the various laboratories who make up the project team will dig into the study update. And finally, we will close with questions and answers.

Housekeeping  
Before we jump in, we're going to review some housekeeping, if we can see the next slide. So again, I'll mention that the presentation will be in English with Spanish interpretation available by clicking on the globe at the bottom of your screen. American Sign Language is also provided. The audio and video of participants is off. However, we do encourage your participation through the chat, and we're recommending that you submit all of your questions via the Q&A box, which should also be at the bottom of your screen, so that we don't mix any of them. Some of them will be answered in writing during the presentation, and others will be asked at the end during the Q&A section.  
  
Finally, please note that this presentation is being recorded.   
  
So with that, let's move into the opening remarks. Our first speaker that we're going to hear from is Marisol Bonnet, the recovery coordinator for Puerto Rico and the federal Department of Energy. Marisol?

*>>***Marisol Bonnet***:* Thank you, Charlotte, and a big welcome to you and the Hispanic Federation in Puerto Rico, again, for joining the PR100 team. We are super excited to have you on board. *[Language other than English spoken, 0:03:38.]* Again, my name is Marisol Bonnet, and I have the honor of being the recovery coordinator for Puerto Rico here at the U.S. Department of Energy. Today, we are here to share with you all the wonderful progress that we have achieved in the PR100 study so far, with this incredible team of six national labs. So we're really bringing together some of the best modeling and analysis capabilities that the federal government has to offer.   
  
But it's not just the national labs. These achievements that you'll see today would not be possible without the hundreds of people that have given their time to make sure that our approach and our results are relevant, that they use the most accurate data and information, and that our work really reflects the needs, the priorities, the challenges, and the vision of all Puerto Ricans for their energy system.   
  
The people that have been part of this, they are energetic, and they're excited to have a voice in the planning of Puerto Rico's future electric grid, and we are delighted to really be a platform for that.   
  
I'm not exaggerating when I say hundreds of people have contributed to this study. We are really proud to say that over the past 6 months, we have worked with many of Puerto Rico's public agencies, including the local Department of Housing, COR3, the Puerto Rican planning board, the Energy Policy Program in Puerto Rico, and, of course, really important, we have formed a really close partnership with PREPA and LUMA, the utility and the transmission and distribution system operator. We actually have the executive director of PREPA, Josue Colon, today joining us on the line and listening in. So we're really excited and proud of this collaboration.   
  
We have also met with developers, community and environmental advocates, universities, renewable energy trade associations, and other groups through our advisory group, which you'll hear about later today.   
  
And then we're super excited to also announce that the University of Puerto Rico, the Mayaguez campus, has officially joined our team, so we're ensuring that we're building on local expertise and capabilities, and we'll also talk a little bit more about that.   
  
So what you'll see today has been really a true collaboration. I can't wait to show you everything that we've achieved and what's to come. I would also like to say that this wouldn't be possible without the support of the Federal Emergency Management Agency, or FEMA, who are sponsoring this work as yet another way that they're helping Puerto Rico rebuild and transform the grid. DOE, FEMA, and HUD, the federal Housing Department, have been working with the Governor of Puerto Rico, providing technical assistance, helping them plan and prepare to execute over $12 billion that the federal government has assigned for the recovery and reconstruction of the grid, while also keeping in mind that we have to plan in the context of meeting the island's renewable energy goals.   
  
This commitment, you may have heard about this earlier this year, but it was formalized in a memorandum of understanding that was signed back in February by the secretaries of HUD, Energy, and the Department of Homeland Security, and also the Governor of Puerto Rico. And PR100 is just one of many activities that form part of the MOU and the ways in which the federal government is helping the island in the recovery process.   
  
Lastly, I want to thank all of you for tuning in today, and for your interest, and taking the time. I look forward to hearing your questions, your comments, and your feedback. And before we move on to the study updates, we have asked FEMA, COR3, HUD, and the Governor's Office to provide an update on the recovery of Puerto Rico's energy system and progress to date and progress towards achieving the objectives that we set out to achieve in the MOU. So I'm going to turn it back to Charlotte to introduce our next speakers. And once again, thank you so much.

*>>***Charlotte Gossett Navarro***:* Gracias, Marisol. Next, we will welcome Jose Baquero, the Puerto Rico Federal Disaster Recovery Coordinator at FEMA, the Federal Emergency Management Agency.

*>>***Jose Baquero***:* Good afternoon, everyone. It's a pleasure to be here today—joined a group of dedicated and talented professionals to focus our efforts on the collaboration that will lead to important results for the well-being of everyone living on the island. The memorandum of understanding demonstrates the commitment between the Department of Homeland Security, the U.S. Department of Housing and Urban Development, the Department of Energy, and the Government of Puerto Rico, to restore the electrical system on the island.   
  
Together, our goal is to help Puerto Rico achieve a clean, resilient, affordable, and sustainable energy system for all its residents. We're here today to support this important strategy, this comprehensive analysis of stakeholder-driven pathways to help meet Puerto Rico's renewable energy targets.   
  
While these conversations take place, DHS and FEMA keep working towards the recovery of Puerto Rico after Hurricanes Irma and Maria. As we reach the 5-year mark of Maria's landfall, obligated projects continue to move forward, and in collaboration with the Government of Puerto Rico, we're moving at a steady pace to help Puerto Rico's communities recover and become more resilient to future disasters.   
  
We know that the amount of funds earmarked for Puerto Rico's recovery is unprecedented, a generational opportunity like no other. We have before us the tools and resources to transform the island's energy grid. These funds not only mean the transformation of a clean and resilient energy system for families and their communities. This also translates into the creation of jobs and an economic boost for small and midsized businesses who suffered the consequences of an unstable energy grid.   
  
Through FEMA's Interagency Recovery Coordination Division, the agency has already collaborated with the Department of Energy by funding 22 recovery projects for a total of $18.3 million. In coordination with FEMA, the DOE continues providing technical assistance on energy matters through the Intragovernmental Reimbursable Work Agreement, by identifying and leveraging resources across federal agencies in Puerto Rico.  
  
Today, we will explore some of the pathways and scenarios that will help reach our goal of meeting the island's renewable energy target, to achieve their short-term recovery goals and long-term energy resilience. Thank you, everyone, for your efforts, your support, and for taking the time today with so many great proposals and courses of action. You all are a part of Puerto Rico's transformation, and your contributions are of the utmost importance for generations to come. Thank you.

*>>***Charlotte Gossett Navarro***:* Thank you, and next, we will hear from Manuel Laboy, director at the Puerto Rico Central Office for Recovery, Reconstruction, and Resilience, also known as COR3.

*>>***Manuel Laboy***:* Thank you. First of all, I feel very privileged and honored to be part of this update webinar. I want to thank FEMA, HUD, the DOE, for this historic collaboration, working with the Government of Puerto Rico to position the island on the path of energy sustainability, resilience, and climate adaptation.   
  
I also want to thank DOE specifically for this technical assistance, and the members of the commitment for their valuable contribution to this effort so far.

## Energy Sector: Cost Estimate by Asset Type

FEMA has obligated an amount of $10.5 billion for the reconstruction of the electrical system after what was the devastation of Puerto Rico's electrical system by Hurricane Maria in 2017. This $10.5 billion includes the federal share from FEMA, which is about $9.5 billion. And as you can see, the majority of the funding will be used to reconstruct a more resilient transmission and distribution system.   
  
This is very important, because the transmission and distribution reconstruction and resiliency is at the core of strategies around the integration of renewable energy to achieve the goal to get to 100% renewable generation in Puerto Rico by 2050.

## Energy Sector: Repair, Restore, or Replace Damaged Assets (428 PA)

And there's a lot of progress that has been made for the last 2 years. As you can see next in my slide, hundreds of projects and programs have already been identified and approved by the Puerto Rico Energy Bureau to ensure that these funded projects by FEMA to be executed by the Puerto Rico Power Authority and its agency LUMA for the transmission and distribution are completely aligned with Puerto Rico's energy public policy.   
  
Now we are in the phase of execution, and so far—next slide—we have been able to submit through the Power Authority and LUMA dozens of projects for FEMA's evaluation and authorization for construction. And so far, we have 29 projects being approved by FEMA, which many of them are already in construction phase. So we can arguably say that the reconstruction of the electrical system has already started, and this marks the beginning of the next few years where we're going to be reconstructing Puerto Rico's electrical system, and in parallel pursuing the different projects and initiatives that are going to put Puerto Rico in the path of integrating renewable energy towards the goal to get 100% by 2050. Next slide.

## Energy Sector: Mitigate Future Hazards (404 HM)

In addition to the reconstruction of the grid, we also have an unprecedented amount of FEMA funds for mitigating future hazards. I can highlight a few of those projects that have been already either presented to FEMA and obligated by FEMA, which includes resiliency generation in the north of the island or around Puerto Rico, also projects related to dams and related infrastructure, which is also crucial for the goals that we are pursuing for renewables. And in addition to that, we are in the process of submitting other projects that are completely aligned with the goal of PR100, including the restoration of hydroelectric power in Puerto Rico, submitting proposals related to solar, microgrids, and most recently, a project that we submitted to FEMA for their evaluation for an ocean thermal energy conversion project. Next.   
  
And this is basically a summary of where we are with the reconstruction today. So it's not whether—when are we going to be starting. It already started. This is a reality. And the projects, as we continue to move towards the next few weeks and months throughout 2022, and of course 2023 and beyond, we are going to be seeing more and more projects go to construction phase and ensure that the restoration and a more resilient energy grid in Puerto Rico is becoming a reality.   
  
So I want to thank again all the participants. There's no way we can achieve this by other means other than collaborating together. The federal government, through FEMA, DOE, HUD, and in Puerto Rico, the major stakeholders, including LUMA, including the Puerto Rico Power Authority, COR3, the Government of Puerto Rico, together, I think that this goal is possible.   
  
We are at a[n] unprecedented situation, and in unique opportunity to ensure that we have a diverse portfolio of renewable energy that is compatible to the possibilities of Puerto Rico towards the future. And I'm sure that we're going to get there together. Thank you very much.

***>>*Charlotte Gossett Navarro***:* Thank you very much for your presentation. Before we jump to the next person, I see a lot more participants have joined, so I want to mention again that there is Spanish interpretation available by clicking on the globe at the bottom of your screen. *[Language other than English spoken, 0:16:59.]* And we also have American Sign Language interpretation available.   
  
Our next speaker, please welcome Laura Rivera-Carrion, coordinator officer for disaster recovery of the Caribbean region at the Federal Department of Housing and Urban Development.

*>>***Laura Rivera-Carrion***:* Good morning, everyone. Thank you to the team from the Department of Energy for the invitation to provide brief remarks today. As mentioned, my name is Laura Rivera, and I am the coordinating officer for disaster recovery, and I work with the Caribbean team of the disaster recovery and special issues division of the U.S. Department of Housing and Urban Development, better known as HUD.   
  
Congress, as we all know, Congress appropriated $1.9 billion in CDBUBR funds for Puerto Rico and the U.S. Virgin Islands for improvements to the electrical grid post-hurricanes Irma and Maria. Last year, HUD published a notice providing guidelines on how to implement this allocation for HUD and DOE, together with other federal agencies, such as FEMA, have worked with the Puerto Rico Department of Housing, the administering agency in Puerto Rico of the CDBUBR and funds, to support the action plan development and now the program design and implementation process for this unique grant in HUD's portfolio.   
  
The action plan was partially approved back in March 2022, and the grant agreement was sent to PRDOH in June, so it should be signed any time now. This provides PRDOH access to $1.4 billion in CDBUBR funds for various activities that were proposed by Puerto Rico that include cogeneration of large and small microgrid projects, small-scale commercial and renewable energy projects and other generation projects, as well as planning and administration funds.   
  
While all of the recovery requires coordination, and I think that has been the theme of all of the speakers thus far, the planning and implementation of the programs for the improvement of the electrical grid and all of its components requires special close coordination between all the funders and implementing agencies, which include public and private partners as well, to ensure the available funds are optimized, include the stakeholder engagement, and yield the affordable and reliable electrical grid that citizens and low- and moderate-income residents in particular deserve.   
  
DOE, and I want to give really special props and kudos to DOE, has initiated its technical assistance with PRDOH for the electrical power reliability and resilience program, ER2, funded under this allocation. And that include advice on procurement, program guidelines, and outreach. This collaboration between agencies around energy projects is not limited to this allocation, as HUD and DOE are also collaborating with PRDOH on technical assistance on the planning and implementation of activities funded under the CDBG-MIT, or mitigation, such as the community energy and water resilient installations, and also addressing concerns from stakeholders.  
  
I am taking the opportunity as well to announce that the Puerto Rico Department of Housing has published an amendment to the CDBG-MIT action plan, which is out for public comment, and is posted to their website. And HUD looks forward to continued collaboration with PRDOH, the Department of Energy, and all local and other federal agencies, as well as community organizations and other stakeholders, for a comprehensive recovery of the energy sector. Thank you very much.

***>>*Charlotte Gossett Navarro***:* Finally, we will hear from Carlos Yamin, the deputy chief of staff to the Governor of Puerto Rico.

*>>***Carlos Yamin**: Good morning to all. Thank you for the invitation. I'm excited to be here to talk about Governor Pierluisi's renewable energy diversification public policy and its related opportunities in Puerto Rico right now.   
  
After the severe damage the island suffered from hurricanes and earthquakes, Puerto Rico is in the midst of an historic reconstruction effort which will fully renovate and modernize our electric grid and power generation system all around the island. Billions of dollars in U.S. federal disaster recovery funds are helping spearhead this permanent public work. The Infrastructure and Investment Act provides us with an additional funding stream to develop critical new projects which will allow us to build for a resilient future, and to spur economic development in Puerto Rico, particularly within the energy sector.   
  
This will serve as a foundation for Puerto Rico's progress, and to position the island as an attractive investment destination. Governor Pierluisi's administration is fully committed to maximizing the impact of all federal funding to the island. Puerto Rico is making big changes to its electric grid and power generation system, which is, as you know, all and obsolete. Over $10 billion of recovery funding from FEMA is helping us reconstruct, modernize, and also funding are going to help us create microgrids and advance our transformation to renewables. Furthermore, we will be building an electrical vehicle charging network around the island.   
  
As you know, the Puerto Rico Energy Public Policy Act establishes that Puerto Rico has to achieve 100% renewable goal for 2050. PR100, based on extensive stakeholder input, the national laboratories reports, and from DOE's guidance, will help Puerto Rico visualize possible pathways to this ambitious goal. With that in mind, the Pierluisi administration is fully aligned with the Biden-Harris administration priorities with regards to renewables, including the use of hydrogen as well as offshore wind projects.   
  
We would like to give thanks to DOE's Puerto Rico Energy Recovery Team for leading the PR100 story, and DOE's national laboratories, including the National Renewable Energy Laboratory, Argonne National Laboratory, Berkeley Lab, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, and Sandia National Laboratory, for their extended collaboration. We look forward to continue working with you to achieve the ambitious goal of achieving 100% renewables in Puerto Rico by 2050. Thank you very much.

***>>*Charlotte Gossett Navarro***: [Language other than English spoken*, *0:23:44.]* Before we move into our presentations, we have a quick poll that we're going to ask all of you to participate in, so we're going to share that on the screen in just a moment. And the purpose of this is that we want to understand a little bit better who is joining us today. And so the question we want you to answer is how familiar are you with the PR100 study? Not at all, but ready to learn. Somewhat, and I've read about the study, or I have attended the public launch in February. Or you're very familiar, you're already a member of the advisory group, the steering committee, or part of the project team.   
  
In the chat, you're going to find a link to the poll. If you can click on that link, you'll be able to answer, and we can see live here the answers that we're already receiving. And so we've got a lot of people who are here for the first time, ready to learn. That's great. And a lot of folks who are familiar, but also this update is going to have a lot of good new information for you, from where we were at the public launch a few months ago.   
  
So it looks like there's a lot of—a lot of people who are going to be getting new information today, so that is fantastic. If you haven't taken the poll yet, you still have another moment. Great.   
  
So this is great. This is what we want. We want a lot of people to get engaged in this study, especially new people. We want to make sure everyone here in Puerto Rico and everyone working on renewable energy across Puerto Rico and the U.S. is aware of what's happening here, and the results of this study as we move forward.   
  
So with that, I am then going to ask Robin Burton of the National Renewable Energy Laboratory to join us here so that she can walk us through the overview of what the PR100 study is and the timeline for the study.

*>>***Robin Burton***:* Thank you very much, Charlotte. Good morning, everybody. Thank you also to our guest speakers for your very kind opening remarks. So glad you were all able to join us today. My name, again, is Robin Burton. I'm a researcher with the National Renewable Energy Laboratory, and I'm co-lead of the PR100 study. I'll start a series of presentations with an overview and timeline of the study itself. Next slide, please.

What is the PR100 Study?  
So what is the PR100 study? It was great to see in that poll that some of you are, again, learning about the study of the very first time, so we'll provide some introductory information.   
  
The PR100 study is a comprehensive analysis of stakeholder-driven pathways for Puerto Rico to achieve its goal of 100% renewable energy by 2050, along with interim targets along the way. And it's based on extensive input by stakeholders.   
  
Six national laboratories are leveraging our unique tools and capabilities in this coordinated effort that's being led by FEMA, DOE, and NREL, and I do want to acknowledge that we've got dozens of researchers from across the six participating national laboratories contributing to this effort. Next slide.

PR100 Scope  
We also want to make clear what is included in the scope of the study and what is outside of the scope. So the purpose of the study is to model possible pathways to 100% renewable energy for Puerto Rico and to analyze the impacts of those possibilities. We're conducting analysis to inform potential investment decisions. We're producing a high level road map with some recommended near-term and long-term actions to transition to renewable resources. We're also facilitating extensive stakeholder interaction and sharing information to create a foundation for future implementation. And we're publishing and disseminating results along the way, including data sets and open source models that stakeholders can use going forward as part of implementation.   
  
Outside of the scope of the study, we will not be making any policy recommendations. We're not developing a detailed implementation plan as part of the study or making specific investment recommendations. The study is also focused on 100% renewable energy but is not a plan for decarbonizing the economy at the economy-wide level. We're also not replacing any mandated capital investment planning processes, such as the Integrated Resource Plan. Next slide, please.

How Stakeholders Can Use PR100 Study Results  
So how can stakeholders use the results of the PR100 study? The idea is that the study will produce a set of results, including data and models, that will present possible pathways for Puerto Rico to achieve its goals. It's also intended to answer questions and inform decision-making using the world-class data modeling and analysis coming from the six participating labs. But it will be up to Puerto Rico energy system stakeholders to choose a path forward and to implement it. Next slide.

Activities of Puerto Rico 100% Renewable Energy Study  
There are five main activities within the PR100 study. Across the top, the first activity is responsive stakeholder engagement and energy justice. This activity is being conducted throughout the study and will inform all of the work that we do.   
  
The next two activities—data gathering and generation and scenario generation and capacity evaluation—are what we're primarily presenting on and providing an update on today. In future updates, we'll talk more about impact modeling and analysis. And the last activity, which is reporting, providing visualizations, also includes data management and dissemination as well. Next slide.   
  
This slide illustrates the activities and tasks being conducted throughout the study. Here, we're highlighting that there are, again, six national laboratories contributing to this study, and providing just a little bit more detailed information about the tasks being conducted within each of the five activities of the study. So yeah, again, it's an integrated, coordinated effort being conducted across the labs. Next slide.

PR100 Timeline  
This slide shares the timeline for the PR100 study. It's a 2-year study. We began at the beginning of 2020, and it will be conducted through the end of 2023. So we're delighted to be sharing this 6-month progress update here at this point.   
  
So at this point, we have established a stakeholder group and we've met monthly for the first 6 months to make sure that our initial scenarios that we've been defining are informed by stakeholder priorities and perspectives. We're also happy to share out today four initial scenario definitions that we have, again, developed in partnership with stakeholders for Puerto Rico to achieve its goals. And then you can see that many of these activities are happening concurrently over the course of the study.   
  
At the Year 1 mark, we'll present high-resolution data sets for wind and solar resource for 10 years, and we'll narrow down the four initial scenario definitions to three feasible scenarios with high level pathways, based on the detailed modeling that will be happening by the project team over these next 6 months.   
  
At the 2-year mark at the end of 2023, we'll present a comprehensive report and web-based visualizations of the full results of the study and conduct extensive outreach and public engagement. Next slide.   
  
With that, I'm delighted to turn it over to a number of project contributors to provide more detailed updates on specific tasks within the study. Next slide, please. And I'd now like to introduce Matthew Lave with Sandia National Laboratories to present on stakeholder engagement and energy justice. He'll be followed by John Murphy with Argonne.

## Stakeholder Engagement and Energy Justice

*>>***Matthew Lave***:* Thanks, Robin. Hi, everyone. I'm Matt Lave from Sandia National Laboratories. I'm a technical staff member. And I'm going to talk about three of the components that are part of our stakeholder engagement process.

Advisory Group Formation and Engagement  
So if we go to the next slide, the first one is the advisory group formation and engagement. We have formed an advisory group of over 80 members, from academic, public and private sectors, community-based and environmental organizations, and other related sectors to energy in Puerto Rico. I'd like to invite anyone from the advisory group who's on this call right now to put their name and affiliation in the chat if they could, and just mention that you're an advisory group member, to give everyone on the call a little bit of a feel of who's involved in the advisory group.   
  
We have been engaging significantly with the advisory group thus far in the project. We had monthly meetings from February through July. Four of those were remote. Two of those were hybrid. We actually did one of the hybrid ones last week in San Juan. And we are going to transition going forward to bimonthly or quarterly meetings. So we're going to stay in touch, but we've really—we got a lot of that feedback up front, and it's really been helpful.   
  
We've also, as you've noticed on this call, partnered with Hispanic Federation in Puerto Rico to facilitate—for facilitation of these meetings and stakeholder engagement support in general.   
  
Some of the discussion topics for the advisory group have been priorities for Puerto Rico's energy future, input and feedback on the scenario frameworks and electricity demand levels that we're modeling in the PR100 project, energy justice priorities, and data inputs, including land use and technology costs. So we're trying to be—we're trying to incorporate and be responsive to local feedback from the advisory group as the project progresses. We can go on to the next slide.

Information Exchange  
The second facet that I would like to talk about is the information exchange. So we've launched this online community on a platform called Mobilize. This is for networking and information exchange in an online community, so it really facilitates wide engagement. And it's a space for the Department of Energy and the national labs to provide project updates, gather feedback, and for all users to share resources and network. So people can post papers that they think are relevant there, for example. The project team can give updates as we go along, as they become publicly available.   
  
And it's a foundation for implementation of these pathways to 100% renewable energy. We want this to be a community and to get lots of input. So there's a link here to register to join the community that will either come through the slides or that may be in the chat. And there's a tip. If you'd like to engage with the site in Spanish, there are some tips for how to use Google Chrome and Translate.

Capacity Building  
And then I'll go on to the next slide, which is the third thing that we—that is part of our stakeholder engagement process, which is capacity building. So we would really like the tools, data, and analysis that we are developing and using in this project to be in the hands of people in Puerto Rico and utilized by them to have a sustaining impact through that. So as part of that, we are facilitating university participation in several of the tasks, including scenario development, technical support and analysis, and basically community engagement.   
  
So this will help support—as I said, this will take the tools that we develop, put them in the hands of local people, and it's not even a one-way—it's a two-way process, where the university members are really helping us develop the tools as well.  
  
Through this, we've put in a subcontract with the University of Puerto Rico at Mayagüez. And during the first 6 months, the DOE and the labs regularly met with UPRM faculty, resulting in this subcontract. Basically, we got inputs for areas that they could help contribute to. And the contract has just gone live in the past month or so. And so in the next year, UPRM is going to advise the team on the development of methods, inputs, and assumptions, so that we accurately capture the rooftop solar resources in our models, to make sure that our models are accurately capturing the unique aspects of Puerto Rico.   
  
The UPRM team will also produce new data through a comprehensive survey to improve the PR100 team's understanding of residential solar systems and then finally will assist in development of energy justice metrics based on outage restoration data from Hurricane Maria. So really, as I see it, really helping us drill down to the local aspects and make sure we capture the things that are important in Puerto Rico. And of course, this will be coordinated with all of the parallel research efforts going on in PR100.   
  
So with those three facets of stakeholder engagement, I'd like to hand it over to my colleague John Murphy from Argonne National Lab to talk about energy justice.

*>>***John Murphy***:* Thank you, Matt. As Matt said, my name is John Murphy. I'm a technical staff member at Argonne National Lab. And I—if we can move to the next slide, I would like to talk about how—our effort in PR100 to make sure that our study is grounded in energy justice.

Energy Justice Definition and Themes from the Literature  
Energy justice builds on a scholarly and grassroots tradition in environmental justice and climate change activism, but it is distinct from these in that it focuses on the benefits and burdens of production, distribution, and availability of energy.   
  
The goals of energy justice are achieving equity in social and economic participation in the energy system while remediating social, economic, and health burdens on those historically harmed by the energy system.   
  
So to begin to incorporate energy justice into PR100, we've conducted a review of literature on energy justice issues in Puerto Rico and have organized it by theme. The themes that we found that emerged from the literature include a variety of academic frameworks within energy justice that give us a range of theoretical tools to understand energy justice and the issues as they play out in Puerto Rico, and a collection of domains where energy justice issues apply.   
  
Among those domains: who has access to energy and who does not, how energy facilitates economic and workforce development, the environmental and health impacts of various energy systems, the ways that different components of infrastructure, such as water supply or transportation, are interdependent and linked to energy, the democratic governance of energy systems, and other themes.   
  
This literature review, in keeping with our commitment to make our data available widely and to facilitate our discussion, is available in the resources section of our Mobilize website. Could I have the next slide?

Energy Justice in PR100  
So within PR100, we organized our work around energy justice in four main areas. The first of those is termed procedural justice, and this is in many ways the foundation of the project. It refers to making sure that the study is inclusive, that stakeholders have access to the process, that local knowledge is incorporated, and that the results are shared as widely as possible. The Mobilize platform and this webinar are both parts of this effort.   
  
The second is the construction of metrics-based energy justice analyses. We want to be able to measure and put numbers on how well we're doing in aspects of energy justice that are addressed by PR100. We want to use these metrics to answer questions about the energy justice impacts, questions like who and how many and for how long, and use these to compare the different scenarios that we are generating in our analyses and that we're modeling.   
  
We combine these two elements with two others. One is infrastructure interdependency assessment, which identifies how electric power is interdependent with other critical infrastructure, like information technology, water, transportation, or critical community lifelines. We want to be able to evaluate the extent to which energy injustices result in other resource justice concerns.   
  
And the final element is a climate risk assessment to understand how changing climate conditions will present future risks, and how this can be incorporated into our decisions about infrastructure today. But I want to talk a little bit more about the climate assessment, if I could have the next slide.

Climate Risk Assessment  
So our climate risk assessment begins with climate simulations. The outcome of these simulations is a data set that is a little bit like having a weather station positioned on a grid every 4 kilometers across the island and taking readings every hour for a period of say 20 years. This 4-kilometer resolution is sharper than many previous data sets that so far, the state of the art has reached something more like 12-kilometer resolution. The 4-kilometer down-scaling that we're doing is cutting edge.   
  
The values in the data set include surface measurements, like total precipitation and temperature, atmospheric parameters, like wind speeds and humidity, but also soil parameters, like the amount of moisture in the soil, and hydrological parameters, such as sea level rise.   
  
To be clear, these are of course not forecasts. We don't pretend to know what the temperature will be at a specific hour two decades from now. But we can use these simulations to estimate averages and compare them to current conditions.   
  
I won't go into much detail about these, but I will share one piece that we've been looking at. First, though, I'd like to take a poll to see what the participants in this webinar think the future climate in Puerto Rico will look like.

Poll Question 2  
So there should be a link in the chat to the poll question. And the question is how much do you think annual daily average precipitation is projected by our models to change by 2045? And in millimeters per day, the options are 1.2, 0.5 increases, or minus 0.5, minus 1.2 decreases, or informally, sort of a large increase, a small increase, a small decrease, or a large decrease.   
  
So I'll let people add their thoughts. It looks like we have a plurality of people suggesting that the rainfall per day is going to increase by 2045 by a large amount. I'll give it two more seconds. I think we've reached consensus.

Climate Risk Assessment (continued)  
So let's see what our simulations say. Can we move to the next slide? So this is the simulation results. The graphic on the left is essentially historical annual conditions. I believe it's actually our retrodictions using the same modeling procedure to generate historic[al] conditions, and make sure that we use it to calibrate it. But the green areas are areas with the higher rainfall and the red areas are areas with lower rainfall.   
  
The central graphic is our projection for the future, 2045. And then the graphic on the right is what happens when you take the future one and subtract it from the historic[al] one, so you get the difference.   
  
The answer is actually that rainfall is going to decrease by -1.2 millimeters on average per day, which is about an 8% decrease in annual rainfall, so a rather sharp decline in rainfall availability. This of course doesn't—isn't discussing extreme events. It is just discussing the sort of daily averages that you'll see over the course of the year. Could I have the next slide?

Infrastructure Interdependency Assessment  
So we combine our climate assessments with our infrastructure interdependency assessment. So again, infrastructure interdependency is asking the question of how are pieces of infrastructure, not just the electrical grid, connected to each other. This allows us to ask if we lose power in one place, what are other places are affected by the infrastructure that that power supports? If you lose an electrical generation plant in one place, do you lose the water treatment plant in another?   
  
The tool that we use is called PRIIA, the Puerto Rico Infrastructure Interdependency Assessment tool. It captures service areas for all electricity-dependent critical infrastructure across Puerto Rico, including substations, cell phone towers, water treatment plants, wastewater plants, etcetera.   
  
We used this to generate this analysis of the geographic impacts of problems that occur in specific places and how they spread through the system. We combined that with FEMA's resilience analysis and planning tool, RAPT, which is more geared towards identifying community lifelines, and these are elements that enable other aspects of society and require action if they are disrupted.   
  
We further support this with the resilient node cluster analysis tool, ReNCAT, from Sandia National Lab. And this tool maps social burden, which is how strong the effects of losing a particular service, like water, would be, given the cost of moving to a replacement service. If no clean water is available in one town, how far is it to get to another source? These kinds of secondary costs will vary, depending on the location, and this tool gives us an opportunity to analyze that.   
  
Using these tools, we can get a detailed picture of how well our scenarios are performing according to the metrics that we are developing for measuring energy justice.   
  
With that, I will pass the microphone to Manajit Sengupta from NREL to discuss our renewable energy resource assessment.

## Renewable Energy Resource Assessment

*>>***Manajit Sengupta***:* Thanks, John. So while John just talked about the climate and how things change looking out in the future, I'm going to talk about resource assessment, which essentially is an effort to provide high-resolution, high-quality input data on solar, wind, and other sources of renewable generation for the downstream models which are being used in the PR100 study. So next slide, please.

Wind Resource in Puerto RicoThis is an example of what we have done with the wind resources. One thing to remember is that high-quality data results in high-quality studies. So in this case, what we—one thing to realize is that the wind and also solar varies from location to location, and over time, to capture that, what we've done is we've run very-high-resolution models with state-of-the-art models to capture the spatial and temporal variability of wind.   
  
And here's an example of the average wind speed, both offshore and onshore, for 2019. And on the right hand side, you can see how it varies over time. Next slide, please.

Technical Potential for Land-based Wind  
So while we know what the wind resource is over the island, to ultimately get to the technical potential, there are other pieces of information that are required. This includes which land is excluded from development, for solar sometimes it's the slope of the land, and similarly, for the oceans, there are regions which would be excluded because of various technical reasons.   
  
So in our preliminary findings, what we found was for wind, we can—we have developable areas between 2,150 and 2,640 square kilometers. With the assumption that the wind density is like 3 megawatts per kilometer square, the preliminary technical potential for land-based wind ranges from 6,400 to 7,900 megawatts. Of course, as we progress in the study, all of this will be much more refined. And I'd like to thank our advisory group for all the inputs they've been providing, which helps us to refine our exclusion zones. Next slide, please.

Representations of Severe WeatherSo as I mentioned, our work here in generating high-quality data involves high spatial and temporal resolution modeling. The other important thing to remember is that if we—as the high-resolution modeling enables us to capture severe weather in a much better way and much more accurately. This is, at the end, extremely important, because we would like to also understand how severe weather impacts renewable generation resources demand, and also power system outages.   
  
So in this case, here's an example of how Hurricane Maria has been represented in our model. So this basically shows us that our data is capable of capturing any severe weather events that have happened over the years. Next slide, please.

Solar Resource in Puerto Rico  
While I've been talking about wind, the other part of the study is the solar energy. And the solar energy data sets for this study come from the National Solar Radiation Database. The National Solar Radiation Database is a publicly available, so high-quality, high-resolution data set from 1998 to 2020, and it's updated every year, and it provides us a really complete data for both solar irradiance and relevant meteorological information. And this database has been—the NSRDB has been leveraged for the solar modeling for Puerto Rico 100.   
  
In this example, we used the average solar radiation, the GHI, the global horizontal irradiance, for 2019, which this year has been a focus of the study. What it shows is that Puerto Rico overall has significantly high solar resource, with the coastal regions having the highest resource available. Currently, we have created an outlier-resolution data set which goes up to 2017. For this study, we are adding additional years so that our data set will cover 1998 up to 2020, so that we can also understand how resources vary over time. Next slide, please.

Wind and Solar Resource Comparison  
So here is the reason why we've created multiyear data sets. As you can see that this is renewable resource or wind, it varies over time, and this is a graphic which shows how the wind and solar varies over—from 2006 to 2020, over a period of 15 years. The blue bars represent offshore wind, average wind, for each year. The green is for onshore wind. And the lines—the yellow line is for solar, the global solar, and the direct solar is represented by the other line.   
  
So as you can see, the resource is not uniform from year to year. It varies over time. So it is important to understand that we choose a year for our study which is not overly optimistic or overly pessimistic, something in the middle. An example of if we were to use say 2010, we would have a year where both wind and solar are low. On the other hand, if we considered say a year like 2014, we would have an overly optimistic year.   
  
So in this case, we chose 2019, which is somewhere in the middle, a median year, as we would want to do. And that's why we've generated over 15 years of data, so that—and we've chosen a median year for the study. So next slide, please.

Residential Rooftop Solar Potential in Puerto Rico  
One thing to consider is that while I've talked about the resource, we are also looking into detail about our residential rooftops. This has been possible because there's lidar data available, and this study was conducted before PR100, and currently, we are updating this study for—so that it can be used for Puerto Rico 100.   
  
One thing to note is that there is significant technical potential from rooftop, with our preliminary estimate from the study showing that it's 20 gigawatts or more. Next slide, please.

What Additional Renewable Energy Resources are Being Considered in the PR100 Study?  
And finally, while I just talked mainly about wind and solar, we are also—our team is—looking at evaluating hydropower, pumped hydro, marine energy, and additional technologies may also be addressed, depending on the scenarios. So rest assured that we are looking at all possible sources of renewable energy for the study. And thank you for your attention, and I will now hand it over to our next speaker. Thank you.

## Poll Question 3

***>>*Charlotte Gossett Navarro***:* Thank you so much. So we are going to jump into one other poll. We just heard quite a bit about the different renewable energy sources that are being considered and assessed as part of the PR100 study, so we want to hear from you. Which of these renewable energy resources are you excited to see represented in the PR100 study? So you have a link in the chat again, and we're going to watch live the results that come in. Just take a moment to click on that link and let us know which of the options that are being considered for renewable energy are you most excited about?   
  
This is a different type of result, where we can see the size of the words and what's coming up. We get to understand what is being shared by those of you participating, and see solar there, solar and wind in the center, rooftop. Let's see what else is coming up. Solar, hydro, wind, rooftop large there in the center. I see words like distributed, decentralized, ocean, comprehensive, residential. So we can see staying strong there in the center solar, hydro, wind, rooftop, solar. Keep sharing.   
  
So I think the good thing is what we're hearing from you is that some of these options that we just heard about that are being considered are things that are—that you as participants are excited about, so that's great.   
  
We are going to move on to the next presenter. Before we jump to him, I do want to remind you, your questions, as you ask them, please put them into the Q&A. It helps us to capture them, make sure they don't get lost in the chat as people are adding their comments to the chat, and it helps make sure at the end of this, even if we didn't get to answer your question today, we have a record of it right there in the Q&A. So please do share in the Q&A function.   
  
So now I'd like to close this poll, and instead, we're going to invite Paritosh Das of the National Renewable Energy Lab, who's going to speak about electricity demand and distributed energy resource adoption projections.

## Electricity Demand and Distributed Energy Resource Adoption Projections

*>>***Paritosh Das***:* Thanks, Charlotte. Once again, my name is Paritosh, and I'm a researcher at the National Renewable Energy Laboratory. Although I'm presenting here, but this section is really a collaboration of a lot of continuing great work from researchers spanning from not only NREL, but Sandia, Argonne, and Lawrence Berkeley National Labs.   
  
It's great to see a lot of consensus coming up from the poll about the different energy resources that people are excited about, and rooftop solar or solar in general being a predominant outlier or predominant player coming in.   
  
I will be discussing a lot of rooftop solar stuff, but I think I'll also be discussing a lot of electricity demand and how demand impacts are considered or modeled in our analysis.

Electricity Demand Impacts  
So let's start by looking at how we are modeling electricity demand impacts. The electricity demand projections are impacted by a variety of different factors. First, we start with demand projections for end-use loads, and this includes all traditional users of electricity across different sectors and in different regions of Puerto Rico.   
  
Then on top of this, we will layer on the impacts of energy efficiency improvements, which will decrease the overall demand projections. But we'll also model the adoption of electric vehicles, which would increase electricity demand consumption. Finally, we'll model the adoption of distributed solar, and behind-the-meter storage, which would reduce electricity demand that needs to be met by PREPA and LUMA. And the remaining net electricity demand will then be met with an analysis by renewable energy resources considered in this project. Next slide, please.

Residential Sector  
So we used our similar methods from PREPA's 2019 integrated resource plan to create electricity sales projections for each sector, although the residential sector is what is shown in this figure, but we do consider the commercial, industrial, and other sectors as well.   
  
We updated the input data that was used in IFP methods. However, we used the latest projections for population, gross national product, cooling degree days, which is high related to temperature, and manufacturing employment, and extended the projections until 2050.   
  
Our temperature projections will later be informed by climate modeling conducted by some of our colleagues in Argonne National Lab.   
  
You can see in this figure that initial residential sales projections used in PR100 shown in the gold color is higher than the projections from IFP shown in blue. But both projections have a similar rate of decline. This is because some of our input data of population, gross national product, and cooling degree days were higher than the values used in 2019 IRP. Next slide, please.

Baseline “High,” “Medium,” and “Low” Projections  
With all of the electricity sales projections by sector, we add energy efficiency losses and other miscellaneous loads to get the total demand projections. An important reminder here in this particular figure is that these baseline demand projections do not yet include energy efficiency, electric vehicle, or distributed solar and storage impact, so they would be eventually added up to our baseline demand, and we would see the effects of all these technologies as an overall level.   
  
Again, we used a similar method that was used in IFP to develop these high, medium, and low projections. These were also informed by comparing the projections to historical load from 2019 to 2021. In this figure, the darker colored lines represent the initial baseline demand projections used in PR100 modeling compared to the IRP projections which are shown in the lighter colored lines. Next slide, please.

Hourly Demand Projections  
We then took these high, medium, and low projections of demand and disaggregated them into hourly projections for each year from 2022 to 2051. The figure on the right is showing the demand projections for each hour of the year for the Fiscal Year 2051. These figures our showing total demand, but we have also broken down them into individual sectors for residential, commercial, industrial. We used various assumptions to turn these annual projections into hourly projections, based on historical and model data from PREPA and LUMA. And we are excited that we have got a lot of great feedback from our advisory committee that are helping us to revise a lot of our assumptions as we move forward through our analysis in this particular PR100 project. Next slide, please.

Hourly Demand Projections by Region  
Finally, we took those hourly projections that we saw in the last slide for each sector and broke them down by region as well at the municipality level at this particular time. We based this off data for Fiscal Year 2020 that showed the distribution of electricity sales by municipality. And we assumed those percentage breakdowns remained constant through the time period analyzed.   
  
To summarize, this process resulted initial hourly electricity demand projections from Fiscal Year 2022 to Fiscal Year 2051, disaggregated by sector and by region, which in this case is municipal regions in Puerto Rico.   
  
On top of this, as I said earlier, that we would be layering on the energy efficiency upgrades, the electric vehicle demand, and the additional solar and storage demand that would come up, and also in the same granularity of municipal regions. We'll also incorporate \_\_\_\_\_ temperature data that will come out from our climate modeling efforts as well. Next slide, please.

Electric Vehicle Spatial-Temporal Projections  
So we talked about the base electricity demand or the baseline electricity demand, so let's move into a little bit more deeper on the electric vehicle impacts that the team has been working on incorporating them. So the team is working on developing an EV adoption model, which uses a data-driven approach to come up with long-term EV projections for Puerto Rico municipal regions from 2020 till 2050.   
  
This would use temporal EV adoptions developed for different states within the continental U.S.—and adapting them to Puerto Rico by incorporating Puerto Rico's specific data, such as like how much EV adoption has happened, what are the number of EVs that are currently there, census data within Puerto Rico, and seeing those effects come up. The final output would be something like the number of EVs in Puerto Rico by municipal regions, which is interesting, because this will align well with our baseline load that we developed in the previous sections. Next slide, please.

Energy Efficiency Savings Sources  
From electric vehicles, now let's move on to energy efficiency impacts. Our colleagues from the Lawrence Berkeley National Lab have been working on quantifying the impacts of energy efficiency within Puerto Rico. This table that you see right now shows the primary sources of energy efficiency savings, such as savings coming from programs or building energy codes and applies and electricity standards, equipment standards, and its net overall impact in a default and stress scenario. So by default, what we are meaning here is that we are considering all transition period and permanent programs that are implemented, or as contemplated in the current energy efficiency proceedings, so whatever is there right now in the proceedings, we are considering them as default.   
  
Some of our stress scenarios do differ a little bit in terms of the program implementation, in terms of how the federal standards and adoption of those standards are coming in, basically in terms of timing, how successful those are, and what effect does it have on if we define a default scenario and then stress scenario. Next slide, please.

Adoption of Distributed Energy Resources  
From energy efficiency, now let's move to a modeling of adoption of distributed or rooftop PV and the behind-the-meter storage. For this analysis, we are using NREL's agent-based dGen model. The team has been working on creating agents, which in this case are considered as potential consumers or customers in various sectors, such as residential and nonresidential. These basically are statistical representative agents with a range of different attributes that contribute towards developing technical, economical, and deployment estimates. This would consider the install cost of installing a PV panel on your rooftop, actual retail electricity tariffs, or incentives and compensation mechanisms, such as net energy metering, which play a major role in the economic calculations that a consumer or a customer has to make while making a decision of putting the rooftop PV or not. So it's a long-term investment for a customer. So getting those incorporated from a customer's perspective we feel are important to get an accurate picture of what makes a decision of putting rooftop PV on a rooftop for a residential customer worth it or not. Next slide, please.   
  
And once again, thank you for your patience is listening to my section on electricity demand and distributed energy resources, energy efficiency. So let me pass the baton to my colleague from NREL, Nate Blair, who will be helping us to go through the four initial scenario definitions in the PR100 study. Thank you so much.

## Four Initial Scenario Definitions

*>>***Nate Blair***:* Thank you, Paritosh. This is Nate Blair. I'm happy to be here and excited to talk about where we're at in terms of scenario definitions as we move through the project. Next slide, please.

What is a Scenario?  
First of all, what is a scenario? I think there are a lot of definitions. When we think about it, we think about a possible pathway, basically. As we look in this graphic from now out to 2050, and we think about switching over from the current electricity mix over to renewable energy, we look at this—now there are a number of different scenario options that we could go in, and on the right hand side, you see some of the different inputs that we could vary to look at different scenarios.   
  
And it's not to say that all of these scenarios are going to happen. Obviously, a lot of things can happen by 2050. But moving towards Act 17, what we hope to do with these scenarios in both inform current decision-making as well as decision-making and directionality into the future. And it's the comparison of different scenarios and the differences between them that really provide some of the answers to some of the questions.   
  
And so we've talked about something on energy supply. I think all of these scenarios will have a series of constraints around them, and we'll get into more of that as we move ahead. Next slide.

Similar ExamplesI would strongly encourage everybody to take a look at some of the other scenario modeling efforts that have been done. As you can see here, we've highlighted three: one in Hawaii, Los Angeles 100% study that was completed last year, and another one, the Solar Futures Study, and there are several more to think about. Each one of those—you can see the check marks—has a different set of focuses. In PR100, we're looking at grid recovery, resilience, land availability, etcetera. And so what are the key issues? And that's one of the things that we've been working on these first 6 months. Next slide, please.

Initial Scenario Definitions  
So we've been working closely with the advisory group, and they're familiar with our process, to try and come up with four additional scenarios that take into account a number of different pieces of variability as well as some of the key issues that were of concern for the advisory group. So energy access, affordability, reliability, and resilience, and so we are looking at analysis that includes resiliency and reliability in all the scenarios.   
  
And the four scenarios that we've come up with are really focused on varying levels of distributed energy resources, such as rooftop solar and energy storage, and we'll talk more about that in a minute. But we're also layering on there, as Paritosh was discussing, variations in electric load and variations in land use, as well as thinking about more or less resiliency in the transmission and distribution expansion, or making sure that the—that expansion is as resilient as possible. And so we are going to be looking at all of those in each scenario. Next slide, please.

Scenario 1: Economic Adoption of Distributed Energy Resources  
So what I've got here is kind of a graphical representation of the four scenarios that we have come up with. And as I indicated, the primary driver here is the amount of distributed PV and storage in the system. And so what we'll see as we go through these four graphics is changes to the graphical representation.   
  
Here, in Scenario One, we have probably the lowest level of rooftop PV and storage—kind of the—what is economic to build out, particularly under high electricity rates. So you can see that there is some level of rooftop PV represented on these different buildings, and then an amount of utility-scale PV and wind and floating PV. And we are including a broad range of technologies, in addition to this graphical representation of just PV and wind, in our modeling. So I've seen that come up in the chat. Next slide, please.

Scenario 2: Deployment of Distributed Energy Resources for Critical Services  
As we move into Scenario Two, not only are we thinking the amount of distributed PV and storage where it's economic, but we're also prioritizing locations for critical services. So you can see now that in the graphic there are PV and battery systems for the hospital and for the fire station and for some of the other community resources and grocery stores. So those will be—make sure to be—covered in Scenario Two, if they aren't already included in Scenario One. Next slide, please.

Scenario 3: Equitable Deployment of Distributed Energy Resources  
Scenario Three then adds even more distributed PV and storage, thinking about remote locations that were maybe difficult to reconnect to the grid after Maria, and low- and moderate-income households as well, to think about energy justice. And next slide, please.

Scenario 4: Maximum Deployment of Distributed Energy Resources  
And then in Scenario Four, we were going all the way to saying let's put as much distributed solar and storage on all suitable rooftops. As you can see in the graphic, there are a couple of buildings or homes without PV on the roof, because frankly, they're in a location or in a situation where it's not possible to add PV or not possible to add enough PV to cover all of that load. I also would point out on the left side that we have now reduced the amount of PV, wind, and utility-scale resources broadly in that distributed situation, where the distributed PV is providing a significant portion of the energy to the system. Next slide, please.

Key Driver: Electric Load Variations  
As Paritosh was talking about—a little bit on the load side—we want to vary the load so that we can include a situation where the load is increasing significantly. So we have high EV adoption, and whereas in our default case, energy efficiency combined with end-use load starts to decrease that combination over time, we want to keep that flat going into the future, and then so the net load will be an increase.   
  
So the Stress scenario results in the highest loads, and it will include the largest electric system build-out and likely the largest land use, depending on the combination of technologies. Next slide, please.

Potential Electric Load Variations  
And this is just a graphical representation of the table that I was just showing. We anticipate that the electricity demand default will decrease over time, while the stress load will increase. And our goal is to try to bracket what we anticipate reality to be. Note that these aren't set and final. We're still working on thinking about what the EV penetrations are likely to be and what the EV penetrations are likely to be as well. And so all of these combined are a little bit illustrative at this point, but the idea is to try to bracket the future reality of the electric loads. Next slide, please.

Key Driver: Marine and Land Exclusion Variations  
And lastly, over the last 6 months, with the help of the advisory group and the help of our different geospatial teams across the laboratories, we have really gathered a lot of different layers of data for both offshore wind or the marine environment and on the island. And we just had a good meeting with people putting together the land use plan on the right, and we continue to do a variety of activities in terms of gathering that data.   
  
And so one of the things we want to think about in the scenarios is a more constrained scenario and what that means in terms of what the model will build out on the utility scale, and what level of land use is even needed, and then perhaps a less constrained scenario where we would deploy renewables in the model consistent with current use of land as we understand it. And so really trying to vary land use parameters to be able to inform the many questions about that in combination with renewable energy. Next slide, please.

Reliability and Resilience Modeled in All Scenarios  
So the last thing is I really want to stress that—you've heard about distributed loads and distributed generation from Paritosh, and utility-scale expansion from me, and scenario generation from me. So the way this system works is that we come up with scenarios, we think about how that impacts the end-use loads and the distributed generation, we put the remaining net load into this utility-scale expansion tool, and then that builds out to 2050, what is cost-optimum, or what the mix of renewables might be under that particular scenario.   
  
But then we go through and we do a reliability and performance analysis—so will that system hold up under normal operations, if one of those EV plants, for example, were to go offline? What happens to the rest of the grid? And then that would result in some changes and some constraints.   
  
We then go into the resilience analysis, where we look at what happens if a hurricane hits the island again, and we have a number of tools that are looking at that. That might result in modifications needed for resilience. And then we loop back to the initial utility-scale build-out with those reliability and resilience issues in play, and work to resolve those.   
  
And so we cycle through here probably a couple of times to try and get to the point where the scenarios are both resilient and reliable, and that we can then do the further analysis that we want to do on those systems. Next slide, please.

Next Steps  
Next steps. So we are going to be thinking about these scenarios more, but more importantly, we're actually going to be modeling them over the next 6 months to get to the point where we start to have some initial results that we can then continue to refine and do post-analysis, I would say, impact modeling, in Year 2. So we're going to be really excited about showing you in a few months the feasible pathways, thinking about how to get those down to maybe three scenarios, even, and really thinking about where we want to go and the results that we really want to present from this scenario analysis in the future. So we've got a number of questions here on the right that we're seeking to understand by doing this modeling and this analysis. Next slide, please.   
  
And Charlotte, I will turn it back over to you. Thank you.

## Questions and Answers

***>>*Charlotte Gossett Navarro***:* Thank you. Thank you, Nate. So we have reached the end of the presentation. We're going to go into our question and answer section. There's not that much time left in our session. We have over 65 questions submitted today live, and dozens more that were presubmitted during the registration process.   
  
I'm going to begin with two that came in through the preregistration, and then we'll see about answering some of the ones that came in live today. So the first question that I'm going to pull up from the questions that were presubmitted is a question regarding our community engagement of this process and the study. So someone in Culebra asked the question, can you describe the community engagement process and how it's going to ensure needs and priorities are included in the study and identification of solutions?   
  
And so, Matt, I think that question would be best answered by you.

*>>***Matthew Lave***:* Yeah. Thanks, Charlotte. This is Matt Lave from Sandia again. I would just emphasize the three things that I talked about already. So we have the advisory group, where we have 80-plus members from a variety of fields and communities that are giving us this input on a regular basis. As we said, we've been meeting monthly so far, and we're going to be at least quarterly going forward.   
  
We also have the Mobilize platform, so we'd invite everyone on this call to participate through that, and make sure that your input is heard.   
  
And then, finally, we are working on the engagement of local researchers through things such as the University of Puerto Rico Mayaguez contract.   
  
So we really are trying to make sure that we get—and the UPRM contract is going to involve reaching out to communities through the university. So we are really trying—we really do want that input. We really are trying to engage and get the local community input.

***>>*Charlotte Gossett Navarro***:* Great. Thank you. Then another question that came in from multiple people and locations is around implementation. And Marisol, I'm going to ask you to answer this question. So whose role is it to implement the PR100 study for Puerto Rico's renewable energy future?

*>>***Marisol Bonnet***:* Yeah. Thank you for that question. I think PR100 is going to answer a lot of questions about how Puerto Rico can fully transition to renewable energy. It's not going to result in one perfect pathway, optimal pathway, for how to get there, because we don't have a crystal ball, and we can't predict what things are going to be like in 10, 20, 30 years.   
  
But what we can do is show different ways in which the system can be configured to meet these goals, based on data of renewable energy resources, on our load projections, and on detailed modeling, and then showing the impacts of these configurations, like Nate said, on reliability, on resilience, on energy justice, on distribution of benefits from this future grid on jobs and the economy, on rates.   
  
And once we have these findings, we are going to produce an implementation road map that's going to have recommendations of actions that would need to be taken to enable one pathway or another. So depending on how the system is configured, if you need new transmission lines, or if you need to upgrade the hosting capacity of your distribution system, if you need to develop and train a specific workforce for installations, operations, maintenance.   
  
The thing is, we'll provide this as data and information and recommendations, but we are not the decision makers or the implementers. This is really in the hands of Puerto Rico, the government of Puerto Rico, and all the energy stakeholders, to use this as a way to make informed decisions.   
  
And so while the project ends in 2023, there are interim deliverables and insights that can inform this decision-making in the short term. So for example, you saw the renewable energy assessments that we're doing, and these data sets will be ready before 2023, or December 2023, so that can be used to inform ongoing procurement of renewable energy resources. We're coordinating closely with PREPA and LUMA to make sure that this study informs the next IRP.   
  
And so the key here is really working closely with our partners in Puerto Rico to make sure that throughout the study they can start gaining and implementing insights, rather than the federal government just handing a report in 2 years. But ultimately, the DOE is not the decision maker/implementer—Puerto Rico and energy stakeholders are.

***>>*Charlotte Gossett Navarro***:* Great. Thank you for that. And now Robin, I know you've been monitoring the questions coming in through the Q&A. Is there any that you want to bring live here to answer?

*>>***Robin Burton***:* Yes. Thank you, Charlotte. I want—I really appreciate all of our participants today for all of your wonderful questions and participation. We really appreciated hearing from you. I'm going to ask one question that we received and do also want to note that we will provide some aggregated responses to the frequently asked questions during today's presentation as a follow-up. So we hear you, and we appreciate your participation, again.   
  
I do have one question that I'll toss to Nate, to do with the scenario modeling aspect. Nate, one question is will this study provide cost reduction projections, such as cents per kilowatt hour, based on different scenarios of renewable energy procurement compared to the current price of electricity?

*>>***Nate Blair***:* Yes. The quick answer is yes. We have an analysis looking at the impact on electricity rates based on the different scenarios and costs incurred in those different scenarios. And so we're working very closely with Lawrence Berkeley National Lab on that piece of the project.   
  
I would also say—there's a couple of questions in here about costs, and we can share more of that as we move forward, where we are—what those costs are, how we're tailoring them to Puerto Rico, and how future costs are declining, and what those sources of costs are. So we will be sharing that as we move forward.

***>>*Charlotte Gossett Navarro***:* Thank you, Nate. And thank you, Robin. So again, Robin mentioned in aggregate form we're taking all of those questions that are in the Q&A and going to be sharing that back out. If we can jump to the next slide, just to make sure all of you who are still with us, we want to share with you how do you get this information and how do you continue to engage.

Contact Us  
So first is we want you all to join the Mobilize online community. That's where these conversations can continue. I see some of you in the chat asking how can you stay in touch with other people who were participants here as well and communicate with the project team. Mobilize is that platform, so please do join us there.   
  
You can also sign up for updates, and you can send in questions to the email on the screen. And if we go to the next slide, you will see that the information is available online.

## Additional Resources

So for example, this presentation is being recorded. It will be shared publicly. There will be a link that will be emailed out to you. But also, to mention that this is actually a summary of the entire 6-month update, which is approximately 200 slides—it's a long read. And that is also being translated entirely into Spanish. The Spanish translation will be available in a few weeks. The English version should be available very soon. And that link will be shared with you.   
  
You can also find links that are going to be shared in email of everyone who registered today, to the original webinar, and other important information related to this.   
  
With that, I think that is our last slide, and I want to thank everyone for participating. We had a few hundred people join us today. By the next time around, I hope we have a few thousand people joining us today. Our goal is that as many people as possible are engaging in this process and sharing their feedback along the way, so we do hope that you let people know you joined here today, what you learned, and start spreading the word about the PR100 study and what's coming for Puerto Rico, so that we can reach our 100% renewable energy goal.   
  
Robin, any closing words?

*>>***Robin Burton***:* I think you did it, Charlotte. Thanks again to all of you for participating today. We really appreciate your attention and interest and look forward to seeing you in 6 months at our next progress update. Thanks so much, everybody.

***>>*Charlotte Gossett Navarro***:* Thank you.

[End of Audio]