DOCKETED	
Docket Number:	19-IEPR-07
Project Title:	Electricity Sector
TN #:	231527
Document Title:	Transcript of 10-03-2019 Workshop on Offshore Wind
Description:	N/A
Filer:	Cody Goldthrite
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	1/15/2020 12:16:19 PM
Docketed Date:	1/15/2020

CALIFORNIA ENERGY COMMISSION

COMISSIONER WORKSHOP

In the matter of,	) Docket No. 19-IEPR-07
	)
2019 Integrated Energy Policy Report (2019 IEPR)	) RE: Offshore Wind)

CALIFORNIA PUBLIC UTILITIES COMMISSION

AUDITORIUM, FIRST FLOOR

505 VAN NESS AVENUE

SAN FRANCISCO, CALIFORNIA 94102

THURSDAY, OCTOBER 3, 2019

10:00 A.M.

Reported By:
Gigi Lastra

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Karen Douglas, Commissioner, California Energy Commission

Mark Gold, Executive Director, Ocean Protection Council

Suzanne Casazza, Advisor to Commissioner Randolph, California Public Utilities Commission

Heather Raitt, Assistant Executive Director, Policy Development, California Energy Commission

Presenters

John Hingtgen, California Energy Commission

Walter Musial, National Renewable Energy Laboratory

Kevin Banister, Principle Power

Ross Tyler, Business Network for Offshore Wind

Robert Collier, UC Berkeley Labor Center's Green Economy Program

Scott Flint, California Energy Commission

Terra Weeks, Senior Advisor to Chair Hochschild

Alla Weinstein, Castle Wind

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Public Comment

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P R O C E E D I N G S

OCTOBER 3, 2019 10:12 A.M.

MS. RAITT: Good morning everybody. Welcome to today's workshop on offshore wind. This workshop is part of the Energy Commission's proceeding on the 2019 Integrated Energy Policy Report. We call it the IEPR for short. And I'm Heather Raitt, the Assistant Executive Director for Policy Development.

And folks who are unfamiliar with the IEPR, I'll just give a little bit of background on it. It's a report we do biannually, with an update on the off years. It assesses major trends and issues facing the state's electricity, natural gas, and transportation sectors. And in it, we develop policy recommendations for the governor and legislature to conserve resources, protect the environment and public health, ensure reliability and enhance the economy.

So, with that, just a few housekeeping items. Today's workshop is being broadcast through our WebEx conferencing system. So, it's being recorded. And we also have a court reporter, who is developing a written transcript. And both of those will be posted on our website, the Energy Commission's website.

We do have a very full agenda. And I thank all our presenters for being here today. And do request

that you try to stay within your assigned time limits, so we can get everybody through.

Also, for the folks, for the presenters, if you could introduce yourselves each time you speak, just to say your name, it helps folks in the audience and WebEx be able to follow along.

And we will have an opportunity for public comment at the end of the day. You can sign up with our Public Adviser; she's at the table at the entrance, to let us know that you'd like to make comments at that point.

And for folks on WebEx, you can use the raise your hand feature to let our WebEx coordinator know that you'd like to make comments. And if you, by any chance, change your mind, you can also use that same feature to let us know you don't want to make comments.

Written comments are due October 18th. And the notice for this workshop and the meeting schedule gives you information about how to do that.

All the materials for this meeting are posted on the Energy Commission's website and information for how to find them is on the meeting schedule.

And before passing the dais over to Commissioners and our executives, we'll just hear a quick safety announcement.

(Safety announcement broadcast)

MS. RAITT: Okay, thank you. Go ahead and pass it on to Commissioners and executives, thank you.

CHAIR HOCHSCHILD: Well, thank you, Heather and good morning to everyone, and welcome to today's workshop. I especially want to thank my friend and colleague, Commissioner Karen Douglas, who has shown extraordinary leadership on this issue and, really, so grateful to her for bringing her multitude of talents on renewables and planning to this question of the future of offshore wind in California.

And, also, to Mark Gold, the new Executive Director of the Ocean Protection Council for, first of all, being willing to come up and do the job from L.A. and bring your talents to this great need.

I just want to open by saying that I spent a lot of time in this room, a little over ten years ago, on the design of the California Solar Initiative, which was an audacious, bold approach to try to get a new industry up to scale. And there was a lot of critics who called that mythology.

You know, this year we hit one million solar rooftops in California. And so, I want everyone here to have an expansive sense of possibility about what we can do with offshore wind. We are in a moment where new

technology, particularly in the clean energy space, can really flourish and go mainstream. And everybody in the room here has a role to play. Folks in the industry, investors, policymakers. I see Admiral McGinn hiding in the back there. He's been an incredible leader, you know, from the military's perspective over his long career, and now in the private sector. And so many others here.

And so, we should all take that to heart and work together, as best we can, to craft a pathway here.

Let me also add that as we're going, now, to 100 percent clean energy and folks are following what has happened, it's been one year since we signed the 100-percent law. Hawaii was first, we were second, and now it's law in Washington, Nevada, New Mexico, Wisconsin, Connecticut, New York, Maine, District of Columbia, and Puerto Rico, and a number of other states are moving it through. Almost 30 percent of the population of the U.S. lives in a state that's committed to go to 100 percent clean energy.

But something else equally important is going on, which is the services that the electric grid provides are expanding. Right. We're adding about 20,000 electric vehicles per month to the roads in California. We have 650,000 on the road today.

And in the building sector as well, since May of this year nine cities and one county have adopted natural gas bans on new construction or an electrification preference. So, things like water heating and passenger vehicles that were never conceived of to be supported by electricity, now are. And that's growing.

And so, the need for electricity and the need for a diverse portfolio of renewables is really important. That's why, one of the reasons I, personally, am really excited about offshore wind is it complements rooftop solar, and utility-scale solar beautifully, and it adds to the diversity of our clean power mix.

So, I want to thank everyone for being here today and engaging in this discussion, and all the hard work that the staff did to set this up.

And with that, let's go to Commissioner Douglas.

COMMISSIONER DOUGLAS: Well, thank you, Chair Hochschild. And I've been excited about this workshop for quite a while. It's such a tremendous opportunity to bring in experts on offshore wind from, really, not just around California or around the U.S., but from around the world to come provide their expertise and knowledge in this forum. And help inform the state as

we think about our best opportunities and paths forward to take advantage of this tremendous, potential renewable energy resource.

As the Chair mentioned, we have a 100 percent clean energy goal. And I'm always quick, when I talk to industry, to say, you know, there is so much renewable energy that we're going to need to reach that goal. And this is really, you know, about figuring out how you best position and understand this market, and the opportunities. And, also, the planning, and the geography, and the stakeholder community, and the science.

And how do we bring all of this together to realize the tremendous opportunities that offshore wind can present to California? Not only as we move to meet our clean energy goals, but also in terms of investment, and development, and jobs, and other benefits.

So, I'm really excited to hear from the speakers. We're going to hear a global overview of what's happening around the world. That information is, you know, A, not easy to find. Or, it can be easy to find, but you really have to know what you're looking at and how to find it. And, B, it's constantly changing. So, we're going to get a really up-to-the-minute snapshot of what's going on around the world, and that's

very exciting.

We'll look at the state of play in California and who's been doing what, and where. And I'm hoping to hear recommendations from speakers and from the public about what the state, in your view, should be doing or should be doing more of as we move to understand and benefit from the potential here.

And we'll have some specific discussions of research. Research that has been done. Research that's underway. There's actually a tremendous amount of research in this area. I don't think we currently have a handle on how we can benefit from everything that's being done that we are aware of, or cognizant of, let alone research that's being done in other parts of the world that we might be able to build on and take advantage of. So, I think we have work to do there.

And I'm hopeful that this forum will -- I know it will be tremendously informative. But I'm hoping we'll take from it some really specific action items, ultimately, as we digest what we hear today.

So, thanks to the CPUC for hosting this event. And I think that's my opening. Go ahead.

MR. GOLD: I'm Mark Gold and I'm Executive Director of the Ocean Protection Council. And I'm glad to be here, frankly, because it's a wonderful learning

opportunity for me. Personally, this is not an area that I've spent a heck of a lot of time on. I've worked a great deal on the oceans for the last 30 years. But this will be a great opportunity to do so.

If you don't know the Ocean Protection Council very well, we help set the coast and ocean policy for the State of California.

As part of our own effort to support California's transition to a decarbonized energy future, we've been working closely with the CEC, as well as the Office of Planning and Research, and State Lands Commission to evaluate the environmental impacts of offshore wind. And these are impacts to marine life and cultural resources, in particular.

And, currently, we're even funding an effort and, hopefully, it will get underway in the next month or so, to start assessing these potential impacts.

So, we want to make sure that when we actually do move forward -- I'm not saying if, I'm saying when we do move forward with offshore wind, as part of California's renewable energy portfolio, that we're doing it right. And I think that's really important.

And so, our lead on energy, if you don't know, is Chris Potter. He'll be on a panel later today. And he has led our efforts working with the CEC, as well as

all other state agencies, with BOEM, and the BOEM Task Force, the State Marine Renewables Energy Working Group, BOEM, NOAA, and the NGO community. And so, he's been doing that for the better part of the last 20 years or so.

So, just glad to be here today and learn from all these presentations. Thanks.

MS. CASAZZA: Good morning and thank you to the CEC for organizing today's event. My name is Suzanne Casazza and I'm a Legal and Policy Advisor for CPUC Commissioner Liane Randolph.

Unfortunately, Commissioner Randolph and her fellow CPUC Commissioners are attending the Utility Supplier Diversity En Banc today, so are not present. But I am representing her today and excited to hear today's discussions and share with her what I learn from the presentations.

And I do apologize in advance, unfortunately, I will need to leave when we break for lunch, so I'm only here for the morning session.

And by way of background and to offer some CPUC perspective, Commissioner Randolph is the assigned Commissioner in the Integrated Resource Planning proceeding at the CPUC. An IRP, the CPUC sets out the optimal portfolio of supply and demand side resources to

achieve our state's ambitious greenhouse gas emissions reductions targets within the electric sector, which you'll be hearing more about today from Branch Manager Molly Sterkel.

The IRP process uses publicly available data and engages in robust modeling to determine the optimal energy infrastructure necessary to meet the state's goals at the lowest cost. And we always want to make sure we are including what we call candidate resources in our modeling.

Candidate resources are available for our model to select as part of our low carbon future portfolios, as long as we have sufficient publicly available cost and information data about the resource that can be included.

And so, one of the challenges in developing inputs and assumptions has been how to address technologies like offshore wind, where some of the available research and data collection is still ongoing and in the nascent stages.

As an update and a bit of a preview, tomorrow CPUC Energy Division analysts will be releasing our proposed inputs and assumptions document for the 2019 and 2020 IRP planning cycle, which will provide an update of our latest thinking. We're using a UC

Berkeley study and drawing from some source material there about the potential for offshore wind.

Look forward to the discussions today and thank you, everyone, for participating.

MS. RAITT: Great, thanks. So, we'll move on to our first panel on global overview of offshore wind. And our moderator is John Hingtgen from the Energy Commission.

And just to note one change to the meeting schedule, unfortunately Edgare Kerkwijk is not going to be able to join us this morning.

So, John, go ahead. Thanks.

MR. HINGTGEN: Yes. The first panel will discuss the global and national offshore wind market, what has happened and what is currently happening globally. Some of the useful lessons for California, and some global cost trends and how they translate to the California market.

The first speaker will be Walter Musial. Mr. Musial is the principal engineer and wind platform lead at the National Renewable Energy Laboratory.

MR. MUSIAL: Thank you, John. I'd like to thank the Commissioners for inviting me here and for organizing this. Good morning.

Since I'm the first speaker, I guess I'll set

the stage for the technology and why we think floating offshore wind is important for the State of California. I work at the National Renewable Energy Lab, so we're a national lab working for the Department of Energy. And whereas we're very excited about what's happening on the emergence of offshore wind on the East Coast, we see offshore wind as a national resource.

And we're just as excited about what could happen here in California. But recognizing that the technology here is going to have to be different than what they're installing on the East Coast. We need technology that is floating in the water, rather than fixed to the bottom, because the water depths are deeper in the Pacific as everyone -- most people here know. But I want to say that out loud.

So, this is not just a new technology that is the next thing in line. This is something that I want to try to make a business case for. And we're -- I'm controlling my slides. So, my first slide really deals with why we think this is important and why we think it can succeed.

When we look at any resource, we look at, well; does it have enough capacity to make a difference? And the answer is clearly yes. In floating offshore wind, 58 percent of the resource in offshore wind, nationally,

is in deep water. In California, it's more like 95 percent of that resource. So, and there's plenty of it.

We've found, and this is yet to be demonstrated in a lot of places, but we've found that the siting conflicts can be lower if we go into deeper waters, further from shore, which is the case for floating offshore wind. This matches very well with the wind visions that the DOE has already created in terms of their scenarios, and we've already stated that there will be about 86 gigawatts, potentially, of offshore wind, probably more. And we can't do that without developing the floating resources.

We've shown in studies, and I can show you many of them, where floating costs can be equal to or even possibly lower than the costs for fixed-bottom systems, once those technologies have been matured. And we're seeing that realization globally as the new technology is evolving out of Europe and Asia. And soon, hopefully, in the Pacific here.

So, I think this all fits together with the policy of the United States, all of the above, and developing that will ultimately put these local regions in a very good economic position. Not just to support their own energy futures, but as an export market to create technology for other regions.

So, this is the business case. It's very strong. We can demonstrate those points.

And I just want to kind of move to the what's really happening globally. And we look at this chart. This came from a market report that we just recently published, by NREL. And we update this information all the time.

So, if you just look at what's happened, there's only been a few demonstration projects put in the water. All of them have been very successful, in my opinion. And there's a lot of -- what we're doing is we're moving to a new phase of pilot -- or, from prototype scale projects to pilot scale projects, which will further demonstrate not just that the technology works, but the technology can be commercialized.

And so, we're in this kind of proof-of-concept phase right now, that you can see these turbines. But the next phase is this pre-commercial phase. The pilot scale, ten times bigger. Technology that is representative of what we might be putting into the water soon, but not at the same project scale. And these projects have all the attributes that we need, but they can't demonstrate the LCU, the levelized cost of energy, because they're too small in size.

But they will demonstrate, for investors, the

capability that we need to move on to the commercial phase, which is actually in the process of -- some of the tenders are being planned right now. As you've seen in California, we have call areas. They're not lease areas, yet, but they soon will be. And in Europe, the same thing is happening. So, those areas will become the first commercial projects as we go forward.

We've done quite a bit of research and gathered together cost information. This chart shows the cost data that we've accumulated from multiple sources for floating technologies, including some of our own models that we can verify. These cost trends are moving down faster than we thought.

To be honest, I did a report on California just three years ago, which is now obsolete because there's new information that's come in to tell us that the costs can be even lower than what we thought they were.

So, we're looking at targets somewhere around $60 per megawatt hour for offshore wind. And that's using the information that we have in the current models. So, we're very optimistic about those costs even continuing to come down beyond that. So, these curves are -- that big, blue line is kind of the composite line of all those different projections that come from various sources around the world.

We just did a recent cost study, and this is my last slide, on Oregon. And this is, you know, a neighboring state, of course, with similar wind resources. And we looked at five sites. Each of those curves represents a site. Based on our projections, these sites in Oregon can come down to -- hypothetically, if we look at those sites around that target, $60 per megawatt hour for levelized cost of energy.

So, we're optimistic that these prices, these costs rather, can be sustained with the technology trajectories that we're on right now. And I think that's the message I want to leave you with, and go to the next speaker, I guess.

This is our boat trip out to Block Island.

MR. HINGTEN: Okay, if there are any questions from the Commissioners, we can take those or we'll move on to the next speaker.

Okay, our second speaker is Kevin Banister. Kevin is the Vice President of Development for Principle Power.

MR. BANISTER: Thank you. Thank you, John, and thanks very much for the opportunity to speak at the workshop. It really is exciting. And I think especially coming on the tail of the last three days

that we've had also here in San Francisco, it really does feel like a moment where people are starting to embrace the opportunity, and see what's possible, and start to get excited about doing the hard work that will enable offshore wind to reach its potential here in the Pacific.

So, my name is Kevin Banister, with Principle Power. The company's actually headquartered here, just across the Bay in Emeryville. So, though it's a global industry, we do have the makings of a California born and bred industry.

This slide is actually a little bit outdated. We talked about growth and our company now has something more like 90 employees. But again, our headquarters are here, just a few miles away.

We have strong backing from global energy players. And I think one of the reasons we like to reference the backing that we have is it's really just a demonstration of the quality and the capability of the backing that the overall industry has, and the type of enthusiasm that the offshore wind industry has received from capitally-rich, industrial players who know how to get things done in the ocean.

The WindFloat is a proven technology today, on the back of a five-year deployment that concluded a

couple years ago off the coast of Portugal. But, of course, the WindFloat is not the only technology that has proven its technical viability. I think we have some of our friends in the room from Equinor and IDEOL, in particular, who also have some very successful deployments that we've been excited to see.

I'll talk a little bit about our project pipeline, because I think it's representative of some of the status that Walt was referencing. Really, how we're moving from precommercial projects and now, as a company, are starting to look to the commercial scale opportunities, really around the world.

So, here is a picture of the WindFloat offshore Portugal. Well, not quite offshore. Very nearshore in Portugal. That's an 8.3-megawatt turbine, so from MHI Vestas. This is a, you know, state-of-the-art flagship type of product from MHI Vestas. And we think it's a really great indication of the comfort, now, that the turbine suppliers even are having in these floating structures that our project has been able to use one of those turbines.

So, really quickly, just to talk about some of the design emphases that we've made with the WindFloat, because I think it's representative, again, of the type of potential that floating offshore wind can have here

in California. We've designed -- our design is prioritized, really, the reduction of costs and risks throughout a project's lifetime.

So, we've tried to focus on developer preference in terms of the siting flexibility that floating structures can provide. And then, even with turbine agnosticity [sic]. We want the developer to be able to choose which turbine they use for a project.

And then, with all phases of the project we've taken into consideration that the cost and risks -- if we want to reduce cost and risk for a project, we need to reduce cost and risks through all the phases of the project. So, this structure has inherent stability, and a shallow draft both at port and then in transit to its location.

The key side final assembly and commissioning means that with a technology like this we can affix the turbine at key side, and then tow out the fully assembled unit. So, that means that we don't need the heavy lift vessels for the risky, challenging operations offshore, which is especially relevant here in the deeper water. And, these vessels just simply aren't available currently on the West Coast of the U.S.

And then, because of the inherent stability of the system, there's a low pretension requirement for its

mooring, meaning that the commonly available vessels that we do see here, prevalent in the West Coast can support deployments for this technology.

And then, really, it's sort of an O&M revolution brewing here because of the opportunity to tow the unit back to shore and conduct whatever large correctives might be required, maybe that require a large crane, or something like that.

The points also being that the developer can always make an economic choice. You can do the smaller maintenance in situ, and then tow to shore for the larger requirements that inevitably will arise in a commercial scale project over its lifetime.

To give a sense of the type of acceptance that floating wind is starting -- has really been receiving, we have worked with a lot of the different classification societies around the world. And, of course, receiving class approval is a prerequisite to receive financing for a project, and often even to build the project. So, we've been successful with the various players in the world.

Under different conditions, using different turbines, under different regulatory requirements. Once again, really just an indication of the global applicability of these floating wind solutions.

Currently, we are under construction or under advanced stages of development and design for three of the precommercial projects that Walt referenced. You saw a picture of one of our units for the WindFloat Atlantic project. That's really being installed today, more or less, off the coast of Portugal. Ultimately, that will be a 25-megawatt project, again featuring 8.3 megawatt turbines.

Next year, we'll be deploying five additional units off the coast of Scotland, featuring 9.5 megawatt turbines. So, again, the state-of-the-art turbines. Once complete, that will be the world's largest floating offshore wind array.

And then, in the following year, we'll be deploying an additional three-unit project off the Mediterranean Coast of France.

So, by the end of 2021, our company alone will have 100 megawatts of projects installed. And, obviously, we're excited about the other sort of players in this field who have their own precommercial project plans under development and underway.

I mentioned our desire to be turbine agnostic. the projects that we're developing today look to be using the MHI Vestas machine, but we've been successful developing designs with, really, the world's premier

turbine suppliers. This is an important consideration for developers who often -- they may have some sort of preferred contractual status with a developer. It may be that at particular sites one turbine will have a better performance for one reason or the other. And so, this is a key part of the design for us is being able to work with any turbine supplier, and we've done that.

I'll close here quickly but wanted just to mention that California is in line here to become a part of the -- genuinely in line to become a part of the global offshore wind movement, and really stake the leadership position that Walt briefly referenced.

So, we're a part of the Redwood Coast Energy Authority's proposed project off the coast of Humboldt County. We're really excited about the potential there. Really excited, one, about the wind resource. Two, about the potential for the port to be developed and become a real center of economic activity for the northern part of the state.

Also, really excited about the existing sort of ecosystem that exists up in the northern part of the state as it relates to the Schatz Energy Research Center and Humboldt State University. Really, a remarkable opportunity for investments to follow investments that have already been made and create a standard of

excellence and, perhaps even, you know, the Pacific capital of floating offshore wind right here in California.

To reinforce some of Walt's message about costs, these are projections that we've made. The dots on here, it all comes from Walt, actually. The dots are our project prices, the strike prices from European projects that have been announced, so the dots are real.

The green band is our projection for where costs will be going with the WindFloat structure.

So, just to say that we agree with Walt's analysis about where costs are going for floating offshore wind.

So, just to wrap up, floating wind is technically viable, it's been proven in WindFloat projects and by other companies' projects around the world. The WindFloat addresses the industry's bottom-fix foundation challenges. Challenges that cannot be overcome here in the West Coast because of water depth. Companies like Principle Power are already executing on these precommercial projects. In the next few years, our company alone will have 100 megawatts of projects installed, not even to mention the other project that are underway that will -- that are also important for the market.

And then, we expect floating wind to be deployed commercially by the end of the decade. And when I say by the end of the decade, I really mean globally. There are clearly opportunities in California and elsewhere for commercial deployments long before the end of this coming decade, in the middle of the decade. Our expectation is that by the end of the next decade floating wind really will be a key part of the energy infrastructure around the world.

Our view is that the key for market leadership is to advance to the next scale projects and to prepare for the development of utility scale commercial projects.

Thank you very much.

MR. HINGTGEN: Our next speaker will be Ross Tyler. Ross is the Executive Vice President of the Business Network for Offshore wind.

MR. TYLER: Good morning. Thank you very much. I might just take this down because I'm on the camera and I'm not Heather.

I'd just like to thank the Commissioners for including the Business Network for Offshore Wind. Let's just go to the beginning in today's event. So, thank you very much.

So, the Business Network for Offshore Wind is a

not-for-profit organization and we focus exclusively on offshore wind. We do not look at any other renewable energy's technologies.

Our main premise has been to educate, inform and -- the business community about the opportunities to do with offshore wind. And our whole focus is looking to develop and grow a strong, efficient, U.S.-based offshore wind supply chain with which to build and maintain the offshore wind farms of the future.

We're working in 11 states. We've held, in the last six years, 42 different events relevant to offshore wind. We have over 330 members. And the members range from the developers, some of which are in this room, some of the technology developers and all the way through to supply chain groups that can be involved in vessels, or survey work. So, I think we have the full suite of representation for the supply chain.

So, I'd like to just start with this slide to sort of give a bit of global context, really, because offshore wind, and I'm talking primarily of fixed bottom offshore wind, has been Eurocentric for the last 30 years. And it's taken the 30 years to produce about 20 gigawatts of offshore wind.

This slide really, I think, illustrates the future. And we should be thinking about offshore wind,

both fixed bottom and floating offshore wind in a global context. We're no longer looking at offshore wind in silos of being European, or being U.S., or being Asian. But we need to be thinking of it on a global basis.

And this has come from IRENA, the International Renewable Energy Agency. And it's projection is that in the next 30 years globally we're going to go to a total of 521 gigawatts. So, I think the individual years are really not so important, but the main message here is that globally we are about to accelerate and we need to be thinking about this global environment as we plan and work forward.

This slide, the next two slides are courtesy of NREL. So, thank you, Walt, for you and your team's work. And this basically shows the global offshore wind pipeline by the different continents. And you can see here that we had last year a growth of 42 gigawatts within the pipeline, which exceeds what the Europeans actually installed in the 30 years.

So, you can see we have this huge potential. And North America has its place and should continue to have its place going forward.

This is, again, from NREL and shows the forecast predicted to 2030. And you can see there are two sets of data that's leading to a very high value of gigawatts

globally, whether it's 154 or 193, the message is we're on a high growth rate.

So, just to quickly look at where we stand as a nation, on the right-hand side you can see, basically, the map of the areas that have either been leased by the Bureau of Ocean Energy Management in federal water, or are about to be leased, and which of the developers have secured those leases and are already underway with the fixed bottom offshore wind developments.

And then, on the left-hand side, as you can see off the coast of California and Hawaii, we have areas that have been identified and have yet to be leased but are in the process with Bureau of Ocean Energy Management.

I think it's important to also remember that we do have, in addition to the West Coast with its deep oceans, and it's through this development of floating offshore wind technology that we are able to now include the West Coast and Hawaii. But also, the Gulf of Maine is looking at bringing in floating offshore wind.

So, the supply chain considerations, which is our area of expertise, obviously there's going to be some similarities to the fixed bottom of anything that's above the water. Except for the hull. Obviously, the hull, the floating platform has to be a replacement to

the fixed bottom foundation. We also need to be considering a supply chain involving the mooring lines, the anchor systems, and the dynamic subsea cables. These are new elements to the supply chain and we need to be thinking about sourcing these in the global context.

So, some of the supply chain drivers. What I'd like to just point out is because of this global growth that we're experiencing and witnessing, the traditional suppliers, such as some of the turbine manufacturers, are finding that they have a very healthy pipeline. So, we should not be thinking that just because we suddenly received all our permits that we can now make an order and we can receive our turbines by next Tuesday.

Right now, some of the predominant turbine manufacturers have a healthy order book that exceeds three years. So, we need to be thinking in advance for how to fulfill our supply chain.

So, this slide basically illustrates that if we are thinking small, and small scale, that it makes commercial sense probably to buy an import from elsewhere. If we go to scale, and I would say that California has the scale and the potential scale, then we also, California has the potential to start thinking about manufacturing and taking a strong ownership in the

supply chain presence. And that supply chain presence should not be thought of just to supply the floating offshore wind farms off its coast, but along the entire West Coast, and Hawaii, and the rest of the world.

So, in the supply chain, apart from importing or manufacturing, we need to be thinking of ports. I think we've all heard about the ports all week and it will be a continued part of the discussion because we need to have the facilities with which to either do the manufacturing, or do the assembly and, certainly, the deployment.

And on those ports, we're going to have to have the right equipment. The turbines are getting larger. The towers are getting taller. And as the main components get larger, then I would suggest that some of the floating platforms will also have to increase in size.

And so, we need to have the right space. We need to have the right equipment with which to manage this changing supply chain. And, furthermore, we need to have the right people, who are trained and skilled to do the right functions.

Just a quick show of what we are doing at the Business Network. We are -- we have a portal online, which we're calling WindLink. And it's a form of a

registry, so businesses are able to come in and basically self-register. There are over 560 subcategories that actually helps define what the company can do. And as you can see, as the activity on the East Coast, the Northeast Coast has built up with the fixed bottom foundations, we're getting the beginnings of a resource both in terms of primary, secondary, and tertiary supply chain.

And I would suggest that as offshore wind starts to take further presence off the West Coast, California will start to look very similar.

So, on a global basis, again I would just like to point out that we need to be thinking beyond just having floating offshore wind, or offshore wind in general supplying to replace existing electricity needs, as we transition to a cleaner form of generation. But we need to be thinking about the future in terms of future demand for electricity.

And one of them, as you're all aware, I'm sure, is that we have electric vehicles in terms of a potential shift in transportation. But I also would like to just emphasize or highlight that there is a growing interest, particularly in Europe, to use floating offshore wind to generate electricity to perform electrolysis for the generation of hydrogen and

the hydrogen market could well be a growing opportunity with which offshore wind can be part of.

And just as Commissioner Douglas mentioned about research and development, my understanding is that the European Union has put $15 billion towards research for the hydrogen market.

And that's all I have.

MR. HINGTGEN: Okay, thank you. Our final speaker on this panel will be Robert Collier. He's a Policy Researcher at the UC Berkeley Labor Center.

MR. COLLIER: Good morning. I'm here to speak of the results of a recent study that the UC Berkeley Labor Center carried out under a grant from the Ocean Protection Council, thank you, in conjunction with E3. It was essentially a two-part study. One part that we conducted was a workforce analysis of offshore wind results in Europe and around the world, the East Coast, and policy options for California.

The other half, which E3 will discuss in the next panel, was regarding grid integration.

So, regarding our portion, this is the report that just came out. Briefly, there are previously published projections that offshore wind, if built out to a max of 18 gigawatts, could create as you see the numbers on the screen, the 13,000 direct jobs in

manufacturing and in construction, 4,000 odd jobs in O&M.

But we found, from looking at the results of offshore wind in Europe especially, the UK especially, that projections are useful, but by no means accurate predictors of final performance.

So, rather than looking at the strict numbers, it's better to look at the -- it's perhaps more useful to look at the qualitative issues raised from other experiences.

Britain, the world's number one in offshore installation, has created about 7,300 jobs in the offshore wind sector. This has been a great disappointment to British Labor Unions, who expected previous projections of much higher employment and a much more localized supply chain.

Britain has taken a relatively hands-off laissez faire approach to the sector, assuming it would -- market forces would drive job creation. It has generally not done so. The British government is now playing catch up. It released a wind sector deal, which is the term they call a new plan, sectoral plan, a government/industry alliance, in which the government will spend about $360 million rehabbing ports, et cetera. It has rehabbed the Port of Hull and drawn a

Siemens Blade Factory. So, the British government is now playing catch up with a much more interventionist stance to compensate for its earlier, more hands-off strategy.

Germany has taken a more interventionist strategy. For example, the Port of Bremerhaven heavily developed with government support. However, it has been successful in creating about as many jobs as Britain has in total, in Bremerhaven. But recently it -- Bremerhaven essentially bet on the wrong horse. The companies that it drew to the port are now going bankrupt and only one is left.

So, Germany shows that intervention works some of the time, but not all of the time.

Denmark, a successful example of direct, heavy sustained government intervention over many decades, is quite successful in terms of, again, about as many offshore wind jobs as Britain as a whole. Heavily export oriented. And it has created an industrial cluster and a port cluster especially around the Port of Esbjerg.

China, of course, as with pretty much any industry is in a class by itself. Just in the past few years it has risen exponentially to become the world's number two and in the coming years, next few years it

will be the world's number one. Currently focused on the domestic market. But it is widely expected to become an exporter.

So, even though California is 5,000 odd nautical miles from China, with the associated shipping costs, we cannot expect automatically that supply chain jobs will be located in California. China and other nations will be stiff competitors.

So, the global, you know, the offshore wind industry, as many have said, is indeed global. And California, yes, we're far away, but we are not an island. We must think of how we compete, what we offer against other locations for that supply chain.

Briefly, the U.S. experience, of course, there's only 30 megawatts of offshore wind in the water off of Block Island, Rhode Island. But as you know, the East Coast states are going gangbusters, have committed to over 20 megawatts -- 20 gigawatts, sorry, by 2035. And they are in a race for developing ports, spending state government money to developing ports. Each state is hoping that their port will attract factories and activity.

It's important to understand that the regulatory agencies of the East Coast states, most of them have greater legal authority than those in California, CPUC,

CEC, CAISO, to directly impose labor standards and local content requirements on offshore wind developers. Largely because NYSERDA is an off taker. NYSERDA has the power to impose conditions on its contracts. Ditto New Jersey. Ditto Connecticut.

So, you see prevailing wage PLA requirements are in New York, New Jersey, Connecticut, Maryland. And the local content requirements in New York, Maryland and New Jersey. Heavy investment in ports development in all the states.

California would have to work more indirectly on imposing local content, even if that's not exactly what it's called, and high labor standards if the state were to take a high road approach looking to maximize benefits to labor and communities.

And I'm here, essentially stealing from a report that the Labor Center produced for the -- where are we here? For the Workforce Development Board. It is about to be released, finally, after intensive interagency review. It essentially reviewed the entire A to Z state employment policy for workforce impacts and policy implications and produced an exhaustive list of policy recommendations.

There are many tools. I won't repeat them. From CWAs, CBAs, responsible procurement policies,

skills standards, such as SB 54 for the state's refineries. Training partnerships, the new High-Road Training Partnership could be adapted, would be an ideal candidate for offshore wind. Not just the state, but municipal power agencies, such as LADWP, have a great opportunity to transit power plants, such as the plants that Garcetti wants to close, Harbor, Haynes, and Scattergood, to offshore wind.

As I mentioned, sort of more details than you ever want to read are in this upcoming report, forthcoming report that should be out in the next month or two.

People, everyone has mentioned sort of the Gordian Knot is the ports and the supply chain. California, of course, lacks a wide variety of ports that don't have clearance problems, bridge problems because the fully assembled platforms and turbines would have to be towed erect out from the port to the ocean. For example, that eliminates the San Francisco Bay Area. The Golden Gate Bridge. Much of L.A. Long Beach Ports. Port directors, when I interviewed them, said -- of active ports said, yes, we'd be glad to move your stuff, but not to lease hundreds of acres for months or years at a time. We do through put. We move things. We don't have static manufacturing operations.

So, identifying port space will be tough. Creating a constellation of possible available ports will take some active proactive work and possibly some bending of elbows by regulatory agencies and politicians, state leaders.

But, you know, the great potential, which is a fascinating example of, you know, how ambitious can we be, is the Port of Humboldt Bay. Which, as you know, is hundreds of acres of industrial wasteland with poor land transportation, a port and docks that are crumbling. You know, could that become the Port of Esbjerg in Demark, which as you see which is the main, the largest single port for offshore wind in the North Sea.

The Danish government has spent hundreds of millions of Euros developing that port. The Danish and local governments.

So, again, it would take unusually proactive, you know, industrial policy by the State of California. That's not something that the State of California normally does, pick winners, industrial policy.

But if you wanted to go down that road, the road of offshore wind, that's really the direction you're going to have to go.

So, finally, floating platforms, I'll just leave on the screen. One has to be aware that not all

platforms are alike. Matter of fact, they're all very different in terms of their workforce impacts, the amount of labor that they would need in California. Some would be almost entirely imported. Some would be built in California. Some would need major port rehabs and, you know, hundred-million-dollar port renovations, others would take very little.

So, be clear about the different impacts of platforms.

But, generally, the overall message that I think everybody here at this panel and in the three days of conference that we had earlier this week, go big or go home. This will require a major commitment by the state, which is not the sort of thing that the state regulatory agencies or politicians want to do. But that is what is needed. So, I think the choice is clear.

The potential for workforce benefits, community benefits is amazing, but it requires a significant gamble and commitment by the state. Thank you.

MR. HINGTGEN: Okay, if the Commissioners have some questions for the panelists?

COMMISSIONER DOUGLAS: I've got a couple and others may, as well.

So, we -- unfortunately, our speaker who was going to speak in more detail to the Asian market, I'm

told had to get to Singapore.

MR. HINGTGEN: He wasn't able to attend, yeah.

COMMISSIONER DOUGLAS: Correct. But I did have some chance to look at his presentation and another one from a representative from Japan, and those were docketed.

I just wondered if anyone, if Walt, or anyone else on the panel can speak in a little more detail to the scale and anticipated timeline of commercial projects in Asia?

MR. MUSIAL: I don't have that data in front of me. We did report that, a lot of that in the market report that was published in August. And I would refer you to that document.

The trends that we're seeing, though, indicate that China is probably going to be the dominant player in the world over the next decade. And so, we'll see China taking more and more market share, and probably is the -- I wouldn't say the technology leader, but the technology coming from China will be driving a lot of the new developments. So, I think we should be watching that very carefully.

COMMISSIONER DOUGLAS: Super, thank you. And anyone else on that?

MR. TYLER: I'd just like to add --

COMMISSIONER DOUGLAS: Is your microphone on?

MR. TYLER: Thank you. I'd just like to add that South Korea is also looking to put something in the water of scale. They're looking to put a gigawatt of floating offshore wind in the water very soon, I believe 2022. And I think that just echoes what Robert said, which is go big or go home.

COMMISSIONER DOUGLAS: And, Ross, since you spoke up, I had a question for you, too. I was intrigued with your mention of the research in Europe on hydrogen. And I wondered if you could talk a little bit more about what's happening and how they are relating it to offshore wind. Presumably, they're using offshore wind to make renewable hydrogen.

MR. TYLER: So, I'm not -- I know about the European Union investment just because I've shared a panel with a gentleman who's from the European Union. And he was giving an outline of how the EU is looking to move forward with different R&D, and hydrogen was a specific line item that they're looking at. And you are right, they are looking at using offshore wind with which to create the electrolysis, and to try it. And I think there are some developers. I'm not sure if they're in the room, but there are one or two developers that are based in Europe, that are actually looking to

do this on a trial basis. Maybe my colleagues on the panel know more about it.

COMMISSIONER DOUGLAS: All right. Well, we have a -- go ahead.

MS. RAITT: Sorry, Commissioner, this is Heather Raitt. I just want to do a time check. This is when we're scheduled to move on to the next panel. But, you know, if you have pressing questions, I'm just going to put that out there.

COMMISSIONER DOUGLAS: I might have one or two more, but I'll try to be quick. I think we have a speaker from the Danish Energy Agency. And I know we had some conversation about that, so maybe he can speak to that a little bit as well.

It's interesting because as we move towards a zero-carbon economy, we have to get more creative about how to use renewable electricity to supplant fossil energy through the economy. And, of course, generating renewable hydrogen is a possibility and it also -- you know, hydrogen can be transported in different ways than electricity. So, anyway, I'd love to hear more about that later.

I just had maybe two more questions. A question for you, Walt. We were hoping to be able to see more -- you know, the maps that NREL has created on the offshore

wind resource off of California are very useful and that's what everyone still tends to look at.

But we were wondering the degree to which we can get more hourly data, so that we can see not only where the resource is stronger, but hour to hour how it varies. Can you speak to that at all?

MR. MUSIAL: Yeah, and I hope that there's a speaker later to talk to this. But we've been very fortunate to get some good support from the Bureau of Ocean Energy Management to look at the resource. Again, we have a new study that's going to begin, as we speak. I think we just -- we just got the funding last week. And we'll be looking at the resource in California extensively, down to a five-minute time series, all the way to the annual averages.

The resource assessments that have been done in the past probably need improvement. They used an older technology. They didn't have bias corrections. They didn't have the best ensemble averaged approach, I would say, to that data.

And we're going to do a much deeper dive into the resource this time and, hopefully, we'll get the information that's necessary. Not just for predicting annual averages, but for actually integrating it with the grid. You know, I could go on, but I think that's

probably enough to know for that. Thanks to BOEM for that.

COMMISSIONER DOUGLAS: That would be exceptionally helpful. Do you have a time frame? So, you just started, right?

MR. MUSIAL: We're just starting now, yeah. I think that, you know, to put a timeline on that, by next summer we should have some results for that.

COMMISSIONER DOUGLAS: Okay, great. Thank you.

I just had one more question and then I'll stop. We started the panel five minutes late, so we're only going over a little bit.

Just for Robert, you know, I appreciated your presentation. You've done some really good work in the area of trying to understand, you know, ports, and workforce, and local content, and all the rest. And, you know, you made a reference to us needing to do more to understand the constellation of what could be done at different California ports, and sort of the art of the possible.

Because as you note, a number of our largest, busiest ports don't really have the space for industrial activity.

So, do you have any further recommendations for how to maybe get a handle on some of those questions?

MR. COLLIER: Yes. To be candid, one of the parts of our report that dropped by the wayside was going to be a detailed port-by-port analysis. Not even analysis, just reporting. Of talking to each single port authority director, and asking how much acreage do you have? What type of acreage? Where is it? How about water acreage for putting a barge? Do you have it for a long-term lease? And go port by port.

And I think what's -- really, no analysis is needed, but that sort of data I think has not been done. Certainly, the only ports analysis was done by Mott MacDonald in 2016, I believe it was, was more of a broad overview of port needs. But I think you just need somebody to go port by port, talk to the port directors, say what do you got? Where do you have it?

And I think the results you're going to get are going to be kind of scary because there's not a whole lot there, really.

COMMISSIONER DOUGLAS: Yeah, they're going to show some real constraints.

MR. COLLIER: They're what?

COMMISSIONER DOUGLAS: They're going to show some real constraints without a doubt.

MR. COLLIER: Yeah. So, what then you do with that information? I mean, this isn't rocket science.

But I think you need that information port by port. That would be my recommendation.

COMMISSIONER DOUGLAS: Okay. The last question for you. You showed a chart with local content analysis for different kinds of platforms only, right?

MR. COLLIER: Yeah.

COMMISSIONER DOUGLAS: And that was just based on the materials that they're made out of or --

MR. COLLIER: Yes. And the production methods that the developers have showed, and many of them have videos, helpfully, about their methods.

COMMISSIONER DOUGLAS: Okay. Yeah.

MR. COLLIER: And so, I got the Northern California Director of the Building Trades to help me in analyzing what type of specific trades would be needed and how much labor would be needed for each of these specific production methods.

COMMISSIONER DOUGLAS: Okay.

MR. COLLIER: And, again, the differences are marked.

COMMISSIONER DOUGLAS: Awesome. Thank you.

MR. COLLIER: Thank you.

COMMISSIONER DOUGLAS: Those are all my questions.

MS. RAITT: Okay, great, it sounds like we can

thank our panelists for being here. And thank you, John, for moderating.

And we'll move on to the second panel on Offshore Wind in the California Market: Opportunities and Constraints.

And so, folks can -- if the panelists could come and make your way to the front tables and we'll get ready.

(Pause)

MS. RAITT: Okay. I think, since we do have a full day, we'll just go ahead and jump into our next panel. If everyone can find their seats?

So, this panel is being moderated by Scott Flint of the California Energy Commission.

And I just wanted to note that in a few cases we've received some updated presentations, or a new presentation, and so we will be updating those on our website probably tomorrow, but that we will have it all up there.

So, take it away, Scott. Thank you.

MR. FLINT: Thank you, Heather. Good morning Commissioners, executives and the participating audience. Sorry my back's to you, but we'll probably use the podium to bring you more in.

So, this panel is on Offshore Wind in the

California Market: Opportunities and Constraints. And, really, today is all about identifying the opportunities and talking about how we start to deal with the constraints that are identified. As we start looking at offshore wind, more questions are coming up than answers, immediately.

So, our panel today, through the panel discussions today listen for opportunities and constraints as we hear about what we're already starting to think, what we need to think about, and how we start thinking about integrating offshore wind into our state energy planning efforts.

So, first, we have Terra Weeks, Senior Advisor to Chair Hochschild, of the California Energy Commission. She'll be followed by Sandy Hull from Energy + Environmental Economics, E3. Next will be Alla Weinstein from Castle Wind.

Folks on the WebEx, please note that that's a change in speaker order. Sandy will go before Alla. Your agenda still has the old order.

Then, next, we have Mark Severy from the Schatz Energy Research Center at Humboldt State University. Followed by Molly Sterkel from the California Public Utilities Commission. Then, Neal Millar from the California Independent System Operator. The next is

some other guy from the California Energy Commission. I'll be giving a brief presentation and trying to time myself. And then, to bring us to close for the panel, Necy Sumait from the Federal Bureau of Ocean Energy Management.

So, speakers, you have about eight minutes and I'll try to hold you to that because we have a big panel. You can speak from the table or from the podium, whatever you're most comfortable with.

MS. WEEKS: I'll do podium. Oh, I think this is your phone. Someone's phone is up here.

I am Terra Weeks, Senior Advisor to Chair Hochschild at the Energy Commission. I'm also serving as Program Manager for SB 100 Joint Agency Report across agencies.

And so, first, I'm going to talk about how SB 100 fits into our larger climate and energy goals, and then kind of dive into some of the details of the Joint Agency Report.

So, as many of you know, California has the ambitious climate energy targets, which have been ratcheted up over time. So, on the greenhouse gas emission side we have a target of reducing back to 1990 levels by 2020. And then, an additional 40 percent below that by 2030 and 80 percent below by 2050.

And Governor Brown last year, before he left office, also signed an Executive Order to reach economy-wide carbon neutrality by 2045.

And our renewal portfolio standard, RPS, determines the amount of electricity retail sales that are procured from renewable resources. And this has been a key policy lever to help us reach our greenhouse gas emission targets.

And so, the first target was 20 percent by 2017, followed by 33 percent renewable by 2020. And then, Senate Bill 100, signed last year, increased the initial target of 80 percent renewable by 2030 to now 60 percent renewable by 2030. And then, also established a goal of 100 percent clean electricity by 2045. And this is actually broken into 60 percent renewable by our current definition, and then the last 40 percent will be zero carbon, which I'll discuss more later in the presentation.

And we're actually already ahead of our renewable energy target. So, today we have 34 percent of our electricity coming from renewable resources, ahead of the 2020 target of 33 percent.

And although our greenhouse gas emission targets are economy wide, in the electricity sector we're already well ahead of schedule. And so, you can see

that our latest data show, for 2017, we're well ahead of the 2020 target, which is that 1990 level line. And we've actually already exceeded the 2030 target of 40 percent below 1990 levels.

And the main takeaway from our clean energy story so far is really that we have decoupled GDP from emissions. And so, as you can see here that as our GDP and population have grown, our emissions have continued to decrease.

In fact, our GDP growth has outpaced the rest of the United States and allow California to grow into the fifth largest economy in the world.

And our clean energy sector in California now employs five times more workers than the fossil fuel industry, with over half a million jobs statewide. And we're also home to nearly 40 percent of the solar jobs in the country.

And we're actually seeing these trends across the U.S. So, when you look at the fastest growing jobs in any sector, also the top two are PV installer and wind technician. And this has largely been driven by long-term policies. The color looks kind of weird.

But as the Chair mentioned earlier, California was the second state, after Hawaii, to establish a 100 percent clean energy target. And now, a total of nine

states, plus D.C. and Puerto Rico, have established goals to get to 100 percent clean energy.

And as mentioned, now nearly 30 percent of Americans are living in a state or city committed to 100 percent. And this accounts for about 20 percent of national electricity supply.

And so, as we're seeing this kind of unprecedented movement, really, toward clean electricity across the country, we're now focusing on how to best leverage the clean electric grid to decarbonize other sectors. And so, you can see here that electricity itself only accounts for 15 percent of statewide gas emissions.

But there's real opportunity, particularly in the transportation and building sector, which together account for half of our statewide emissions. And if you include petroleum refining, it's actually closer to 60 percent.

And as Chair Hochschild mentioned, we're seeing trends in this direction across both sectors. So, on the transportation side, you're probably well aware that electric vehicle adoption is gaining momentum rapidly. We have 627,000 EVs on the road in California today, and are on our way to our target of 5 million by 2030. And we're seeing a lot of innovation, both on the charging

side, both in technologies and new business models, and in vehicles, particularly around medium and heavy duty.

And then, on the building side we're seeing a lot of technological innovation around heat pump water heaters, space heaters, clothes dryers, and induction stoves, as well as local policy innovation, as was mentioned. And so, starting with Berkeley in July, we now have nine cities, plus a county in California that have established local policies to either ban natural gas in new construction or favor electric -- all electric new construction.

And so, as these trends continue, the clean electricity grid will increasingly serve as, really, the clean energy backbone economywide.

So, now, to kind of dive into some of the details of SB 100. So, the bill calls for eligible renewable energy and zero carbon resources to supply 100 percent of all retail sales to end-use customers by 2045.

In addition, the bill calls for the California Energy Commission, Public Utilities Commission, Air Resources Board, the three agencies to draft a Joint Agency Report, due to the California Legislature by January 1st of 2021. And the report is to be done in consultation with the California balancing authorities

and through a public process.

And so, the report is to include a technical review of the policy, including technologies, transmission, safety, affordability and reliability. Also include an evaluation of the potential benefits and impacts on both system and local reliability. Looking at the nature of anticipated financial costs and benefits to utilities, including rate impacts. Barriers and benefits of achieving the policy, and then also start thinking through alternative scenarios to actually achieve 100 percent clean electricity.

And so, we've assembled an interagency team on the staff level, which is led by the SB 100 principals from each agency, who are CEC Chair David Hochschild, CARB Chair Mary Nichols, and CPUC Commissioner Liane Randolph. And we will be hosting a series of workshops over the next six months or so, through a robust public process, and then develop the report over the course of the next year.

And so, our goals for the report are, obviously, to meet the statutory requirements. Also, to provide direction to the electricity market and coordinate planning processes of the three state agencies, including the integrated resource planning process, renewable portfolio standard, IEPR and others.

And for this first report, we really want to make sure that we're forming consensus on interpretation of the statute, including considerations around the definition of zero carbon resources.

And so, we're really trying to kind of balance and incorporate all these different facets of the policy. So, including reliability, particularly as we integrate more intermittent renewable resources on the grid, looking at resource diversity and flexibility, as was mentioned, as really key tools to ensure reliability.

Energy equity, ensuring that all Californians have access to the benefits of clean electricity. And affordability is really key, especially as we electrify other sectors, including transportation, heating, and others.

We also want to make sure that we're allowing flexibility for innovation and emerging technologies that are not yet commercialized or scaled, including offshore wind in California. And then, of course, considering environmental impacts, particularly looking at land use and water use.

And so, as I mentioned, going to 100 percent clean is actually 60 percent renewables by our current definition, which is located in this left-hand column.

And then, 40 percent zero carbon, for which we do not have a definition for, and that's going to be one of the main focus areas of this report.

And so, some resources under consideration now are existing contracts for large hydro and nuclear, carbon capture applications, and others. And many of the comments that we've received to date are encouraging us to kind of err on the side of being technology inclusive and allowing for a lot of flexibility from different resources.

So, just a quick overview of our timeline. We are now hosting a couple of scoping workshops, so we're going to have three across the state. We had our first workshop in Fresno, on Monday. We're going to hold another one in Redding and one in Diamond Bar over the next few weeks. And we're just confirming timing for those coming up.

And so, these are really opportunities to solicit regional feedback and start kind of homing in on the exact topic areas of the report.

And so, after our scoping workshops, we're going to finalize our topic areas workshops, which we'll hold over the next six months or so. We plan to have a draft for review by next summer and then submit the report to the legislature the beginning of 2021.

And so, these are our tentative list of workshops. Again, these will be finalized after we receive feedback through our scoping workshops. But I would say for the offshore wind community, probably the two that are of most interest are the scenarios and technologies workshop. So, we can really make sure that we're using the correct assumptions around offshore wind development in our modeling and scenarios.

And then, also the reliability workshop, particularly as offshore wind can complement other renewable resources, namely solar.

And so, I really encourage everyone to stay engaged with SB 100. There is a lot of overlap between the content we're covering in this workshop and SB 100. The best resource is to just go to the SB 100 webpage, which is on the Energy Commission website, and it's linked to on our home page so, hopefully, easy to find. And there, you'll find links to both the document, and you're welcome to submit comments at any time, and our Listserv. So, you can sign up to receive notifications about workshops and other events.

And as always, I am a resource, so please feel free to reach out to me with any questions, even if it's just I can't find the docket. I don't know how to use your website. I'm happy to be a resource.

And with that, I will turn it over to the next speaker. Thank you.

MR. FLINT: Thank you, Terra.

Our next speaker is Sandy Hull from Energy + Environmental Economics, E3.

MR. HULL: Hi, everyone. This is Sandy Hull. I'm a managing consultant at E3. And I'm going to talk about a couple of the recent studies we've done looking at the value of offshore wind and California's long-term energy mix.

And so, we'll talk about a couple of the long-term needs that offshore wind can help fulfill in the state's energy plans. Specifically, dive into two recent studies we did, one for Castle Wind and one with Rob Collier, supporting the OPC. And I'll close with a couple of areas where I think there's room for further study as we try to plan for and assess the opportunities of offshore wind in California.

A quick disclaimer. Both of these studies we did were utilizing the RESOLVE model, which is a capacity expansion tool. It's used to support the California CPUC's IRP process. This work that we've done here is outside of the IRP process. It is not endorsed by the CPUC. So, just need to put that up front.

But diving in here, I won't dwell on this, but I think one important thing to recognize is where California is today and where it needs to go in its long-term energy plans. I think Terra did a good job framing the long-term goals that are in place in the state. And I think it's important to know right now California has a pretty diverse set of renewables in that 34 percent. We have a mix of about 10 percent solar, 10 percent wind, and a lot of kind of diverse other renewable sources like geothermal, biomass.

But in order to meet the state's long-term energy goals, I think we have fewer and fewer alternatives that really scale to meet the size of the demand, especially as we're looking to the longer term where we're electrifying other parts of the economy. Specifically, transportation and buildings.

So, in the IRP, the last cycle of the CPUC IRP, we've identified about 20 gigawatts of new renewables needed by 2030, with most of that being composed of wind and solar. But the scale grows substantially when you look at the 2040, 2050 time frame, with the state needing potentially 100, 150 gigawatts of new renewables. So, I think that is a whole different order of magnitude than the planning we've done over the past several years.

Right now, the state has, you know, about 12 gigawatts of utility scale solar. When you look at our forecasts we've done, with some of our deep decarbonization work for the CEC, we're looking at tens or a hundred gigawatts of solar, so maybe ten times what's on the grid today. So, this is a whole different scale. And I think our resource options are a lot narrower at this scale. We don't have tens of gigawatts of geothermal. We don't have tens of gigawatts of biomass.

And so, our models historically have shown a great reliance on more and more solar, storage and, you know, to the extent possible, more in-state wind. There's not a lot left in California. And so, we've also looked at incorporating new transmission and delivering out-of-state wind from New Mexico or Wyoming. But that's also limited in scale and limited in what you can actually get built, just given that it's difficult to site those big, interstate transmission lines.

I think the real value and potential role of offshore wind is that it's another kind of rare, scalable resource and it really complements solar, which is the most abundant resource that we currently have in our planning models for California.

So, if we look at adding offshore wind as a

resource option in these long-term planning studies, what we see is that we can greatly reduce the reliance on solar and storage in the future. And this, ultimately, offers a lot of savings. Solar's really cheap today. It's come down greatly in cost. I think it's one of the big success stories of the state. But we're facing a scenario today where solar has less and less value. We've served more of the hours in the middle of the day with solar energy. We're starting to see over supply in those hours.

And so, to continue to rely on solar in the future, as the only scalable resource, we would need increasing amounts of expensive battery storage, and the cost to integrate that solar is going to continue to get higher.

So, solar plus storage is an increasingly expensive solution if we really want to fully decarbonize the grid and start serving more of those evening hours, where we still have GHG emissions that need to be offset.

So, the value off offshore wind is that it actually complements solar really well and reduces the need for all of that battery storage if you want to serve energy in the evening hours.

Both of these studies, we've done recently, show

that for every megawatt of offshore wind you add, you're reducing the amount of solar and battery storage you need substantially. A megawatt of offshore wind might offset that 1.7 megawatts of solar in the longer term, and over a megawatt of battery storage.

And, ultimately, that's the value proposition of offshore wind. It's that it's profile is more aligned with the long-term needs and complementary to solar in terms of its ability to serve those remaining evening hours, where we still have a lot of GHG emissions left in the grid today.

And a quick illustration of this is a sample week of generation. This is using some of the existing offshore wind speed data. And what we'll see here is that while solar is generating all of its energy in a pretty concentrated, maybe eight hours of the day when the sun is highest in the sky, offshore wind is going to, in general, show a tendency to ramp up in the evening hours as the sun's setting. It doesn't do this every day. But on average it's going to help serve that need.

And then, also, offshore wind is going to have to have periods where it's blowing and generating energy substantially throughout all the evening hours. And that's really where the value proposition of offshore

wind is, is that ability to basically serve baseload energy throughout the night and reduce our reliance on gas plants that are currently running throughout all of those hours.

So, it's the emissions reduction value. It's the ability to retire more gas plants, rather than rely on those gas plants. And avoid over building on solar and building a lot of energy storage to shift all of that energy outside of those few hours when solar tends to generate. So, that's the value proposition of offshore wind.

I'll talk quickly about two studies we've done to try to quantify that value proposition. And I want to highlight that one challenge in these studies is identifying the cost of offshore wind. I think we can quantify the value well. But what the optimal amount of offshore wind is and what it's net value proposition is really depends just how cheap it can get and how fast.

So, we've taken a couple different approaches in these studies. With Castle Wind, we've used a set of industry cost estimates about, in the ballpark, I think, of $65 a megawatt hour by 2030, is roughly where that ends up. I think that's consistent with all of the new studies coming out on costing for floating offshore wind.

And we identified what the economic value proposition is for California putting offshore wind on the grid. What the grid savings would be. And what the total capacity might be at that cost level.

For the report we did for the OPC, we did not take a stance on the cost of offshore wind. But, rather, we assumed a couple different scales of deployment and looked at the value proposition, and what offshore wind would be worth when deployed in different places and at different scales.

I think both of these studies come to very consistent results on the value of offshore wind, how that compares to the cost of offshore wind, and what the scale of this opportunity is.

A quick note on the cost assumptions. In the Castle Wind study, our costs that we assumed were actually, you know, potentially conservative in the longer run. I think they came in a little bit lower than NREL's cost assumptions in the near term and assumed a similar trajectory to the 2018 NREL annual technology baseline, just as a reference point.

But the latest NREL studies actually show even steeper cost reductions farther in the future. And I think we're looking forward to seeing more and more studies coming out on the cost of offshore wind.

I think the tendency in all renewables and cost forecasting we've seen is that these costs tend to fall faster than anyone expects. And I think this is a key caveat in these results is that we're using, you know, today's estimates. But, really, these studies need to be continually iterated on as we get better and better ideas about the costs of offshore wind and just how quickly industry can beat last year's estimates.

The findings in the Castle Wind study were that offshore wind looks economic by 2030 or 2035, in every scenario modeled, and is increasingly in higher demand in the future as the state's GHG emission targets get lower and the cost of offshore wind gets lower.

So, we see, basically, an increasing need and an improving resource and cost profile for offshore wind that leads to a demand on the order of, potentially, 7 to 9 gigawatts in the 2040 time frame. And that has the opportunity to save ratepayers around $2 billion in that present value.

So, this is a big opportunity. This is something that's not currently in the state's resource planning, or at least in the last IRP cycle. But I think it's clear that this needs to be part of the planning process going forward.

Shifting gears, the study we did with the OPC

focused on characterizing California's offshore wind resources in a little bit more detail, versus the Castle Wind study which took a more generic approach at valuing offshore wind.

So, for the OPC, we took a look at what the possible and ideal zones for resource development would be in California. And, basically, took the existing California offshore call areas and tried to identify other zones that kind of fit the ideal constraints for development. So, both technical potential, in terms of good wind speed, you know, water depths that are viable for development. And then, also accounting for constraints around marine sanctuaries, fisheries, navy exclusion zones, and then distance from shore.

And so, we identified a couple additional resource areas in Northern California. And you add up all these zones, we have over 20 gigawatts of really ideal potential for offshore wind just here. Obviously, there's an ongoing discussion around all of the great offshore wind resources farther south and whether those can be developed, subject to navy constraints.

But I think the big takeaway here is we have 20 plus gigawatts, all in the ballpark of about 50 percent capacity, so very strong offshore wind resources. And if you developed all of these, this is a big chunk of

the state's future energy needs. So, not a lot of resources like this, that are this scalable in the future.

In terms of what offshore wind would be worth to California, this was the other key takeaway from our study with the OPC. And this gets a little bit technical. But, effectively, we put offshore wind into the grid planning model and looked at the potential savings versus a future where we don't have offshore wind as a resource option and look at what the avoided costs would be or the value of offshore wind.

And what this is showing is that offshore wind is worth in the order of magnitude of $70 to $80 a megawatt hour to the grid. So, if you can beat that in terms of cost, it's a winning proposition. If offshore wind can be built for $65 a megawatt hour and it's saving the grid 70 plus, it's an economic resource.

And what we've shown is that that value of offshore wind only increases in the future as our GHG goals get lower.

And another thing we've modeled here is what that value proposition is for the first gigawatt, second gigawatt, up to 10, 20 gigawatts. And the value is pretty robust. Unlike solar, where you start to have a saturation effect on the grid, where you start to over

generate and over supply the grid in certain hours, which we're already seeing today at about 10 gigawatts, 12 gigawatts of solar. In California, offshore wind actually is going to continue to be worth 70 plus dollars a megawatt hour at this 20-gigawatt scale. So, I think that's really important to note. It's showing that even if we build out, you know, all of those resource zones we identified, the offshore wind economics are going to continue to look pretty strong, assuming costs come in as everyone's planning.

MS. RAITT: Time check.

MR. HULL: So, just to wrap up. I think one challenge that we, you know, want to flag for further study is that a lot of those ideal resource zones we identified are in Northern California. If you'll look at the existing transmission grid, it's up and down the center of the state and largely designed to serve all of the load in Southern California.

So, I think this is a big area that needs to be assessed in order to really capture the value of offshore wind. So, this is something we didn't, you know, get the chance to look at in a lot of detail. I know there are a number of people here who've started to study this. But I think, in order to really seize this opportunity, there needs to be a comprehensive look at

where the best offshore wind zones are, where the transmission opportunities are.

We know of a couple kind of low-hanging fruit, where there are existing power plants on the coast that are retiring and freeing up transmission capacity. But to interconnect something on the scale of 10, 20 gigawatts, it's going to take a much more comprehensive planning effort and transmission effort.

And then, lastly, you know, as we're modeling all of this, we would always love to have better data to really assess these opportunities. So, I'm happy to hear about some of the efforts underway to collect more information on a more granular level on things like wind speed.

So, I think we have a lot of the initial work underway, but I think there's -- this is a big opportunity. And, you know, what we've identified is that there needs to be further study of this resource and the kind of long-term value it offers in California's planning needs.

MR. FLINT: Thanks Sandy.

The next panel presenter is Alla Weinstein from Castle Wind.

MS. WEINSTEIN: Thank you for having me here, Commissioners. It's a pleasure to talk about offshore

wind.

Castle Wind is a joint venture between EnBW North America, which is a whole-owned subsidiary of EnBW in Germany, a large utility, and Trident Winds. Trident Winds is based in Seattle. Looking at the deep-water offshore wind development in the United States.

When Trident Winds submitted unsolicited lease request back in January 2016, I don't think anybody was really thinking about offshore wind, yet. And it was a wakeup call. And at that time, both Commissioner Douglas and Commissioner Hochschild asked me a question: Why should we bother about offshore wind?

Well, it took us three and a half years to answer that question, but I think we answered it. Why should you bother? Because it is a great saving and because based on the studies that was done, I don't think California can get to meeting its statutory requirements of SB 100 without offshore wind. It is needed. And it is needed in large scale.

And so, what's important to think about why and what we need to do to get so that California can realize the benefit of offshore wind.

I'm going to repeat some numbers that Sandy said because it's important to remember them. The savings are almost $2 billion, but it can only come with

installation of 10 gigawatts of offshore wind by 2040. However, you can't assume that 2040 comes and it will be all installed. It has to be planned. And infrastructure, in particular, will need to be prepared for it.

Supply chain can come. Investors are there. Industry can develop ports and everything that's needed, as long as there is a goal and commitment by the state to those targets.

And so, if we look at going down the road and looking at 2030, when the offshore wind already becomes, or coming into the IRP model, we need to look at maybe 5 gigawatts by 2030 and 10 gigawatts by 2040, such that we can prepare the infrastructure and get the investments in place.

So, offshore wind offers resource diversity, reliability and adequacy. Those are all the words that are very important to CPUC and the CAISO. And that's exactly what the resource does.

It is a new resource. Even though the technology had to be developed, it has been developed. And so, what we're asking for is actually set a goal for accepting the new resource into the energy mix.

We are entering industrialization of offshore wind, not necessarily R&D stage, because R&D stage

already passed as you saw, and as you heard from technology developers.

I'm going to just give a couple of slides, just in the interest of time because there are a lot of panelists that are sitting there.

But again, I reinforce, I do want to reinforce a couple of things. We all hear about the duck curve and we all know what it means, so I'm not going to repeat all the scary numbers of 3 hours and 13 gigawatts that has to come online. But what's important -- and I'm not sure if this thing will work. Well, yeah, it will.

I do want to point out one line. This black line on the chart is the value. During the day of renewable energy sources, solar, onshore wind in California, potential onshore wind from Wyoming and New Mexico. And this line is offshore wind. And you can see that during the day, during the years, during the months you will have the highest value of the resource available to the State of California.

Again, repeating some of the things from Sandy, it is a significant reduction in cost to the State of California because you don't have over build to compensate for solar and storage with a resource that actually can be available at the time when it needs to be available, providing reliability, adequacy, and

system diversity.

We heard some numbers. You've managed to install 18 and a half gigawatts of offshore wind. By the end of 2020 and going into 2021, you'll have over 200 megawatts installed in Europe and other parts of the world.

What California can do, which California does very good, is scale. Scale matters. Like Rob said, go big or go home, because without it you can't get from here to there. And so, that is where California can shine. Yes, we had to go to Europe to develop technology. Thank you, Europe, for all the money you spent on developing it. Now, let's put it to use and put it to use in good commercial scale.

Yes, the area's constrained. We do know that. But we also know that there is plenty of capacity available in the Central California, and we do call on the State of California to work with Department of Defense, to work with BOEM to clear out parts of the area that is actually physically constrained. It's constrained by the sanctuary on the east side of the area. It's constrained by the physical canyon on the west side of the area. So, constrained will not expand the area, but try to use as much as you can in that particular area called, generally, Morro Bay.

And it is something that we do ask the state to put a lot of attention in trying to work out solution with Department of Defense.

So, in summary, the state needs to have a goal. Industry will come. Supply chain will come. But it will not come, as we saw what happened in the United Kingdom, if the goals are not there. The only thing we're asking is commitment to the goal. The rest, the industry can bring as necessary.

The issues could and should be resolved and we are all hoping that those issues will be resolved between Department of Defense, and the State of California, and BOEM.

And we are really on the verge of industrialization of the technology and this is where California can actually say we did it. We did industrialize. And we will have more installed capacity of floating offshore wind than probably anywhere else in the world because of the demand, because of the size, because of the scale of the resource.

Competitive criteria that we will be looking at going down the auction, needs to include industry best practices. Because without it, it will not happen in California. California is a state that is very particular of what they accept and what they don't

accept. There's quite a number of projects that fell into the boneyard because they were extracted by the local communities. And so, local communities do matter a lot and industry best practices do matter a lot.

To that extent, Castle Wind worked very closely with the City of Morro Bay, and now we have a community benefits agreement and the local fishermen. And the local fishermen when from skepticism to the support of offshore wind because they see the benefit of it. That becomes extremely important.

Monterey Bay Community Power signed the MOA for a thousand gigawatts because they believe that they will be able to have customers and the demand for that power.

So, we're ready, able, and willing to do it. Industry's ready. Investors are ready. We just need you to set up the target. Thank you.

MR. FLINT: Thanks, Alla.

Next, we have Mark Severy from Schatz Energy Research Center, Humboldt State University.

MR. SEVERY: Thank you Chair Hochschild and others on the panel for inviting me today. I appreciate the opportunity.

I'm Mark Severy. I work at the Schatz Energy Research Center at Humboldt State. We're doing a variety of studies on the North Coast to investigate the

potential and feasibility for offshore wind.

First, I want to thank our project funders, including the Bureau of Ocean Energy Management, the California Ocean Protection Council, and the California Governor's Office of Planning and Research, as well as the partners. Our partners helping us do this work, including PG&E, and others.

We have a variety of research topics that are under study, but today I'm just going to focus on the resource assessment and the grid compatibility on the North Coast. We've probably all seen this map before. You have, on the right side, California's offshore wind resource and this is just an annual average of wind speeds. And on the left side is the North Coast. The highest wind speeds are concentrated up there. And then, that green box outlines the Call Area on the North Coast.

And here's just some example footprints of what the potential size is of different wind farms. So, there's a 50, a 150, and then 2 gigawatts if you built out the entire Call Area.

So, our study's looking at these three scales to investigate what's the generation profile from this resource and then, what are the transmission issues that need to be overcome to accommodate this type of

generation.

So, some of our basic assumptions are outlined here. We have the three sizes and they're using 12-megawatt turbines in each case.

First, before we go into summarize results, I want to look at three weekly profiles to show how does the generation profile change over time. And these are all going to be from just randomly selected weeks in the month of July.

So, first, this is a week of variable generation. There's periods of high generation, near max capacity, periods of low generation and places in the middle.

This is a week in July where it's nearly producing 100 percent for six days of the week.

And, lastly, there's also extended periods of low generation where there is not enough wind speed to go beyond the cutoff speed of the turbines, or the cut in speed of the turbines.

If we look at these same data over the course of a year, in a generation duration curve, you can kind of see how this plays out. There's 30 percent of the time where the wind farm is producing its rated capacity and then, on the right side of this chart, there's 20 percent of the time where the wind farm is producing

zero megawatts.

Similarly, we can break this down by season and by hour of day. And I think this is important to look at this, not just in an hourly -- or an annual average but, actually, how does it break down over the day. And so, if you look at the average, you see that it's actually quite flat and consistent between seasons and between parts of the day. And this is specifically on the North Coast.

And then, the capacity factor for this area is about 46 percent based on our modeling. But if we add behind this the distribution of where the wind speeds fall, it's a little bit hard to see with the light, but there's a large area -- like, most of the time it's either at zero or high capacity. So, if you see the green band at the bottom, that's between the median and the 25th percentile. And then, the bluer band at the top, that is showing the 75th percentile is actually at max capacity.

And so, some of the key takeaways from this is there's just a widespread in power production in all seasons and in all hours. And that when you look at the annual average, that's not very representative of what's being produced at any moment during the day.

Next, I just want to motivate some of the

reasons for why transmission upgrades are necessary in Humboldt County. And this is an overly simplified look at power flow in that area. But, first, we can just see what the load is in Humboldt County. It's about 800 gigawatt hours per year. Current generation for large power plants is approximately 600 gigawatts per year. There's another 400 or so proposed, new generation in the area.

And then, if we just compare that the potential for offshore wind for a 50 or 150-megawatt hour -- or, megawatt wind farm, you see that it drastically changes, or it's a large fraction of what is currently up there.

So, there are three major transmission corridors coming into and out of Humboldt County. There's 215 kilovolt lines going east and a 60-kilovolt line heading south. Their right of ways are small, they're in mountainous terrain, and the existing infrastructure is also very small.

These are some pictures taken outside of Bridgeville, on the 115-kilovolt line heading east. If we take that line all the way east, this gives a good visual of what the existing transmission looks like compared to, for example, a 500 kilovolt WAPA line. So, you just see there's a big difference and a lot of changes that would be needed to accommodate offshore

wind development.

So, and that's what our study's investigating. We're kind of in the early phases now, but we're working with PG&E to do a transmission power flow analysis to estimate what the infrastructure upgrade costs are. And then, so what the cost and what infrastructure's required to suit this. We're looking at transmission going east, transmission going south and then, also, a high voltage DC cable going under the sea.

And kind of to end, I just want to say that transmission is a big constraint. And there's a variety of different aspects of this. It's a technical constraint from an infrastructure and electricity grid management perspective, but it's also an environmental and a stakeholder issue as well. There's a lot of environmental impacts associated with upgrading a transmission line, and there's also a lot of stakeholder considerations that need to be taken into account.

So, our work is kind of about a third or a quarter of the way done and we'll be having final reports towards the spring and summer of next year. Thank you.

MR. FLINT: Thank you, Mark.

Our next presenter is Molly Sterkel from the California Public Utilities Commission.

MS. STERKEL: Good morning. I'm the first speaker officially starting past the noon hour. I apologize about that. Thanks very much. Good afternoon, Commissioners.

I'm going to spend a few minutes giving you a brief overview of the IRP process, the integrated resource planning process at the CPUC. What it does. How it works. What it can do.

I'm also going to tell you that our electric system is on track to meet its very aggressive greenhouse gas emission targets for 2030. And that is very, very fantastic news, especially if you're looking for a talking point. Because if you run into Greta Thunberg in the hallway, in your upcoming travels, you really want something good to tell her.

But it's very challenging news if you're sitting in the audience today, as an offshore wind developer. Because you're hearing these two opposing points of view. One is that we need to, you know, work very hard to get to our very aggressive goals. But on the other hand, we're well on our way to meeting them. So, what can we do?

In the middle of all that confusion is the state's integrated resource planning process. So, I'm going to try my best to try to meet two audiences here.

One that might not know much about IRP, and the other that might want to know how IRP and offshore wind fit together.

I am not changing the slides by changing my computer. Let's see if I can fix that. Okay, there we go. Just give me one second.

Okay. So, our electricity system is definitely on track to meet its very aggressive 2030 goals of getting to the statewide electric sector target of 30 to 53 million metric tons. We can do this with existing policy.

As of 2016, we were at 83 million metric tons in the electric sector, as Terra's slide showed earlier, with just over 30 percent of RPS in the electric sector.

SB 100 puts us on target for 60 percent RPS by 2030 and that will get us close -- in the 40s of the million metric tons.

And the Commission's 42 million metric tons target by 2030 will likely be achieved with existing and known resource types that are already quite proven in California.

However, deep decarbonization scenarios that go below 36 million metric tons by 2030 might require new technologies and market transformation. So, there's really two things going on here. If you go below the

existing targets all the modeling shows, whether it's paid for by the CPUC and done through the integrated resource planning, or if it's done by outside parties, and they can often come and talk here, it shows that you're going to need some variety of new technologies and market transformation.

However, there's a high degree of uncertainty around demand forecast and what those new technologies can provide. So, that's why the state's integrated resource planning process is really challenged.

So, one of the other key considerations for policymakers is that the electricity market is tremendously fragmented. Market fragmentation with over 20 CCAs, over 14 ESPs. We have legislation last year increasing direct access in California, the Herzberg bill. We have over -- we're predicted to have over 50 percent of PG&E's load served by CCAs by 2021.

That means that your buyer, your market, your off taker for whatever the integrated resource planning proceeding says, is challenged.

So, in the -- I just wanted to throw up here, you know, we're not -- I'm actually, probably not supposed to do this as a California State employee. But in the big red here, this is China's emissions. This is the U.S. emissions. You have to get down to this little

dot over here to get to California's emissions. This is 2016 figures. So, 340 million metric tons.

So, I was just telling you that we are on track to get to 40 million metric tons in the electric sector. We're going to go from like the 80s today, and then ten years from now we're going to be in the 40s.

But if we go to 30, we're going to need new technology. We're going to need new market procurement structures.

And why I put this slide up here is to emphasize to you that we're talking about going big or going home for a mere 10 million metric tons. So, anyone who's going to get us to push below 10 million metric tons better believe that there's going to be serious looks at costs, and risks, and reliability impacts. Because it's a lot you're asking to go in an override-global-emissions perspective not very far. Okay.

And so, it's not to say that we're not going to do it, it's just to say that, you know, the last bit is going to be really hard. This is very consistent with what Terra's presentation said, which is we can get a lot of the way there. We can get to like 80 percent of our SB 100 targets without too much difficulty. But it's that last bit that's going to be really hard. So, we're going to do really tough analysis on it. And

that's what the IRP is here to support our decision makers to do.

So, I think I've covered most of these things. I've got -- I want to hit slide 8. This is IRP in California. These slides will be available to you in case you are relatively new. Statutory basis for IRP. IRP framework.

Okay, so IRP is a two-year planning process. It merges with the California Energy Commission's demand forecasting process, done in the IEPR, which is the host of today's workshop. And it also merges with the California ISO's transmission planning process, who you're going to hear from Neil next.

But we do a two-year process. And in year one we adopt a greenhouse gas planning target and we create a reference system plan. So, we sort of -- we do a ton of modeling. We get a ton of inputs and assumptions and we say what's the best way to get there from here if we were planning -- essentially, if we had some old-fashioned world view, where we could plan it all together, and we were in a centralized planning system. And we're not in a centralized planning system, so that's why it takes us two years.

In year two, we ask the load-serving entities to develop and deliver plans. And then, we aggregate those

together as a preferred system plan. And then, when we add them up, we see if it all works. And that's why we do a two-year process.

And we've gone through this cycle one time and we're at the beginning of kicking off the second round of it. So, tomorrow, you heard Suzanne preview that we're going to be releasing the 2019 inputs and assumptions. And in that, you will see assumptions for offshore wind, using NREL's 2019 annual technology baseline, as well as many other details over the course of 50 odd pages.

And then, we're going to use those inputs and assumptions and we'll give you draft, preliminary draft staff results looking at what the modeling shows us.

And I don't think it's going to surprise you that it's going to be very consistent with what non-CPUC entities have found in their recent modeling, which has already been discussed on today's paneling -- panel.

So, anyway, we do -- so, we're going to do this IRP framework. We do this capacity expansion model, dah, dah, dah.

Okay. I want to show you one more I chart. This chart was put up by Sandy earlier. I think it was maybe on one of his first slides. And this is the results from last go-round in integrated resource

planning. So, this is an example of what the selected 2030 resource mix would be. And the first column shows you what it will be in the baseline. This is basically what we adopted in our plan.

A 42, it says at the bottom, 42 RSP references a plan using the 2017 IEPR. And then, the next three columns show you what happens to the total amount of resource build out you need if you want to go 32 with existing transmission only, or if you allow new transmission to Wyoming and Texas, or if you allow new transmission and any out-of-state wind.

So, essentially, these three bars show you that regardless of whether you do or do not allow new transmission, if you want to get from 42 to 32, you're going to build a lot more gigawatts of new resources.

And so, in this modeling cycle, that you're looking at the results here, we did not have offshore wind as a candidate resource for selection. However, in this next upcoming round, we will have offshore wind as a candidate resource. And you're going to see, very likely, very similar results. Because offshore wind and out-of-state wind have the same acronym and have the same impact on the model. Okay. You like that one, Alla? You can have it. You can use that one.

MS. WEINSTEIN: The same acronym, I like the

acronym.

MS. STERKEL: You like that one? Good, okay.

Anyway, the last thing I'll say is this is a slide, and you can see lots of these if you join the IRP fan club, where you get from today, 2018 -- or, I guess that was last year, to 2030. And it shows you, you know, the type of resource. And it shows you that in this slide you get the purple. Purple is, in this case, battery storage. You can kind of get a lot of the way to 2030 with just solar. And then, by 2030, you see that you need battery storage.

And then, this affect just gets amplified as you go beyond 2030, as you go to either deeper carbon reductions, or as you go to 2045. Either which way you change the lens, the amplification of you need something else after 2030 is going to occur. And so, we'll look at lots of sensitivities around cost.

Next steps are on the next slide. And that is I think the modeling and progress, the third bullet there is what you want to hear. Offshore wind is included in the 2045 framing study, with results to be released soon. And that's an ARB study, which we've collaborated with the Air Resources Board on. An offshore wind sensitivity analysis is going to be included in the main IRP process.

So, thanks very much. The links for all of the IRP things, if you would like to become a full-fledged member of the IRP fan club are up there on the slide. And I'll take your questions later.

MR. FLINT: Thanks, Molly.

Next up, Neil Millar from the California Independent System Operator.

MR. MILLAR: Thank you very much. And recognizing I'm between the rest of you and dinner -- lunch, I'll try to keep this moving.

So, Neil Millar with the California ISO. I just wanted to mention up front we're strongly supportive of broad diversity in resources. I just picked a representative day from last year, showing that this was a profile of the load and what resources were meeting the load.

As the solar wanes, unfortunately, the load continues in California to stay on for another couple hours before it starts to drop off. That's a daily cycle issue we do have to look at.

On this particular day, as the solar was dropping off, which is expected, wind made a surprisingly strong appearance that day, while gas-fired resources were positioned to pick up the requirement as the solar dropped off, together with imports. We

actually had a bit of a strong showing from the onshore wind that helped meet some of that requirement.

Now, the uncertainty factors about what's going to show up is always an issue in managing these types of resources. So, resource diversity is very attractive to us.

Now, I was going to talk about our transmission planning process and generation interconnection processes. Both of these are focused on what we're actually ready to move on or initiate action on between now and over the next ten years. So, they're not looking out so much 20, 30 years, as saying what do we need to start moving on today, or how are we moving projects through that need to be initiated over the next few years.

Our annual transmission planning process is coordinated with the Energy Commission's integrated resource planning -- sorry, the Energy Commission's IEPR process, which is where we draw our forecast information from, as well as the Public Utilities Commission's IRP process which, in particular, provides the resource portfolios that we use for our resource planning.

In our transmission planning process, we focus on reliability needs, policy needs, as well as overall economic transmission opportunities. And planning for

renewable generation development clearly falls into that state and federal policy bucket. So, we really rely on the coordination we have with the state agencies for those efforts.

Our generator interconnection process is a little different. It's an open access framework. It's open to competition. It's largely first come, first serve, and there's a lot of competition for generators seeking to get connected. It's not an academic study process. It's meant to winnow down and move forward with the projects that are ready to move forward. And it's also designed to push out the projects that actually aren't ready to move forward, so that they apply when they actually are.

It's a two-stage process because we get so many applications each year. The first of study helps us winnow down and provide an initial level of requirement for a relatively large number of generation in each area. The second year takes the people that were willing to put some money up and keep moving forward and provided them with results that then would be the basis for contracting initiating projects.

Obviously, if the transmission is already moving forward as part of the policy-driven framework, through the coordinated efforts with the Energy Commission and

Public Utilities Commissions, generators seeking to locate in those areas are advantaged both from a certainty that the transmission will be there or is already moving forward, as well as some cost advantage knowing that the grid's already being reinforced for their needs.

I know the numbers here are too small to see, but I'd ask you to focus on the picture. This is a picture of our Queue Map, the generators that were in our interconnection queue at some stage as of July 24th. It is constantly a moving target.

The offshore wind projects are represented by 8 gigawatts of applications here and 1.6 gigawatts up at the North Coast area. That's out of, though, at the time, 53 gigawatts of renewable generation applications.

There's also a number there of 36 gigawatts of energy storage projects. Most of those are coupled with either a wind or solar project. There are some that are stand alone, but the majority are coupled with one of the other renewable projects.

Now, I mentioned this shifts fairly quickly. As of September 26th, the 8,000 megawatts off of the Diablo, Morro Bay area had already dropped to 3,600. We did have projects drop out of the queue that weren't ready to continue moving forward. The projects that are

up in the North Coast area are still hanging in.

One issue I do need to point out here, though, that is a challenge for our studies is that there's actually a technology gap issue where a number of the projects tell us they're planning on using HVDC technology to bring their power ashore, but they're all giving us AC models right now because there's a lot of difficulty in actually providing models for the DC technology they plan on using.

That needs to be fixed because if we can't study it, we can't hook it up, putting it bluntly. So, that is a real technology issue for us that products are being designed they can't -- functional models can't yet be provided to us for study purposes.

So, a few observations about available capacity, and I do have another picture of the transmission system, I'd like -- especially given some of the earlier comments, I'd just like to touch on.

That, yes, the most obvious place for bringing offshore wind ashore is where there's already the transmission infrastructure. And for it to be available, it's because some other power plants that are already retiring.

So, in the North Coast area, very tight for capacity. Even some of these smaller projects are

triggering larger transmission upgrades. Generally, more at the 115-kV level, as opposed to having to move up to a higher voltage.

But if you are looking at a larger project, the nearest 500 kV grid is 200 miles inland. And that would require some major cost to get to those points. Or, a marine cable coming down the coast. Those options are available, but neither of them are inexpensive or fast. We need to know about them and properly take those into account to make sure they're working with the other things on the system.

In the central area, with Morro Bay and Diablo Canyon's anticipated retirement -- Morro Bay already retired. Diablo Canyon retiring. We do see capacity available there for roughly half the numbers. You know, we were looking at 3, 4 gigawatts can be accommodated with the existing system as these units are dropping off.

We're hearing 8 to 20 gigawatts. Eight would be a problem. Twenty means redesigning a lot of our existing grid, putting it bluntly.

So, there are implications. That's not to say they can't be done, but it can only be done if we see it coming, if these targets are set longer term, and the planning and infrastructure development gets underway

fairly quickly.

One example, though, there are competing uses for these facilities. We have other types of generation, including energy storage projects that are also in that queue and are seeking to move forward. And we're not preserving capacity for one type of project in favor of another. It's an open access framework we're in. If projects are ready to move forward, we carry them forward.

One consideration from the system side is that one of the midway Diablo Canyon, 500 kV circuits is being considered to be repurposed to reinforce the 230-kV system in the area. If we want to retain flexibility to retain that full capacity out of the Diablo area, it will start costing us money to preserve that capacity.

So, those are issues that we need to integrate into the holistic planning process, instead of just moving forward one small decision at a time, or we might end up where we don't expect to be.

Once we get past the 4-gigawatt level, as I mentioned, we could be looking at implications on the much larger, 500 kV backbone, and our ability even to transfer power back and forth between Southern and Northern California. So, these are things we're looking at but, again, need the resource planning in place to

actually take it beyond a conceptual consideration.

One other point I just wanted to make is that as we rely more, and more heavily on different types of renewable resources, we're also having to consider a broader range of scenarios in all of our transmission planning. The specific type of circumstances, the blend of resources that actually show up at any given hour, of any given day can be across a broader range of possibilities. And having more flexibility from the transmission side is going to become more important.

Now, proving that you need the reinforcement is going to be more of a challenge because, contrary to what you may have heard, transmission is not that popular in some parts of the country.

Okay, it's not popular in any part of the country.

(Laughter)

MR. MILLAR: You need a very solid case to get transmission built, not that it might be helpful. We need stronger cases and we need to work with the state agencies to build those cases.

One scenario I just wanted to put up here was that in February of this year, we actually had one of those unusual situations where even though there were high hydro conditions in the Pacific Northwest, their

load took off. We ended up exporting hydro resources out of Northern California. No one ever expected that we would be exporting hydro north, out of California. There were limits there that actually we started to encounter. We knew of those limits for years, but they hadn't been an issue before.

So, we are running into a broader range of operating conditions that the system needs to manage, and that's only going to increase as we move forward. This will just be another part of that pie.

Sorry for taking that long, but I'll look forward to any questions. Thank you.

MR. FLINT: Thanks. Thanks, Neil.

Our next presenter is Scott Flint from the California Energy Commission. I know we're getting near lunch, so I'll go as quickly as possible. And you've heard me talk enough in other venues, anyway.

So, it's not a surprise that we're looking at drilling down on identifying on what's going on, and what we need to do to bring offshore wind in these different areas of California, these different areas that we're talking about.

And it's no surprise to everyone in this room that California has an abundance of offshore wind resource.

In late 2017 and 2018, CEC began to take a look at which areas might work best for offshore wind generation, off the coast of California. Staff, working with the Bureau of Ocean Energy Management staff, and supporting activities of the BOEM California Offshore Wind Task Force, started taking a more drill down approach of looking to identify these areas.

And first, we identified and then applied technical criteria, jurisdictional permitting considerations, and operational considerations to identify areas that might work.

So, here, we're talking about technical considerations such as wind speed, average wind speed greater than 7 meters per second, annual average. The depth to the ocean floor, so that we could allow for anchoring. Distance from transmission and proximity to load center, and then distance from ports to support the workforce, the construction, and the maintenance of these facilities.

And then, also, from BOEM's perspective, looking at their jurisdiction to permit, which is three miles offshore and not in marine sanctuaries. So, the first map kind of turns into this map, where we have areas on the North Coast and the South Coast to focus in on.

So, for illustrative purposes, I'll just walk

you through some of the South Coast areas. So, this is a large, large area and some of the benefits of the South Coast areas are they're closest to load center, and have available transmission, or transmission that might be available at some point in the future.

And in the North Coast, they have the highest wind speeds off the California shore, the best wind resource, and some of the best in the world.

So, within these larger areas, we looked a little -- started to dig a little deeper. And so, with BOEM's help, we did some modeling, looking closer at different and more detailed wind speed data for wind power, generating a wind power curve, and then looking at depth and distance, and coming up with a simple model that optimized for those three things.

And so, you see that black and grayish area superimposed here on the map. The darker, the better. So, within those areas there are areas that showed up as being more optimal from the technical standpoint.

And we cleaned up this area down here by also eliminating some areas too far from transmission. We also explored, using existing data, the seabed slope and the substrate type as best as possible.

Then, we took all that and looked at other constraints, again using existing information. So,

here, we looked at things like potential overlap or implications to existing uses, such as traditional ocean uses, fishing and recreation, industrial activities, existing leases, undersea cables, shipping lanes, vessel traffic, various ocean habitats, important areas for marine birds and marine mammals. And, of course, we also looked at commercial interests. And we did this for both the North and South Coast.

One trend that we did find out -- some trends we found doing this sort of look are about 20 miles offshore you consistently find a better wind resource and also, usually, lower biological conflicts. Not zero, but they get lower the farther offshore.

The same thing with commercial fishing conflicts. And also, further offshore fewer visual considerations that will need to be examined as we move forward.

Southern California and the Northern California both have constraints from DOD operations. Obviously, more so of an issue on the South Coast.

So, from this work and extensive outreach, feedback and public comments from extensive outreach to elected officials, local governments, fisherman groups, partner agencies, universities, research institutions, citizens, environmental and user groups, ocean user

groups, we took that sort of input information in, too. And BOEM selected these areas that came out in the October 2018 call.

So, you see the larger areas that were identified on the North Coast for the first time on this map, plus the Humboldt call area there in the center, in darker blue.

And the same thing on the South Coast, using the same sort of identification effort, you have the Morro Bay and then the Diablo Canyon subareas there.

So, I just wanted to quickly walk you through that and say that we -- again, it's no surprise why we're focusing on the areas that we focused on. The good news is there's opportunity to look at explore other in other areas beyond the call areas that we're currently looking at. And the other good opportunity is the call areas, based on existing information, seem to be areas that are optimized for technology purposes and will likely -- likely may be some of the areas with lower conflicts with the other uses of the ocean, and ecological concerns.

But we know there are constraints in those areas from those issues. And this work has also pointed us in to investigate where we need to fill data gaps related to identifying those constraints and how to deal with

those constraints as we move forward.

So, after lunch, you'll hear in those panels a little bit about where we're going to fill those data gaps. And thank you very much.

Our next speaker, and last speaker, Necy Sumait from Federal Bureau of Ocean Energy Management.

MS. SUMAIT: Good afternoon. It's a pleasure to be here. Thanks for the opportunity.

I was asked to confirm industry interest. And for any of us that have been together for the past three days, and you've heard it this morning, I confirm there's industry interest, so we can all go to lunch.

(Laughter)

MS. SUMAIT: But I do have a few slides. So, as Scott said, we've been working with the Energy Commission. It's been a pleasure to work with the state under the leadership of Commissioner Douglas to identify and just explore the opportunity for offshore wind offshore California, both in the North Coast and the Central Coast.

We have reached out through different interest groups, put in data in the database, and it's in a transparent manner, and we came up with three call areas that Scott described.

In the Northern area, we have what we call the

Humboldt call area. That's approximately about 206 square miles. It's roughly 21 miles offshore Eureka.

In the Central Coast, we have two call areas and that is the Morro Bay, roughly 312 square miles, and about 24 miles offshore. Cambria and the lower site is the Diablo Canyon call area and that's about 556 square miles, and about 22 miles offshore Los Osos.

So, we did issue the call for information. We received over 106 comments. And one of the things that was also useful is that we received nominations of interest. So, 14 companies expressed nominations of interest. All the names here are familiar to you. You know, there's at least two or three companies there that are also active in California, that is not even on this list, yet. So, clearly, companies are responding to the possibility for offshore wind here, in the state.

We do have a qualification process for these companies. Basically, they have to be in good standing. We look at their technical qualifications, what they've done in the past, the team they bring forward, and financial qualifications, as well. And just to make sure that, you know, everything is in order.

And, you know, we go through and at the end of the day these companies are termed legally qualified. They are assigned a BOEM number and they can participate

in a future auction.

Prior to any auction, we are also going to be able to receive other companies, who haven't been prequalified, so they can be qualified for a future auction. So, any of these companies can bid going forward. And, you know, we may see others as well.

So, this is just a snapshot of, you know, who, what, and about what kind of projects have been proposed. On the two call areas, we have two companies that expressed interest in just one of the call area, either just on the North Coast or one on the Central Coast. Three companies actually picked a particular area within the call areas. But the rest of them just, you know, will be interested in anything that is identified going forward.

The project size that was talked about ranged all the way up to 2,500 megawatts. And turbine sizes that were proposed are about 6 to 15 megawatts.

So, you know, going forward, what the next step for BOEM would be is to identify wind energy areas on which we will do a NEPA review for potentially lease issuance.

I don't really have much more. This afternoon, you'll hear from our studies group. BOEM has a very robust studies program. It's already been talked about

a little bit this morning and you'll hear a little bit more from Jeremy and, specifically, he'll highlight some of the environmental studies that we do do.

And to the extent that we can inform the state in terms of the IRP, the IEPR, and even in the ISO process, we would be certainly interested in doing that. And maybe, we can get NREL to speed up the hourly profiles, as long as it's -- so that it can be timely in any input that's received from the state.

So, with that, that is really all I have.

MR. FLINT: Thank you, Necy.

We are 11 minutes over, so I defer to the dais for next steps.

COMMISSIONER DOUGLAS: All right, we have some very quick questions, but we're hoping to wrap in six minutes or less for lunch.

A question for Sandy, for E3. To what degree did you incorporate transmission and distribution costs in the cost modeling you did?

MR. HULL: Yeah, so the models we ran incorporated NREL's costs for offshore wind and effectively that was the -- we had two cost scenarios for Castle Wind. One used the NREL costs, one used costs provided by Castle Wind. Both incorporated some generic transmission upgrades.

I think what's challenging is knowing how transmission costs would vary at different scales of build out. So, we did not get into detail on that. But we did include kind of nominal transmission costs for a gen tied to shore.

COMMISSIONER DOUGLAS: Okay.

MR. FLINT: For the transcript and folks on the WebEx, that was Sandy Hull answering. Folks, please repeat your name if you answer. Thank you.

CHAIR HOCHSCHILD: This question, I think is Alla, although I should have probably asked it at the last panel as well. It's just about the policies and incentives that are currently available to offshore wind developers and other related industries that we should be mindful of.

I mean, it's the ITC, you know accelerated depreciation. Are there, for example, the possibility of using enterprise zones in any of the assembly areas, or any other policies at the state or federal level looking ahead you think will be particularly important to sustain, or strengthen, or new policies that don't yet exist to help drive down costs?

MS. WEINSTEIN: I think if you look at how things developed in Europe and on the East Coast, in particular, probably a little bit more applicable to the

United States. What drove creation of the supply chain, what drove things to happen on the East Coast were the state targets. It's when the state set the target, things happen. Because supply chain and developers cannot just do things without knowing what the pipeline is going to be. As was demonstrated by a number of studies and, particularly, Rob mentioned the UK, turbine manufacturers will establish turbine facilities, or fabrication facilities locally, if they see the pipeline for the next ten years. That's what they need.

And the same thing would be with ports. If the ports need to be redeveloped, as we're already seeing on the East Coast, developers are investing in the ports to redevelop them, as long as they can see the pipeline.

So, it all comes together. At the same time the state, really the only thing the state did is set up the target.

Now, on the East Coast, you have states that procure energy. California does not procure energy. So, certain conditions are different. But if the state sets the target and we know what we are trying to achieve, then the industry will be able to develop a lot of capabilities.

CHAIR HOCHSCHILD: Right. No, I'm very familiar with the value of targets. But I'm saying in the solar

industry we had a target, right, but we also had a whole bunch of policies in place, you know, in terms of rate design, and rate metering, and interconnection standards, and state tax credits, and permit acceleration, the whole suite of policies that accompanied the target that were critical.

I mean, so I don't know if anyone else on the panel has any specific thoughts on that. And, certainly, folks in the panels to come this afternoon, that's a question I'm interested in. What else do we need to do to support -- whatever the state target ends up being, to support cost reduction?

COMMISSIONER DOUGLAS: So, I just had one more -- I guess, probably more of a comment. So, Scott's presentation was brief and high level. We're hoping to have more information from him, in writing, that will go through datasets, and sources, and logic model how it's put together so folks can really see that in more detail.

And, Neil, appreciated your presentation. And, you know, we do need to do some thinking together about how to understand the big picture, you know, different levels of scale, different geographies, and what does that mean on the transmission side. Because, obviously, using sort of a stock number for what transmission costs

might be isn't going to cut it, as we really get there and try to get there with our analysis.

So, you know, I don't exactly know how to do that, but I think it's definitely important to go to the next level there.

We've got one minute, let's do it. So, I think we've conferred a little bit up here. We're going to cut lunch a little bit short in order to be on time. So, if everyone could please try to be back by 1:30, we'll start up again at 1:30.

MR. FLINT: Thank you, panel members.

(Off the record at 12:44 p.m.)

(On the record at 1:39 p.m.)

MS. RAITT: Great. So, just a reminder, we are going to have public comment at the end of the day. So, if you want to make comments, you can talk to our Public Adviser, who just stepped away. But she is normally at the table right there, Rosemary.

So, we'll go ahead and get started on our third panel on the Status of Research, Data Collection, and other Initiatives to Support Environmental Analyses and Public Outreach in California.

And the Moderator is Chris Potter from the Ocean Protection Council. Thank you.

MR. CHRISTOPHER POTTER: Thank you. Good

afternoon Commissioner Douglas and Assistant Secretary Gold. Thank you for this opportunity to moderate a panel on the status of research, data collection, and other efforts to support environmental analyses and public outreach around offshore wind development in California.

Initial efforts have enabled the state, in collaboration with the Bureau of Ocean Energy Management to begin assessing tradeoffs and compatibility of offshore wind with a range of ocean uses and identify environmental issues that need to be investigated during the planning phase.

It's important to note that important environmental studies are already underway and being conducted by West Coast researchers. Funding for this research has been provided by the Bureau of Ocean Energy Management, the Ocean Protection Council, the Energy Commission and foundations. You'll learn more about these studies, momentarily.

But last, but not least, environmental NGOs and industry have begun an initiative to identify environmental research needs.

The first speaker today is Jeremy Potter, Chief of the Environmental Sciences Section at the Bureau of Ocean Energy Management's Pacific Region Office.

MR. JEREMY POTTER: Good afternoon. Are there slides? Oh. Oh, thank you.

My name is Jeremy Potter. I'm the Environmental Sciences Section Chief for the Bureau of Ocean Energy Management, in the Pacific Region. It's a pleasure to be here with you today.

And in the brief period of time that I have, I want to make sure to at least spend a bit of time hitting the priorities that both Commissioner Douglas and Executive Director Gold highlighted at the very beginning in terms of there's a universe of amazing work going on as it comes to offshore, science related to offshore wind energy. Trying to keep up with that is pretty close to impossible, but we need to do a better job of it, and we need to do a better job of coordinating future efforts.

And I can speak for BOEM to say that that is something that I'm dedicated to making happen. OPC, CEC and BOEM staff are actively talking about how to do a better job of that. If you have any recommendations on how BOEM can do a better job now or in the future, I would welcome any of your thoughts.

But jumping straight to BOEM, briefly. We categorize studies, we fund a number of scientific efforts every year. We categorize them in two different

ways. One being resource assessment, the other being environmental studies.

The resource assessment front, when Walt talked, he gave a really good description in the very beginning about resource assessment. I think, in terms of characterizing wind energy resources, also, even electrical grid constraints are types of studies that BOEM has worked to fund in conjunction with PN&O, NREL, also Humboldt State University.

But that's not the purpose of this session. This session is on the environmental studies, which is the other category of BOEM studies that we do fund. When we talk about environmental studies, we're thinking in terms of what are the data information we need to appropriately assess the potential environmental impacts of offshore energy development?

I'm going to briefly give a little bit of context about the studies program, but then dive into a couple new and emerging studies that BOEM's very excited about doing with our partners, and I think many of you would be interested in, as well.

BOEM has an annual environmental studies process. It starts in a couple weeks from now, really. It goes for about a year. It starts with reaching out to stakeholders, inviting external ideas for concerns or

study ideas that we should consider funding.

Parallel to that, our internal scientists develop ideas that we should also be considering. We consider those efforts in parallel by identifying, prioritizing, and then ultimately selecting for funding which studies we want to fund on an annual basis.

So, this week is actually a really interesting time because we are in the process of finalizing the funding for this coming year's work, but we're also just starting the idea or process of thinking about next year's work.

So, jumping to highlights of four different studies. If I did a verbal -- looked for verbal concurrence in this room of people that have a high degree of confidence in government, multiple government agencies, I'll say federal government agencies to highly effectively and efficiently coordinate activities amongst themselves across federal agencies, I don't think there would be a lot of takers.

This is an example of why you should have hope. I think this is a great example of how those groups, in conjunction with nonfederal partners can do an amazing job of doing some really big things together. It takes work. It takes time. Sure, there's problems, but you figure them out.

I will say that our biggest concerns that we hear about from stakeholders, it typically isn't deep water habitat information. Certainly, it does come up. Sensitive habitats like deep water corals, cold seeps are things that are brought up, but it's not of the top three that we always hear about. The top three being things like marine mammals, birds, fishing activities.

That said, as you've heard from several people this morning, wind --if there is wind development offshore California, it's going to be in deep water. And you need deep water habitat information to appropriately assess the potential environmental impacts.

Moreover, if you compare offshore California to areas in the Atlantic and in the Gulf of Mexico, for the most part, there are some exceptions, especially in Monterey Bay, but we do have less information about these types of habitats off the West Coast, than we do in those areas, for a variety of reasons. That said, there is a lot of good information out there. And getting additional regional information, regional contexts for where these habitats are and how they relate to each other is really important when we consider future, potential environmental impacts.

All that context is to say that in the last

three years, among three federal agencies, the Bureau of Ocean Energy Management, NOAA, and USGS, along with partners primarily at the Monterey Bay Aquarium Research Institute, we've executed 22 different cruises to do a combination of mapping and visual habitat characterization in deep water areas.

What's very exciting is next Monday a major expedition is starting underway out of Newport, Oregon, and going to work all the way south, both inside and outside national marine sanctuaries, to try to further this regional context.

The website, which just went live today, you can look at the bottom of the slide. There will be live streaming -- anybody that's following along at home, scientists, the public, can see the live video feeds going on, to see for themselves what is offshore California.

Jumping -- I've already flagged marine mammals as one of the things that we hear most about and, obviously, needs a lot of attention. One of the questions that we hear is about what is the risk associated with entanglement of marine mammals?

Okay. Now, ideally, you'd have a system or platform out there that you can go study and look historically about what information, how many marine

mammals have been entangled. That doesn't exist. So, how do you start cracking that nut as far as what is the information that you need to appropriately assess what that question is and what the risk is.

Well, we started last year with trying to actually just look visually at what this would look like, get a better sense of scale. PNNL did a visual simulation of humpback whales' perspective on wind energy farming. But that's not enough.

So, what we're starting, what we have just initiated now, in conjunction with PNNL, is actually trying to do a computer simulation of what that behavior and the interaction would be. Again, it just got started. It's not due for completion until 2023. But it is underway. It includes digitally, morphologically accurate computer models of two different species of marine mammal, as well as Leatherback Sea Turtle. Also, doing two different layouts for wind energy development and then, looking at simulating the interactions.

Two, over water migration movements of black brant. As I mentioned, birds are a big topic that always frequently come up, needs attention when it comes to environmental analyses. Why I think this is particular important is it gets back to the stakeholder issue that I mentioned at the beginning.

This was not a topic that was high on BOEM's radar to be thinking about, the black brant specifically were not. It was what we heard about through meetings with the State of California, as well as through our annual studies process. When we received that information, we started paying a lot of attention to it.

More importantly is BOEM, at least the Pacific Region, does not typically fund single-species studies. We have always, to the best of my knowledge, only funded avian studies that are multi-species. This is the first one that is prospectively single species, it's not awarded, yet. It's pending this year's fund and we don't have an appropriation. Assuming it comes, this will be a study that we are planning to fund. Which is trying to get a better sense of the migration patterns of black brant, largely because of the stakeholder concerns listed on the slides that you see in front of you.

And last, this is one that if you think about any of the slides that I present tonight, I hope you think about this one.

I admit, I am not amazingly passionate about marine mammals. I like the really deep-water stuff, right. But every once in a while, there are these projects that come up that you hear about the science,

you hear about what they're trying to do, and you hear from the scientists about their vision for what could be done. And this was one of those projects that really gets you. At least it got me.

Everybody that hears about this project gets very excited about it and sees how they could play a role in it. This is one that we need help with. It initially developed as an idea. You can read about it on the slides. But think about it in these terms that never before, that I can say, do you get both spatially and temporally robust data when it comes to marine mammal abundance and distribution. Right, you can do one or the other.

What we wanted to do was, thinking about off of Humboldt, how do you do that in a small area? How do you get them both at the same time? And drifting passive acoustics buoys are how we're -- was proposed by NOAA and some of our BOEM scientists to do it. And it was really intriguing. And it's actually, relatively low cost.

If you tried to do this across the entire California current ecosystem, there is no way that you could fund that with the traditional technologies. That being fixed moorings, aircraft visual surveys, ship-based surveys.

But if you think about drifting passive acoustic buoys, you can do that in a small area. Yes, it costs some money. But if you wanted to scale up to the entire California current ecosystem, you could actually do that with a relatively reasonable amount of funds. It's never been done before and we're trying to get there.

What BOEM is preparing to allocate funding towards is the smaller, initial effort, which is focused on Northern California. We're actively in discussion with NOAA right now. But we're looking for partners right now so that we can successfully expand that up to the entire California current ecosystem.

And I've gone over my time by one minute. I apologize. Thank you.

MR. POTTER: Thank you.

Our next speaker is Dr. Jaime Jahncke. He's the Director of the California Current Group at Point Blue Conservation Science.

DR. JAHNCKE: Hello and thank you for the invitation to be here today. I work for Point Blue Conservation Science. Our mission is to conserve wildlife and ecosystems through science, partnerships, and outreach. And for the purpose of this project, we have a collaboration that brings together, also, the Conservation Biology Institute.

What we aim to do is to use available data to identify offshore wind energy areas. And the reason for this is that during the common process to BOEM there was a large series of comments that requested a transparent and objective analysis to identify siting locations and additional research to identify key data gaps, and models that have the ability to be updated as new data comes forward to better inform you of the siting locations. And, also, the explicit presentation of uncertainty.

So, the goal of our work is to promote transparent and objective decision making around the selection of locations and types of renewable energy development.

The background for this is that there was a lot of investment from BOEM and the California Energy Commission in developing the California Offshore Wind Energy Gateway and Database. And there's a lot of information there, over 700 datasets, and they have not all been synthesized into a few products that are easy to understand. So, that's where we wanted to collaborate.

Our objectives: Identify sea level locations for renewable energy; identify data priorities and gaps, conflicts, and tradeoff with wildlife and human uses;

examine the areas that have been already identified by BOEM; and eventually suggest additional ones, and disseminate these results widely to managers, to industry and to stakeholders.

Our approach is like, basically, to bring all the data back into Point Blue servers to conduct a data search simply to understand, you know, what are the critical datasets that needs to be included, what are the vulnerabilities, what are the risks. Assess the quality of the data, bring it back up to date and put together an optimization analysis.

For this, we will be partnering closely with the Conservation Biology Institute that is working on additional models using that logic framework for this, that will bring in some stakeholder input as part of the assessment. This will help us with our prioritization but provide a sensitivity and evaluate for our analysis. And we'll have a series of products that I will describe in a bit.

I guess most of you are familiar with this graph that was also shown by Scott a little bit ago. This provides a landscape of the offshorewind resource along the West Coast of California. Then, they separated the areas that are not available because they are protected or because they have busy shipping traffic in it and

suggested a bunch of polygons where potential development could happen.

But before, I saw the slides earlier today from Scott, I have not seen and others have not seen wildlife and human use data being considered in this analysis. So, that's where we come in. There is a lot of concern about deep sea habitat, as were mentioned early on, for fish and migrating fish species, sea birds, whales, the multiple human uses that occur along the coast, and coastal resources.

And so, we will be getting together with the stakeholder community to identify which are the key science-based datasets that are critical for this analysis, working with them to figure out what are the vulnerabilities that we are talking about, and what are the risks to each one of the species and habitats, and then bring those together into the models.

The deliverables will be a new, large-scale analysis that shows -- it's a map that shows locations where you can maximize energy production and you will minimize potential impacts with wildlife and humans. And then, a series of fine-scale analysis where we will go into detail about the data availability within the selected areas, or the core areas. Looking at the data types, quality, resolution, the extent of the series,

and trying to identify the gaps for that particular location.

We believe that the outcome of this work will be recommendations on offshore energy siting that are guided by and based on a comprehensive analysis of all the data you guys have collected over the last three years. Our analysis would include a quantification of impacts to habitat, species, and ocean uses. We'll account for the energy potential in a rigorous way from the perspective of multiple stakeholders. And we will try to provide a measure of uncertainty so that you guys know the different risks that you are taking by making different decisions.

This work is funded by the Ocean Protection Council and we appreciate that. Thank you.

MR. CHRIS POTTER: Thank you, Jaime.

Our next speaker is Garry George. He's the Clean Energy Director with the National Audubon Society.

MR. GEORGE: Hi. And I think I'll just give my presentation from here, if that's okay. I don't have a PowerPoint and that will be faster.

I want to thank the Ocean Protection Council, the Energy Commission and the CPUC for inviting Audubon here today. As you know, we're a hundred-year old organization. Our mission is to protect birds and the

places that birds and people need now and in the future. We're local everywhere in North America, especially in California, where we have 49 chapters, three state offices, and about 75,000 members and supporters.

And we wanted to call your attention to our climate report of 2015, which revealed that 314 North American species of birds are seriously threatened with losing their climate suitability of their breeding and wintering ranges. Depending on how we do with our emission reductions, and that some may go extinct by 2080 because of climate. So, we have a hundred-percent clean, carbon-free energy future to meet emissions goals to protect those birds and that's a conservation outcome for us.

We've been working on offshore wind probably since 2016, since the first kickoff in Morro Bay, with our NGO colleagues. We've been asking, and asking, and asking for data gap analysis, more data, more data collection, et cetera. And I just wanted to say that I want to thank the Ocean Protection Council, and BOEM for the great research that they're doing in response to that. It's fantastic to see, three years later, that we're actually kicking it off.

And, you know, this is very impressive for us. The brant study is new to me. That's fantastic. Thank

you. We've been concerned about that.

So, there is one major priority for Audubon and that is that there is no verified technology to actually monitor what happens to birds offshore in California or, actually, in the East Coast as well. And so, we think that's a priority for developing those new technologies.

And I want to just acknowledge that the Department of Energy just gave $2.3 million in grants for those kinds of technologies. And I would suggest that in any way that the agencies can also provide some support for that, for the development of these new technologies. And if the developers of the energy can do that now, before those machines go into the waters, I think that would be really, really helpful and we consider it a priority. I don't know how you can address impacts or do adaptive management if you don't know what's happening. So, that's a priority for us.

We'd also like to say that the BOEM Call Areas were really identified around commercial interest. And so, we never really had, and the state had to respond to that. So, we never really had a state-driven, stakeholder-driven, data-driven analysis of the California offshore waters for areas to avoid, other than a quick analysis that Scott did, that was very good.

And so, we think that maybe included in the IEPR could be a consideration of a long-term evaluation of the role of offshore wind energy and, also, maybe a process to actually create what I would consider to be least conflict areas. To help the industry avoid those areas and also identify where transmission might be more -- to just get ahead of the BOEM process a little bit and to maybe interject some of our own California values and the protection of our natural and marine resources that we love so much.

So, in summary, the research and data collection is very, very important to us and we prioritize that. We participate and collaborate with the industry often, nationally with some of the biggest generators in the United States, in the American Wind and Wildlife Institute, where we've been able to facilitate millions of dollars in research that will help them avoid and minimize impacts to our birds.

We don't know how to build a wind project and they don't necessarily know how to conserve birds. So, this info sharing relationship is really, really key. And it's done very well.

We've also been a participant, for four years, in the Avian Solar Working Group, which is resolving conflicts with birds and PV solar.

And we've just started a California Offshore Wind Working Group, and I'm going to turn it over to my colleague, Tyler Studds, from EDPR, to talk about where we are today.

MR. STUDDS: Thanks, Garry. Did somebody leave a phone up here? Okay. All right.

MR. CHRIS POTTER: So, for the record, Tyler is with EDP Renewables. He's a Project Development Manager there.

MR. STUDDS: Good afternoon and thank you very much for this opportunity to present to the Commission. I'm going to be presenting on behalf of an emerging working group, of this collaboration between offshore wind developers, NGOs, with support from the UC Berkeley Center for Law, Energy and the Environment.

Our objective is to advance responsible development of offshore wind using best available science to ensure that offshore wind is developed responsibly and in a manner that mitigates or avoids impacts to California's unique coastal environment and resources.

I'm going to talk about the basis and need for this work, how we propose to go about it and what sort of results we'll produce. A general timeline that we plan to produce those results and provide some

recommendations on how to advance this important work.

It has been repeated often here, and throughout this week, and it bears repeating again that climate change is a severe threat. And that we believe that it's absolutely urgent to decarbonize California's electricity system as soon as possible. And that we believe that offshore wind can provide a significant role in a diverse energy portfolio required to fulfill the mandate of SB 100.

Offshore wind is a proven technology that's been demonstrated around the world and it's new to California's unique marine ecosystem.

At the scale that we as an industry are proposing and that we believe offshore wind is needed, we also need to propose a similar plan of scope and scale to enable and ensure that that development happens in a responsible way.

So, in order to kind of set the stage to inform the basis for this, I want to first highlight the existing regulatory framework within which offshore wind projects develop and that site-specific data is collected and analyzed under the regulatory process.

There's three points that I want to emphasize here. Number one, as I had mentioned that each individual project is required to gather site-specific

data for a period of up to three -- you know, at least three years, that inform a NEPA and CEQA analysis. That data collection continues during construction, to monitor construction activities, often with protected species observers to ensure that vessels do not impact marine mammals. And then, that monitoring continues through operations for permit compliance.

Number two, want to emphasize the timing at which that data collection begins, which is post-lease. And just for reference on this timeline, the first starting point here is actually with area identification. Which, as you heard from BOEM earlier, would be the next step in the process. So, that data collection begins after a lease acquisition and after approval of a site assessment plan by BOEM.

The third point here is that, and this has been a frequent critique of this process, is that the data that is being collected by each project is not typically made available until submission of a construction operation plan.

So, again, this is a rigorous, defined data collection that's associated with a specific project and a specific location. It's sufficient, we believe, or it's necessary, we believe, associated for specific projects, but definitely not sufficient to identify and

assess potential impacts associated with the scale of development that we're proposing.

So, therefore, we're proposing to conduct a broader framework approach that helps to identify and guide specific data and research questions associated with each development time frame. There's a couple different benefits to doing this approach.

Number one it helps, as I mentioned, to identify the specific information and data needs at each development phase.

Number two, it allows an integrated approach and a holistic approach that envisions data collection needs that flow into the next phase. For example, specific research questions that get conducted on an operating project will require and be enabled by baseline data and wildlife surveys that will be identified by needs for desktop studies.

So, for example, the work that we're proposing to do, which I'll describe further later, to jointly identify and scope key research questions, that's work that we do now, but that gets conducted in the future in an operating project. The benefit of taking this holistic approach is that we are then able to understand the baseline data collection that's needed in order to best help those studies to be successful.

So, in particular, baseline data is particularly important in order to distinguish the changes that are happening and we're seeing in an ocean ecosystem as a result of climate change, and to be able to distinguish those changes from any potential changes associated with offshore wind development.

The third aspect, too, I want to highlight is that this framework takes into consideration what funding sources are available at each stage. In particular, developers will be more likely and interested to fund research after a lease acquisition and then during project operations, as well.

So, again, the key points here is this holistic framework approach allows us to really identify specific data and information needs along the way, as we're proposing to develop this resource at scale. It enables us to ask a specific set of questions that are different than are asked and answered associating with a specific project permitting process.

For example, the questions we're asking underneath this framework will be population level, regional focus long term. It's a different set of questions and in order to design studies to specifically answer those and measure affects, it requires a very focused effort and consideration of the data needs

throughout the entire project lifecycle.

So, in order to implement this work, we're proposing to conduct a series of stakeholder workshops based on the models that have been proven, including the AB and Solar Working group, to jointly identify and scope key research questions and design studies to execute those.

As I mentioned previously, this is an effort (indiscernible) by offshore marine developers and NGOs. In order to advance this important work, we have a number of recommendations, which include strong funding support from the state, including appropriate agency staff participating in an advisory capacity to ensure that we're coordinated. And also, pursuing funding opportunities through cooperative agreements with the Bureau of Ocean Energy Management. This approach has been used in the East Coast states to leverage, you know, millions of dollars for such research.

And lastly, we propose to come and brief agencies on this within a month to provide a more detailed plan on how we propose to move this work together.

And for reference, on the benefits and outcomes that we're looking for, refer you to the Massachusetts Marine Mammal Science framework, which was published in

May 2009, and is available on the BOEM website.

So, thank you very, very much for this opportunity to present this important work and look forward to discussing it with you further at a later date.

MR. CHRIS POTTER: Thank you, Tyler.

Our next speaker is Dr. Carrie Pomeroy. She is with the California Sea Grant. She's an extension specialist.

DR. POMEROY: Well, good afternoon and thank you very much for the opportunity to speak to you this afternoon. As Chris mentioned, I am an Extension Specialist with the California Sea Grant Program, based at University of California, San Diego. I'm also a research social scientist with the Institute of Marine Sciences at UC Santa Cruz.

I conduct research, education and outreach related to coastal and marine activities, with a particular focus on the human dimensions of fisheries, fishing communities, other coastal and marine space users, and associated marine policy.

I've conducted research on offshore renewable energy development, potential space use conflicts and challenges in connection with proposed offshore wave energy development several years ago, over a decade ago,

or about a decade ago. And have served on the BOEM/Energy Commission Data Science Core Group, discussing information needs and opportunities associated with fishery activity.

I also serve on the National Academy of Sciences Committee on Offshore Science and Assessment, which is advisory to BOEM it its science programs.

And, finally, I'm a member of the Ocean Protection Council's Science Advisory Team.

So, I'm going through that long litany to help you understand and to lay out my background in the social sciences and its application to coastal and marine decision making.

I've been asked to briefly address information needs and considerations related to fisheries' research and outreach for potential offshore wind development. And I'm happy to be able to touch on that in a very general sense today.

There has been work done in California and elsewhere that it can certainly inform the decision-making efforts going forward with offshore wind development in California.

There are, of course, both statutory considerations that are associated with human dimensions, if you will, information needs,

understanding social, cultural and economic dimensions of things, and the impacts of offshore wind development or other changes to the human ecological system.

There are also some very practical considerations. So, one of those is that the ocean is a big place. It's also a very busy one. Multiple complex and dynamic uses at sea, and onshore, and critical connections between those. All of these activities are shaped by environmental, social, economic and regulatory factors. And these are all playing out at different scales and with different scope.

There are, of course, potential synergies, compatibilities and, as you all know, conflicts associated with trying to coordinate these use activities. And the realm of fisheries, of course, has been a highlighted topic of discussion.

So, there's really a diversity of space use practices, patterns and needs associated with all of these different space uses. And this is a very general representation here and I know I've left off lots of critical things. But I'm trying to make the point here that we have a number of uses that are, essentially, permanently fixed in ocean space. And you can think about, typically, that being the case with aquaculture, ocean energy, seafloor cables, et cetera. Although,

there is transit between those facilities and shoreside facilities in order to provide service and so on.

And then, when we think about other types of ocean uses and zeroing on fisheries, as that's my charge right now, we have a range of activities from the stationary, not fixed permanently in space, but maybe temporarily fixed in space. Fisheries, such as trap fisheries, set long lines, set gill net, and so on.

And then, we move along a continuum to more mobile fisheries, ultimately ending up with things like salmon and albacore trawl fisheries, which are very active as you get further offshore, as well as closer to shore, and are moving around a bunch.

So, understanding the nature of that space use is actually sort of front and center in thinking about siting a new use. The other part of it is that if you're wearing the lenses of a fixed space user, you may not fully understand or appreciate the needs of a mobile space user, and vice-versa.

So, the other thing I want to point out here, also, is that fishery space use is highly contingent, even within these broad categories that I've outlined. There are a number of different factors that influence where, when and how people participate in fisheries. And we have commercial, recreational and subsistence

fisheries active in our waters off California, whether they're state waters or federal waters.

And often, that jurisdiction is important for rulemaking and those purposes. But when you're following the fish that distinction sort of gets a little blurry.

But there are a number of things that influence where, when and how people fish. It's everything from the individual preferences and skills, the vessel, the gear, the purpose in fishing, to the regulatory constraints or opportunities that may be laid out, that may tell you, yeah, you can fish here and you can fish at this time, but you can't fish there and you can't fish at that time.

And these things are, of course, always varying and changing. Rules change, but so do environmental conditions. And we've seen that especially lately, for example, with the blob, the blobino, which has the fundamental warming of our ocean environment led to elevated levels of DA toxins in certain species and led to some closures. And, ultimately, when the fisheries reopened, some undesirable interactions with marine mammals. And so, this whole series of events.

So, stepping back a little bit from that and thinking about, well, okay, so what kinds of information

are really important for understanding and informing these decision-making processes and keeping track of things over the long term? And when decision making involves both state and federal processes, we have, of course, CEQA in California, we have NEPA for the feds, and we have all of the other policies that govern what people do.

So, late last year I completed a project with Department of Fish and Wildlife staff, with support from the Ocean Protection Council, and the Resources Legacy Fund, where we were helping to build socioeconomic guidance for -- to inform the development of fishery management planning and assessment of that work.

And, historically, folks have looked at information about demographics, employment, expenditures, revenues, and something called resource demand, which is all very important information from an assessment and impact assessment perspective. But there are many other types of information that underlie that and that, actually, in some ways go beyond or are just fundamentally different from that in understanding how people use ocean space. What they value. What they need. And how they might be affected by change.

And so, we expanded to include a set of what we call the socioeconomic essential fishery information to

be more inclusive of things like operations, and practices, values, preferences, needs, attitudes, opinions, and beliefs, and so on. And all of these things that influence what people do, but also mediate the impacts of any change and what people can and cannot do in the ocean and in coastal areas, where there is support infrastructure, and so on. And the implications, also, for their communities.

When we developed this guidance, we also urged a look or outlined a look, really, at not only fishery participants themselves, the people who are on the water, but other parts of the fisheries' social ecological system, or social system in particular, to include shoreside providers of goods, and services. And infrastructure, and the communities themselves, which may have a lot more going on besides fishing, but this is maybe a very critical part or at least a part of their identity and livelihood.

Just to give you a quick example. And this is way out of date, but I kind of did that on purpose because I didn't want to get embroiled in very recent events, particularly. But we've done this in a number of fishery contexts, where we have taken a diversity of sources of information, both the data that may already be collected by the State Department of Fish and

Wildlife, for example, for the commercial fisheries, the fish ticket data, as they call it, that tells us how much fish was landed. In this case, this is for the squid purse seine fishery in the Santa Barbara Channel.

But here you see a chart and you're looking at that, and it's like great, what in the heck is going on there. Right. But then, we spend some time looking into existing information from other sources, and we talk to fishermen and others, and they help us understand what's going on.

And so, it's about bringing together these different types of information and ground-truthing with people who know things well.

So, to sum up, I'd like to just highlight the critical importance and interdependencies between research and outreach. There is a difference among data information and understanding. You start with data. The goal is to get to understanding. But it takes a lot to do that and you need to engage a lot of sources, people, who sit in different positions in a research context in order to build that understanding. Interpret that information. Vet it. Make sure is passes the test. Right.

And fishermen's knowledge is a really important part of that for understanding on-the-water implications

of change and for thinking about their connections back to the coast.

So, for outreach, engaging with fishery participants to build and interpret information, identify common interests and needs, facilitate coordination and minimize conflict, and enable this kind of thing, this new use if you will, to become part of that seascape effectively, and great benefit, it's worth making the reach and engaging folks. Thank you.

MR. CHRIS POTTER: Thank you, Carrie.

Our next speaker is Dr. Sharon Kramer. She is a principal with H.T. Harvey & Associates.

DR. KRAMER: Thank you for having me here and thank you, Chris, for this opportunity. I'm going to just start by saying I'm going to build on a presentation that was given earlier by Mark Severy. I'm part of the team working on this Offshore Wind Feasibility Study that's underway at Humboldt State. I'll touch on that in a moment.

But I wanted to say the context for my viewpoint really comes from working for 12 years, now, in marine renewable energy, more specifically tidal and wave energy projects. And I've been on several teams' permitting projects, starting in 2008 for Reedsport's OPT Wave Energy Project 2. Right now, finishing up;

getting close to finishing up permitting, Oregon State University's PacWave South Wave Energy Test site. So, I've worn up some bolts on the ground getting projects permitted, so that's my starting point.

You've seen this slide before. This is just to acknowledge this project I want to talk about today, which is the Offshore Wind Feasibility Study. And again, the project funders as you can see, and Humboldt State leading us as a partner. The main partner, Schatz Energy Research Center. And then, all the other partner teams.

And more specifically, and you've seen this slide, too, from Mark. Mark talked earlier today about these topics and he focused on talking about the resource assessment and the grid compatibility.

Our role in the team project is to focus on the environmental impacts and also on the subsea cable environmental, which I won't really touch on today, but really to focus on the environmental impact piece.

So, we're approaching this from a regulatory framework. In other words, what animals are there? What species are there in an area that you want to look at? What are their habitats and how are the various lifecycle stages using those habitats? And, so, are they temporarily there? Are they migrating through? Do

they rely on using those habitats for their whole life history?

And then, focusing as we move forward on what the potential impacts, then, are of the various scenarios that Mark touched on today, earlier, including project construction, port infrastructure, operations and maintenance of a wind energy project off Humboldt.

And again, I'm trying to focus our analysis and our assessment on how do we satisfy permitting requirements? Can we provide enough information to get this started, this dialogue?

And what we're on right now is the left side of the environmental baseline and we're just completing the baseline assessment and, then, we'll move into the impacts as the scenarios are being developed and we get the port infrastructure information.

So, I'm not going to go through this litany of different permits. Obviously, there's a lot of them. These are focusing primarily on the environmental permits. Our goal really is going to be, to be able to provide enough information to kick off these baseline assessment and analysis for some of these permits. So, it's not going to be a complete record of entire great site-specific information, but we'll have a lot of information that I think will be very useful for moving

forward with the permitting process. So, again, we're hanging it on the regulatory considerations.

Again, you've seen this from Mark. We're looking at the offshore call area off Humboldt. We have to look at the cable route from the offshore area to land. We have to look at the cable landing, which is not all that straight forward, either. How does the cable come to shore? What's involved in getting the cable to shore.

The port infrastructure changes that need to be made. How much new infrastructure? How can we update or improve existing infrastructure?

And then, not to minimize the impacts of terrestrial cables, that has been brought up earlier, but that is a huge issue for the large build-out scenario. As this illustrates, there are east/west and north/south cable upgrades that are going to need to be made. Terrestrial transmission upgrades. And they're significant and not to be taken lightly.

So, even though our main focus is oftentimes focused on the wind project offshore, the terrestrial component is not trivial.

And then, we just got under contract to do the hypothetical DC cable going south, subsea cable. So, we haven't started that process, yet.

But again, this is sort of the world we're looking at. There's facets to the project that have different impacts.

So, let's look at the offshore piece, first. Bathymetry is really important. And not only the bathymetry because that defines, often times, the habitats that species use, but what is the geology of those habitats? Is it rocky? Is it soft sediment? Because you're going to have, in fact, very different organisms depending on the type of substrate.

Again, we're looking at three different size scenarios, so that's going to obviously have a big impact on how we analyze these effects.

And then, construction details not to be minimized, either. When does the cable get laid? How long does it take for the cable to get laid? How long does it take to build out a wind project? If it's 5 turbines, 15 turbines, a hundred and something turbines that scaling and that timing is going to have a much greater impact. So, those all have to be considered.

And again, what the type of disturbance is going to be. If you're laying cable, are you burying it? Are you plowing it? Are you laying it on the surface? So, all of these impacts, again, we can't get at the super small scale, but we are definitely going to be looking

at all of those tradeoffs.

And then, back to my wave energy bias. This is a very old slide, provided by OSU. But it's still -- there are a lot of crossovers between the wave energy world and the wind. The one that doesn't obviously cross over is the turbine, itself, the blades. But we certainly are going to be looking at these types of interactions between animals and the blades, animals and the structure in the water, whether there's collision or displacement. And again, effects on the habitat, whether it's on the benthos itself, by putting structure, anchors on the benthos, or structure in the water. So, some organisms are very attracted to structure in the water. Some are not.

What are the acoustic impacts? Electromagnetic fields, associated with the cables, and cabling, inter-array cables. Lighting for navigation and other purposes.

Fishing, which another group of HSU faculty looking at the fishing side of it. And then, contaminants.

And so, we're looking at most of these issues with respect to what we've learned from Europe, what we have learned from Oregon, and Washington, and other projects that are ahead of us, and trying to apply that

information to the best that we can.

And that's all I wanted to mention about that. Again, Mark mentioned that our reports will be coming out in spring. And so, like I say, right now we're focusing on the environmental baseline and moving forward from that. So, hopefully, we'll have a nice, complete project by summer. Thanks.

MR. CHRIS POTTER: Thank you, Sharon.

Our final speaker for this panel is Lane Johnston. She's a Programs Manager with the Responsible Ocean Development Alliance.

MS. JOHNSTON: Hi and thank you for having me. I'm very glad that Dr. Pomeroy went before me because she kind of set the stage for some of the things that I'm going to touch on.

So, the Responsible Offshore Development Alliance is a nonprofit, membership-based organization of fishing industry associations, companies that are all interested in proving compatibility of new, offshore development with commercial fishing.

So, we represent over 150 different individual members from Maine to North Carolina, and also have association members and different shoreside businesses, dealers. So, we have probably over a thousand different people who are working with us and that we represent.

And, recently, we actually had a West Coast member join, so we're slowly coming this way.

So, we use science and policy approaches to directly collaborate with regulatory agencies, offshore developers, scientists all to minimize conflicts between fishing and offshore development. So, this means we work closely with BOEM, NMFS, Fisheries Management Councils, U.S. Coast Guard, and state agencies. And have also just developed strong collaborate relationships with offshore wind companies.

So, I just wanted to put this slide up. U.S. fisheries are some of the most sustainable in the world. They're heavily regulated and studied. And for decades, fishermen have had to adjust their practices as regulators understand our oceans better and as environmental conditions fluctuate.

So, the most recent comprehensive report that I'm referencing here is from 2017. So, I want everybody to keep that in mind when we think about how long it takes for adequate data to become available.

As a result of being directly affected by these frequent management changes, which can make it difficult to plan or invest for multi-year business decisions, many fishermen I have met, have had the sentiment of fighting an uphill battle. Often, they have to be on

the defensive to protect their livelihoods.

Fishermen know how management and regulatory processes for changing fishery management plans. They know how and when to provide public comment, who the players are, and the duration of the process. So, management plan amendments take five or more years to develop, analyze and implement.

With wind energy stakeholders rapidly becoming a new player in the marine and coastal environment, fishermen are very concerned about the consequences these development projects will have. Some of the biggest fears we hear from the industry revolve around the unknowns, and lack of information about wind energy impacts to fish biology, behavior, fishing efforts, habitat, and interactions with protected species, such as whales and seabirds.

There are definitely lessons to be learned from the UK, from Europe, and probably soon the East Coast. But it's necessary to understand that there's a scalability issue. As technology continues to improve, not only are you talking about bigger turbines than ever, but rapidly are implementing large wind energy areas.

But we're also talking about different sized fishing industries, with different gears and different

community structures.

In 2017, landings from the U.S. commercial fishing and seafood industry was valued at $5.4 billion. Landings on the Atlantic Coast was just under $2 billion. And for reference, the Pacific Coast, not including Alaska, landing were valued at $670 million. These values continue to increase, tracking a similar upward trend in number of stocks that are rebuilt due to strong management structures I have mentioned earlier.

So, not only are we talking about a profitable industry, but also fishing employs and supports many individuals in coastal communities.

Our hope is that the introduction of and the excitement around a new industry does not come at the cost of an existing one.

A question was posed earlier this week, asking a fisherman if he liked anything about offshore wind. And so, I'm going to give you my answer. It depends on who you ask. But mostly, fishermen want to keep fishing.

We have a wide coalition of fishing businesses that we represent. We know that some of our members may want to pursue different avenues than others. Some may want disruption payments. Some maybe want to work as support vessels for the wind energy areas. And some will want nothing to do with wind farms.

But all of our members want to minimize any negative impacts to their ability to fish, to their livelihoods, and to the marine environment itself.

Different from what we're seeing on the East Coast because offshore wind will be floating turbines. For commercial fishermen, these areas here will become de facto closures, especially for fleets that are using mobile gear.

So, the short answer to the question earlier this week; it's complicated and it depends on who you ask.

There are three things I want to leave you with when we start to think about fisheries and offshore wind coexistence.

It must be recognized that we're working in a data-poor arena. Both here and on the East Coast, data from landings do not provide high enough spatial resolution to sufficiently assess the fishing displacement that we might see from wind energy areas.

Future assessments need to look beyond VMS and AIS data which, from my understanding, is even more limited on the West Coast than what we see on the East Coast.

Since, it's never been done before, these studies will take a lot of time and need to start as

soon as possible in order to have any planning value.

Also, or secondly, engagement needs to happen early, often and inclusively. RODA was formed out of the need for Atlantic fishermen to provide a unified voice to engage with federal agencies and developers, as well as help get information from those bodies back to the fishermen. Whether it be RODA, or another similar group, we have found a strength in numbers approach is really the only way we can get significant traction to bring fishing interests to the forefront of the offshore wind conversation.

Furthermore, these efforts need to be driven by trusted fishing industry representatives, not specific fishermen that developers or regulators prefer to work with.

So, RODA has signed a 10-year memorandum of understanding with BOEM and NMFS and this memorandum of understanding is to collaborate on science and the process of offshore wind energy development.

Currently, we are working with both agencies to ensure that local and regional fishing interests and concerns are involved early and often throughout the offshore wind development process.

RODA has also formed the Joint Industry Task Force with fishing representatives, as well as lease-

holding developers, which are all on the East Coast right now, to explore a purchase-to-project siting design and operations.

Our collective hope is that through providing a transparent process and speaking directly to each other, we'll be able to plan better, minimize future conflicts, and come up with creative solutions to ensure the sustainability of both industries.

And lastly, I just want to briefly introduce ROSA. So, ROSA is the Responsible Offshore Science Alliance, and RODA is a founding member of this new organization, along with a number of developers that are active on the East Coast, and federal and state agencies.

So, ROSA is an independent, science-focused organization dedicated to providing for and advancing regional research and monitoring of fisheries and offshore wind interactions in federal waters.

ROSA has received expressions of support from NMFS, BOEM, five offshore wind energy lease holders, and several state agencies. This new nonprofit is just getting up and running, but the framework is available for anybody who's interested.

So, as a native Californian myself, in fact I'm from San Francisco. It's really exciting to be home. I

hope to stay involved with the development process here on this coast. And RODA's happy to be a resource for fishermen, developers, regulators, and pretty much anybody who's interested. So, thank you for having me.

MR. CHRIS POTTER: Thank you, Lane. I think that's our last speaker and that leaves us with about ten minutes remaining of the time allotted to this panel. I'll leave it to Commissioner Douglas and Assistant Secretary Gold to pose some questions.

MR. GOLD: Okay. I think, since we're talking about environmental impacts, rather than about siting questions, I can actually hang with this group a little bit better.

So, one of the things that I was curious about, and thank you all for your presentations, is that there were a lot of really great questions posed and there were a lot of recommendations on the sorts of data that are absolutely critical before making any sort of final decision. But I was just wondering, since we didn't -- not surprisingly, we didn't hear much of that from the morning panels, about the European experience. Since they are, you know, quite a few years ahead of us here in doing floating offshore wind, perhaps in deeper water, maybe not as deep as what we're talking about here, what can any of you tell me about the impacts that

we've seen on seabirds, the impacts that we've seen on cetaceans, from other marine mammals, those sorts of things? I think it would just be very helpful because, believe me, the sensitivity is, obviously, to conserve those species and not have any impacts. But it would really be helpful to know what we've seen in the years that these other developments have been in place.

MR. GEORGE: I can address that for seabirds. And that is that the abundance and the difference of the many species that are in the North Atlantic are not comparable to what's here in California. It's a more robust bunch of species.

And there has not been effective monitoring systems in Europe, as well. Much of what they do there is based on models, where they predict what the impacts might be, and then they let it maybe go at that.

There are some monitoring techniques that they are developing in Denmark and Scotland. And the State of California has an MOU with Denmark and Scotland, and I would suggest that we have a special workshop or spend some time talking to them, and finding out exactly, and the UK, exactly what the story is over there.

The only project that I know that was really monitored was by ORJIP in the UK, and they only monitored during the day, so it didn't address night.

So, I think there's gaps here and these are the kinds of gaps that Audubon would like to close.

MR. GOLD: So, that would explain, Garry, why I didn't really hear about that since this point.

You also brought up the idea of bird monitoring offshore, which is something that I have been very concerned about, myself. Do you have any ideas on how one would go about doing that? You said there was an investment in resources --

MR. GEORGE: Yes.

MR. GOLD: -- but not what they were investing in.

MR. GEORGE: Using different technologies and a mix of technologies, video, thermal imaging, there's sensors they can put on the actual turbine blades that are sensed when something hits a turbine blade. That's for collisions, right.

MR. GOLD: Right.

MR. GEORGE: Displacement's a little bit different because you have to have a baseline and then you have to compare what happens and watch those birds and see how far they move away from, or if they have to change their flight behavior.

So, there are a lot of great systems that I'll point to you. To the IdentiFlight system, which was

developed through AWWI, which is an eagle detection and avoidance system, which is working to reduce the take of golden eagles, for instance, on a couple of projects in Wyoming, and is being tested on some projects for condors here, in California, that can detect and, using AI, can actually identify quickly where a species is. And using a smart curtailment software can turn off the turbines exactly the amount of time for that bird to pass through that farm and not be harmed. And, also, so that the project doesn't lose that energy amount is a very smart curtailment.

So, those technologies are moving forward. They just need to move, in my opinion, a little farther, and there needs to be more investment in it.

The Department of Energy, I think, is giving a presentation later, and I think they're going to talk a little bit more about what they're doing. And I think the state could also play a role here. That's, for me, the most critical part, especially at night, through radar.

MR. GOLD: But the other part, Garry, what I was wondering is because we are talking about offshore, and it's not an area --

MR. GEORGE: Right.

MR. GOLD: -- that, you know, people are out

there studying 24-7-365 to look at seasonal variation, seeing how that changes over time, climate impacts. You know, changes in the California current, et cetera.

MR. GEORGE: Right.

MR. GOLD: What about getting a good baseline, just from the standpoint of what populations are there, what's at risk in any given time? I think I've run into you and talked about ashy storm-petrels as being of concern.

MR. GEORGE: Yeah.

MR. GOLD: So, I mean, it's great once you build that you put in a monitoring system. But from the standpoint of really understanding potential impacts, you've got to know what's there, now, and how it changes over time.

MR. GEORGE: And that's data collection. And that's the great thing about what -- the California Energy Commission set up that California Portal --

MR. GOLD: Yeah.

MR. GEORGE: -- on the Conservation Biology Institute website, still there. So, we have all those data layers and so, Jaime's going to go through them and look at where the data gaps are, especially on some of the species. We put a lot of species data in. The Fish and Wildlife Service did, the California Department did.

So, we should be able to begin to look at where the gaps are in that baseline, and then start to develop that baseline. And that's why we've been calling for that baseline to be developed now, before, and to help the developers, so that by the time they actually get a lease, there's actually some data that they could begin to rely on. And, that we can have some sort of planning process that will show that data, and California can provide some recommendations on priorities for protections for our ocean, beyond just protected areas that are legally protected. Does that make sense?

MR. GOLD: Yeah. No, it does make sense. So, obviously, other than birds, like have we seen fisheries impacts, and where we have offshore wind in Europe, is something that you want to inform us about or --

MS. JOHNSTON: Sure. Yeah, I tried to get to that. There have been studies, definitely, and we can definitely learn from what's been done elsewhere. But from my understanding, the U.S. fishing fleet is a different scale than some of the European ones, so we're kind of talking about impacts that might be unheard of here, than what they've experienced already.

MR. GOLD: Okay. Yeah. No, I'm sure it wasn't perfect info, but just trying to get something, yeah.

Yeah? Carrie?

MS. POMEROY: Yeah. Carrie Pomeroy with California Sea Grant. Yeah, and then as part of that now-long-ago-BOEM-funded project on identifying potential space use conflicts and mitigation for offshore energy development, and it was focused on the idea of wave energy development, there was an extensive literature review that was done that included tapping into what was understood at that time.

And I'm not immersed in that at this time. But it's worth going back to that. The nature of fisheries and their management is quite different in the EU, and in the larger European region. But there are some things to be drawn from that, so it's worth revisiting that information, and seeing what more has come of it as well.

There have been changes in offshore energy production facilities, and such, since that time as well which, in turn, have implications for other space uses and so on.

MR. GOLD: All right, thank you.

MS. POMEROY: Thank you.

MR. GOLD: Did you have something, Sharon?

MS. KRAMER: Yeah, this is Sharon Kramer. I just wanted to add that there are -- we did some work for BOEM and DOE on looking at surrogate structures on

the West Coast. So, what we could learn from oil and gas, what we could learn from discarded cargo, all kinds of things. And we actually did a whole series of guided discussions with people that have done of ROB and video work. That was not the question they were asking was, you know, novel structure and how do critters use it? They were looking at what are the habitat relationships?

But they oftentimes ran into novel structure and they were able to communicate to us the kind of species aggregations.

And so, from that, we were able to kind of make a leap forward, if you will, about what kinds of fish associations we might expect with novel offshore structure.

And so, it's not the European case, but we do have surrogates on the West Coast that we can draw from, as well.

MR. GOLD: All right, thank you.

COMMISSIONER DOUGLAS: So, I'll just, you know, say one of the things that we did at the Energy Commission, as we saw offshore wind moving forward, at least in terms of our own attention and planning was reflect back on the experience of the solar industry coming to scale here, in California.

And, you know, there had been some of these

larger projects in Europe and other places, and presumably they had, you know, done environmental review, and had some mitigation measures in place, or some level of monitoring. But we really weren't able to bring that information into our processes in any useful way. And so, by the time we were in permitting, it wasn't terribly easy to learn from experiences in other places.

And so, that's one reason why we pursued the MOUs with Scotland and Denmark. And I'm hopeful that we will be able to benefit from that experience, but it is a very different environmental setting. It's the North Sea --

MR. GOLD: Right.

COMMISSIONER DOUGLAS: -- you know, and our Pacific Ocean, it is very different. I'm sure there are things we can learn and bring across, but it really required us, I think, to be at a higher level of understanding of our own needs before we were really even able to start doing the review and kind of understanding what might make the most sense. So, we may be at a good point to kind of really pick that up again.

And I just wanted to, maybe more comment, briefly, on a couple of things I heard. You know,

Garry's point that we collected a lot of data, I think that we used that data to the extent we could to inform the call areas, working in very close coordination with BOEM. But we did not have the level of analyses that Point Blue, in partnership with CBI, is doing now to synthesize the data and try to draw some high-level conclusions.

MR. GOLD: But it's still based on existing data.

COMMISSIONER DOUGLAS: It is based on existing data.

MR. GOLD: Right, so I'm sure they're going to identify some pretty significant gaps along the way.

COMMISSIONER DOUGLAS: Yes. I would expect them to.

MR. GOLD: That's the goal.

COMMISSIONER DOUGLAS: And that would be helpful. And, you know, I guess one question I had for Jaime was in the work that you're doing, how -- you know, how closely or what kinds of information would you have that would help us get at cumulative impacts, as well as kind of direct impacts as we look at this?

MR. JAHNCKE: No pressure.

MR. GOLD: I can see the uncertainty caveat now.

MR. JAHNCKE: Yes. It will be easier to answer

that question after we are working on it for a few months. But we have been compiling a series of literature of people that have been working on cumulative impacts, and going through the process of identifying what is the question? What is the best dataset to answer this question? Being very specific about the variabilities and the risks and coming up with the right parameters to model it.

So, we're going to be sticking all of those together and giving you an answer in a few months.

MR. GOLD: So, yeah, and --

MR. JAHNCKE: I would like to add one thing to the seabird question, which I didn't have a chance to reply to. But in the North Sea, I think I'm aware of two papers. One of them that shows there was baseline and there was the monitoring after the development was done. And they actually show displacement and the species for an area, they were present in a completely new area.

There was a small fraction of the population that kind of learned to go and feed within the turbines, but that was a learned behavior.

And then, I think from the last year, probably, there was another paper that show an overall reduction in breeding success. So, I'm happy to look for them and

send them your way.

MR. GOLD: All right, thank you.

MR. GEORGE: If I can just make one more point, the difference between land-based wind turbines to do a before and after comparison, or to do a mortality report, you had biologists or dogs, both, walking around looking for carcasses. Well, this can't happen in the ocean. And that's why we emphasize technology.

COMMISSIONER DOUGLAS: And, well, we may hear about this on our next panel, I'm not sure. But we did, at the Energy Commission, fund one of these kind of AI projects, and that was land-based, but it is a potentially, really good possibility for marine as well.

I just have one more, I don't know, question for Lane. But I really appreciate you being here. And, you know, whenever we can get experience from people who have been in the trenches somewhere else, longer than we have, there's a lot we know that we can learn.

But I'm glad to hear that you have at least one West Coast member, now.

MS. JOHNSTON: Me, too.

COMMISSIONER DOUGLAS: And I'm glad to hear that you're interested in staying engaged with California.

But, you know, I heard some of your high-level recommendations, you know, doing some of this analysis

early. I don't know if you can, if you want to just take the time and maybe capture some of that in written comments, or if you want to just give us a quick answer now. But, you know, what do you think are some of the most useful steps the state could take to get a handle on, you know, both potential impacts to fishing, but also ways to address that? And, you know, informed by the East Coast experience.

MS. JOHNSTON: Yeah, I'm happy to follow up with written comments. I think one thing that I would like to acknowledge and it's really interesting to see is that the Intergovernmental Panel or group exists, which on the East Coast we're dealing with so many different states, and each of their energy commissions, and each of their fisheries groups. And so, it's actually kind of nice to have everybody in the same room. And so, I think that's really good to continue that discussion.

And then, also, take that to all of the fishing communities that will be impacted, and kind of trying to do a big information exchange. I think there's a lot of small resolution data that needs to be captured that we're still struggling with on the East Coast. And I can follow up with more.

COMMISSIONER DOUGLAS: Yeah.

MR. GOLD: May I ask one more question?

COMMISSIONER DOUGLAS: Yeah, please.

MR. GOLD: A question for Jeremy. I was really intrigued by the passive acoustic drifting buoys. And, I mean, I know we don't have a lot of time to get into it, but what are you hoping will be the capabilities for detection for cetaceans?

MR. JEREMY POTTER: I'd probably -- if you want to get into specific detection capabilities, I need to connect you directly with the scientists that are doing that work, which I'm happy to do at NOAA and BOEM.

That said, what I do understand is that the hydrophones would be in the mid-water, where the sound travels the farthest, so we would actually get some of the highest levels of detections that's actually, currently capable.

You know, we've been talking about building up to 75 of these DSPR (phonetic) instruments which would allow that temporal and geographic coverage across the California current ecosystem, if we are able to get the money to do it in total.

MR. GOLD: Yeah, we should definitely -- it would be wonderful to get a little bit more information on this. Because I think the question that Karen was bringing up earlier, that stumped Jaime, was about scaling and, you know, what do you do when you have a --

you know, a modest-sized project is one thing. But, you know, earlier we heard goals of 10 gigawatts by 2040 which, obviously, changes the impact question quite substantially. And so, that would be very, very helpful to better understand what that could do.

MR. JAHNCKE: Can I chime in on the hydrophone question?

MR. GOLD: Go for it.

MR. JAHNCKE: So, I guess I'm a collaborator on a project in the Gulf of France, where they are comparing data from acoustic buoy with observations of cetaceans migrating around the Farallon Islands, and from counts we do along the vessel.

And it's kind of interesting to see that there is no match between one and the other. Like when they're going, when they're coming back north and going north to forage, they're quiet. And when they're coming back south to reproduce, they're really vocal. And depending on the species. That's the case of blue whales.

In the case of the humpback, at the time with the current and the voice is very strong, there's a perfect match between voices and presence. But at the time when the ocean is stratified and the sounds travels a lot, large distances, the projections just go to a

maximum, they don't match presence locally. So, it will be an interesting study to see what you guys learn from that.

MR. GOLD: All right, thank you very much.

COMMISSIONER DOUGLAS: All right, I just had -- oh, sorry, Chris.

MR. CHRIS POTTER: I was going to make a number of comments, but since we're running out of time, I'll make one --

COMMISSIONER DOUGLAS: Go ahead.

MR. CHRIS POTTER: -- if you can indulge me. And that is the OPC and Humboldt State are planning to convene a workshop of West Coast researchers to create a roadmap. We feel like we're far enough along with a number of studies that some reflection early next year would be well-timed.

COMMISSIONER DOUGLAS: I was just going to say, kind of by my way of closing my comments on this panel, you know, I think we have a long way to go to coordinate and focus research on this topic. But I also think we have a great start and you can see that here. And I want to thank OPC and BOEM for really getting us off to a great start with some near term, very focused, very relevant research.

And, you know, not only that but we've heard

from NREL. We're hearing from DOE. We've got an Energy Commission-facilitated panel coming up next. We've got multiple universities in the state involved in this. And an industry environmental group that's prepared to work together, and to work with the state agencies, and the research agenda.

So, I really think that, yeah, there's a long way to go on a lot of this, but we've got a great foundation here. So, I just want to thank you guys for your work, and to be continued, but it's a good start.

MR. CHRIS POTTER: Thank you.

MS. RAITT: So, thank you so much for that.

And so, we'll move on to the fourth panel, which is on Research Opportunities Supporting Development and Deployment of Offshore Wind Technology in California.

So, if the panelists can make your way to the forward tables, that would be good.

(Pause)

MS. RAITT: All right, I think if we can kind of try to reconvene here. Did you want to start? Okay.

MR. ALDAS: Okay. It looks like we're all ready to start the fourth panel.

MS. RAITT: All right, folks, we're going to restart. So, if people can take seats, that would be great. So, we're going on to our last panel. Thank

you.

And, so, Rizaldo Aldas from the California Energy Commission is the moderator. So, here we go.

MR. ALDAS: All right. Thank you, Heather and good afternoon. I'm Rizaldo Aldas. I'm with the Energy Research and Development Division of the California Energy Commission. I'd like to thank you all for staying on for this, our last panel on Research Opportunities Supporting Development and Deployment of Offshore Wind Technology in California. Last, but certainly as exciting and as informative as the previous panel.

I think this is a good segue from discussing environmental analysis and public outreach to looking at technologies and project development.

We have a great, also, set of panelists to talk about some of the research and technological development. I know, a lot of them are happening outside of California, but certainly have implications and applications here in California. They'll be touching on things like advancement in the manufacturing, infrastructure and resource characterization.

Before I call on the first panelist, I would like to make a short plug. This week, the Energy

Commission just released a grant funding opportunity, last Monday. It's called -- it's a solicitation for what we call next generation wind energy technologies. It will have three research funding groups. Two of them are related to offshore wind. The first one is on advancing manufacturing and material science that, while it's based on onshore wind or land-based wind, it actually has implications for offshore. And just like what Commissioner Douglas mentioned a while ago, we have one project that's looking at onsite manufacturing, using additive manufacturing.

The other two groups are on remote monitoring and control, and the focus is kind of to find ways to lower the levelized cost of producing offshore wind energy.

And the third research group will be looking at the environmental aspects of the offshore wind.

And so, next week, October 9th, we'll be having our public workshop to discuss more of the details about this funding solicitation. And the deadline to submit application is December 13th.

All right. So, with that, I would like to call on our first speaker, Mr. Gary Norton. He is the Senior Renewable Energy Advisor to the Department of Energy's Wind Energy Technologies and Waterpower Technologies.

And he's been there since 2009. Gary.

MR. NORTON: Thank you. So, as Rizaldo said, I'm with the Department of Energy Wind Energy Technologies Office. And we're small, but I believe an impactful office within the Department of Energy that's been supporting wind energy development for about 40 years. And in the last 10 years or so, we've gotten very engaged in offshore wind.

And the framework in which we've been involved in offshore wind is guided, has been guided by an initial strategy on offshore wind that we put together with, in partnership with the Bureau of Ocean Energy Management, and was announced in 2011 by the Secretaries of Interior and Energy. And then, we revisited that, with a lot of stakeholder input, in 2016 and issued and updated version.

And the key elements of that, which laid out things for both BOEM and Department of Energy to do, to realize the objectives, and the strategic themes were reducing technology costs and risks, and supporting effective stewardship, and improving understanding and the benefits of offshore wind. And within that, we each have particular things that we agreed were important to focus on.

And how do we operate? We support National

Laboratory work directly. A number of the reports, and analyses, and even technology developments that we've heard about in different panels today were supported by projects within the National Laboratories of DOE that we funded. We have competitive awards. And I'll mention one or two of them later on.

We collaborate with federal partners, like BOEM and NOAA. And then, we have an emphasis on convening and communication of information with various types of stakeholders.

So, one area that we're focused on is taking the next level of wind technology development is less focus on the individual turbine, but more on the whole wind plant. Particularly, in terms of cost, and able to reduce cost, increase annual energy production, and increase efficiency.

And scientific research is a big part of that. Understanding the atmosphere, so going from right to left -- left to right, excuse me, on the screen there, we start with basic atmospheric science and moves toward optimized whole wind plant design. And that may include, as an example, controls within the wind plant that rather just yawing and individual turbine, actually groups of turbines are moved and manipulated, as it were, to enable -- to reduce the effects of wake that's

diminished output on downstream turbines.

So, and high-performance computing is a very big part of that. So, there are several high-performance computing capabilities within our National Labs that are engaged in that.

An example of a solicitation to move the technology forward is that as the turbines become so large, now, 12.5 megawatt turbine from GE going online this month, in the Netherlands, the prototype of that, and even larger turbines are envisioned, and to do that we've got to increase efficiency and decrease weight.

And so, recent solicitation that we issued and chose several awardees, are these three companies, including GE and American Superconductor, who are working on a superconducting generator capability. Something that's not been adapted effectively in wind turbine technology, yet, although it's been used in applications like medical scanners.

And after an initial $500,000 to each of these, for initial engineering, there will be a down select and one of them will get $7.5 million to continue that effort, and plus at least 20 percent cost share. In one case, a company has put $40 million forward.

We have an upcoming award on test facilities. Our funding is dictated by Congress. And one of the

things Congress mentioned in the 2019 appropriations was supporting national-level test facilities. So, we have a solicitation, after doing a request for information, on different types of testing. What kind of testing in labs and wave tanks, et cetera, are important for offshore wind? And based on the RFI results, we put out a solicitation and will be announcing those awards in a few weeks. And there are several California companies that have applied within that solicitation.

Another thing of high relevance is wind radar interference, wind turbine radar interference. And for about six or seven years, now, we've been part of, and we convene the working group on radar, interagency working group which includes the Department of Energy, the Department of Defense, Interior, the FAA, NOAA, and BOEM. And collaborating under an MOU.

And the steps that they've gone through is in analyzing the problem, looking at mitigation strategies, and then looking at new technologies, new types of radar that wouldn't cause interaction with wind turbines. And that's been largely on the land-based side, but recently there have been some studies from this group on offshore wind, and that focus is continuing.

You've heard reports, like the one today, from E3. We have done similar studies on the northeast,

through the National Labs on the benefits of offshore wind within the electrical sector there. And, also, assessments of how cost and how cost will be reduced over time. Several of those studies have been quoted today.

And I'll draw your attention to the bottom right, I think it's an important bullet there, open source design and evaluation tools, such as open FOAs (phonetic). There are a number of open source design tools that I'd say all, or most of the companies that were represented today, who are developing offshore technologies, floating technologies have used these tools, or used these tools to help develop their own sets of design codes, and other types of tools.

Again, an important thing for California here is resource characterization, as I mentioned, is very important and a lot of the data, a lot of the projections you've seen are based on modeling, not actual observation. There's limited observation. So, we're working with BOEM to put two Lidar buoys off the coast of California. And that's contingent upon permitting process, but something that we've just gotten underway with them.

So, on the environmental side, tying to the previous panel, we focus on three key areas, data

collection and experimentation, monitoring and mitigation. And that's basically the advanced technologies that were mentioned before in the prior panel, that Garry George particularly pointed out.

And then, information synthesis and sharing. Getting the information out there, working with others, and that was something that came up earlier. I'll mention a couple of things about working with the European entities and sort of compiling that information.

These are three awards that Garry George mentioned, that are for monitoring right whale activities, for avian and bat monitoring. And there are several other types of these technologies that we're also active in investigating. In fact, on the buoy system I mentioned earlier, we're planning to put a thermal tracking system that Pacific Northwest National Laboratory developed as a validation of that system.

So, on the environmental side, again looking at -- this is a new initiative that we're starting out, and that's to summarize what we understand, and others in the field understand regarding environmental impacts and global research to date. Examine which of these are anticipated to have impacts in the U.S. and to work with other entities to pull these together.

And Bethany Straw, I'll ask you to raise your hand. Because Bethany -- anyone in the audience who's interested, and obviously a lot of people are interested in environmental aspects, who would like to pool together, to work together on this initiative, please see Bethany as the primary contact.

And, lastly, we have resources that are very valuable, again in terms of aggregating information in the field. The Tethys database is a collection, a compendium of trying to pull together any environmental information related to wind energy, published anywhere in the world. And I recommend going there.

Wind Exchange is a source of information for communities and other groups who want to know about wind.

And then, the Offshore Wind Technologies Report is updated regularly and is a source of quite a bit of data that I've seen in some of the presentations earlier today.

So, thank you.

MR. ALDAS: All right, thank you, Gary.

Our next panelist is Carrie Hitt, with the National Offshore Wind Research and Development Consortium. She's the Executive Director since September 2019. Prior to being the Executive Director,

she served as President of New Hampshire Transmission Company, a regulated subsidiary of the NextEra Energy Resources.

MS. HITT: Okay, good afternoon and thanks for having me today Commissioner Douglas and Mr. Gold. And I should caveat my presentation today. This is my inaugural talk about my consortium. I just joined less than a month ago as the Executive Director. So, feel free to grill me, but I'm not sure I'll withstand any test. So, again, thanks for having us.

So, the National Offshore Wind Research and Development Consortium has been in existence for about a year and a half, now. As I said, I'm relatively new. It was founded by, primarily, Department of Energy, Gary's group, and NYSERDA, which is sort of the equivalent of the CEC in New York. They have cofounded a research and development consortium. The total dollars committed by them is $40 million, around $40 million.

And DOE and NYSERDA's goal here is to accelerate practical application of technologies for offshore wind. And our research is primarily driven by the goals of developers that have -- you know, provide us information and we'll talk about that in a little bit, and guidance and advice on, really, what is needed to commercialize

and construct offshore wind in the near term, so that is our focus.

I should also say that the organization is also funded by a number of private entities, including some of the developers that spoke here today. And several states have contributed to the initiative and are participating.

And while, initially, the group, you know, really came out of New York, with New York providing matching funds to the DOE grant of $20 million, it is -- the goal is to be a national consortium and to engage other states that are looking at offshore wind technologies, and implementation. So, that's why I'm here today because we want to make sure that California and the community here is aware of the consortium, and the funds that are available, and the work that we're doing. And hope that you'll consider, you know, participating either through a solicitation, or joining us, you know, as a state entity. And, obviously, we'll talk more about that.

We're supported, as I mentioned, by four advisory groups. They help guide where we focus our solicitations and the projects that are chosen for research. Primarily, right now, and it's a relatively new organization, so the major focus is on the first one

here on the left, on the Research and Development Advisory Group, the RDAG. That consists of academic institutions and other organizations that really help us figure out what should we be looking at in the short term.

And then, next up is the third group over, the Manufacturing Supply Chain and Service Council. That will be launched earlier next year with BNOW, who spoke earlier today, to really focus on supply chain. And then, the other councils are in formation right now.

I mentioned the RDAG, which really helps to guide the research that we pick and focus on. And there are a number of educational and academic institutions that are involved in providing us guidance on our solicitations. You can see, by the map here, they cover the country. I'm hoping that we can engage more of the West Coast organizations and economic institutions, now that I think there's a renewed focus here in the Pacific for offshore wind.

To guide what we're doing, we have designed a roadmap. We're now working on the second kind of draft of the roadmap. And I'll talk a little bit more about what that does. But the roadmap really lays out what solicitations we're going to pursue. We'll be releasing a new one in just a few weeks' time, that kind of tweaks

our efforts and makes sure that we're staying up to date with the work that's needed to be done.

And I should mention, actually, I don't think I said this, that NREL is a significant contributor to this as well, helping us write the roadmap, draft it, make sure that we are on point for what's needed.

So, we are -- wait a minute, I want to make sure this is -- yeah, okay. As I mentioned, we are currently in a solicitation process. We're running an open-ended solicitation. Which means that the funds that are allocated are open and as we receive proposals, we evaluate them against certain criteria. I'll talk about the categories of where the proposals kind of fall and what we're looking for in a moment.

It's an open-ended solicitation. We've made one formal announcement for an award that's already been contracted. I'll mention that at the end. I believe, as of today, we have 27 proposals before us to evaluate and we're about a third of the way through them. But more will keep coming over the course of the next year or two, which is fantastic. There's a lot of interest. We're receiving a lot of good proposals for research along these areas. And, you know, a few won't -- we, obviously, will evaluate them against the same criteria. Some won't get chosen for grants and funding. Others

will. But so far, we have one that's been contracted for and we're soon to announce many more by the end of the year.

So, we have three technical areas that we've identified challenges in and where the solicitations and the proposal are coming in. The first area, we call them pillars, looks at -- I'm sorry, I'm trying to read my slides and I realize I probably need better glasses.

So, array performance and control optimization, cost-reducing turbine support structures for the U.S. market, floating structure, mooring concepts to shallow and deep waters, and power system design and innovation.

And I should have mentioned, this reminds me, that all this R&D is focused on U.S. implementation. Of course, we are learning from the experience in Europe and many of the proposals are based, are coming from European developers and have that experience in mind.

Pillar 2 of technical challenge areas is comprehensive wind resource assessment and development of meta ocean reference sites.

And our third technical challenge area are heavy-lift vessel alternatives, offshore wind digitization through advanced analytics, and technology solutions to accelerate the U.S. supply chain. So, this is really supply chain, how are you going to get the

equipment there, that sort of thing. Addressing things such as the Jones Act, which I'm sure many of you are familiar with.

And we are receiving proposals for each of these pillars simultaneously.

As I mentioned, we've awarded one proposal so far, and contract, and that happened to be to NREL. But any proposal, academic institution, private company is eligible to submit a proposal. NREL, who's very active in this space, submitted and won our first contract. And this is on shared mooring systems for deep water -- excuse me, deep floating wind farms.

And that's it. I guess I would finally just say I'm happy to provide more information to anyone that's interested in submitting a proposal, and to answer more questions about the consortium, itself. Thank you very much.

MR. ALDAS: Thank you, Carrie. That's a great overview of the R&D Consortium.

Our next panelist will be joining us via WebEx. Mike Optis is the Senior Scientist with the National Renewable Energy Laboratory, with expertise in wind plant performance assessments.

Mike, are you online?

MR. OPTIS: Yes, I am. Can you hear me?

MR. ALDAS: Yeah, we can hear you. Go ahead, please.

MR. OPTIS: Perfect. Okay, thanks a lot for having me and apologies I can't be there in person. I just wanted to spend a few minutes talking about some state-of-the-art wind resource modeling that NREL's currently conducting for the California offshore region.

So, please change the slide, Rizaldo. So, I think it's a bit of an obvious statement about getting the wind resource right matters when we're talking longshore offshore. So, I thought I'd grab a couple slides that were published at the AWEA Wind Resource Assessment Conference back in 2015, by EDF Renewables. And the focus is really on, you know, the bias between a preconstruction energy assessment and what the plant actually produces.

So, that graph on the left is showing that difference. Whereas a value of 1 would be a perfect estimate, and then deviating from that is either an over estimation or under estimation. And this is currently a big problem in the industry onshore, where it's not uncommon to have a 10 percent, or as high as a 20 percent bias in your estimate. And this has very real financial consequences, of course.

The example EDF used for a 200-megawatt project,

if two consultants had a 3 percent different in their annual energy production estimate, that would translate into $17 million in that present value. So, and this is onshore.

And when we pivot to offshore, the risks start to get a bit higher given that, you know, we're dealing with larger turbines, you know, a lot less experience in understanding and quantifying the wind resource and conducting energy yield assessments. And as well, we're dealing with a lot less measurements. It's not uncommon to have 8 to 10 net mass for a preconstruction campaign onshore, whereas we're not going to have that luxury offshore. So, getting the resource right matters.

The next slide, Rizaldo, please. And I think it's talked about earlier in this panel, when it comes to offshore measurements, we really don't have much to work with. These are plots showing the different buoy locations off the California coast. These tend to be about 5 meters off the surface. Of limited applicability when we're trying to quantify winds between 100 and 200 meters or even higher. You know, those heights relevant for wind power.

So, it's in general the case for the U.S. offshore, and especially I think California, that the resource is not yet well-characterized and there's a lot

of work to do to better understand that.

The next slide, please. So, again, as was mentioned earlier, in the absence of detailed observations, we tend to rely a lot on models, particularly numerical weather prediction models. And we're showing the results from such a model on the left there. That's NREL's offshore wind estimates. These are annual, 100-meter averages. These are based on our own Wind Toolkit, which is itself a numerical weather prediction model based on the open source, sort of community-driven weather research and forecasting model that's developed and maintained by the National Center for Atmospheric Research.

So, this dataset was produced in 2013. At its time, it was a very state-of-the-art dataset. And I know today it is the best timeseries-based dataset available. You know, it provides information at 2 kilometers, 5 meter -- or, 5 minute (indiscernible) -- and we're currently modeling 7 years of timeseries data.

That was seven years ago and we're due to redo it for several reasons. Especially for offshore, it's not currently -- it was currently validated to any offshore measurements in its initial release. And the fact that it's only 7 years of data it is limited in its application to long-term analyses, be it annual energy

production or (indiscernible) for example.

The next slide, Rizaldo. So, one of the bigger sources or limitations of the previous Wind Toolkit is the model sensitivity. The Wind Toolkit is like a weather prediction model, as I said, but it represents a single model run. Like, we have inputs that drive the model and setups within the model to get a certain result. And about a decade of research, now, has demonstrated considerable sensitivity to output from a model, be it wind speeds, wind direction, temperature, et cetera. Depending on the inputs that you're using to drive your model and the setups within the model is how you represent turbulence or deviation, and things of that nature.

So, we were really interested, in the last year, in exploring this. And on the right, we're showing some results from a pilot study we conducted off the coast of New Jersey, near a lot of those wind energy lease MUs (phonetic).

The blue lines represent different model members or different setups of this Wind Toolkit numerical weather prediction model. We considered 24 different setups. This line is the mean of the values.

So, on just a quick snapshot, over four days what we see is considerable sensitivity in the wind

speed, depending on the inputs and setup you're using to devise your simulations.

It's not unusual to have a 5-meter-per-second (indiscernible) at a given time stamp.

We convert that to power using the basic 5-megawatt NREL power curve. Those differences amplify to the tune (indiscernible) three differences in power.

So, again, this is all based on reasonable average setups to a (indiscernible) model. And so, what we're really trying to push for the next generation of wind resource datasets is the use of an ensemble approach by uncertainty or sensitivity in these models results. So, we can let that uncertainty inform analyses that make use of this data, and we kind of stop treating a single model run as truth.

Okay, the next slide, please. And when we start to quantify uncertainty in different time scales, it allows us to produce pretty useful metrics. Nonetheless, here's a slide that looks pretty familiar. This is, again, off the coast of New Jersey in this pilot study. The hundred-meter annual average winds, you've seen this before. Seeing larger wind speeds being offshore, the lower wind speeds onshore, for example.

What we're advocating for now is accompanying

the figure on the left to the figure on the right, we're now -- in addition to wind speed information, we're quantifying our confidence or uncertainty to that information, based on the ensemble approach. After this pilot study we're seeing lower uncertainty offshore and higher uncertainty onshore, and there are good reasons for that.

So, this is something that's been developed over the last year on the East Coast. I'd just also note that we are kind of (indiscernible) our colleagues in Europe, who are developing a similar scale through the European Wind Atlas. That's been a number weather prediction model over the continent, the entire continent of Europe.

Okay, the next slide, please. Okay, so what are we actually doing for California? As I said, the New Jersey was the pilot study. California's going to represent our first, kind of large-scale, long-term production runs for this next generation wind resource dataset. So, it's going to be, when finished, a 20-year time series-based wind resource dataset applicable for long-term estimates. Keeping with the 2-kilometer spatial and 5-minute time resolution approach from the previous iteration. And we'll be adding this ensemble approach to quantify uncertainty.

Given the computational requirements of running a lot of different ensemble numbers over 20 years, we're going to start with running a 1-year ensemble. So, over 2019 or 2018, for example, using at least 24 different setups to quantify uncertainty.

We've been using some machine learning approaches that we're developing, and we'll then extrapolate, essentially, the uncertainty with (indiscernible) -- the remaining 19 years as they relate to environmental parameters like wind speed, wind direction, and some turbulence.

So, we're excited to have partnered with BOEM on this work and we're eager to get going and produce this next generation dataset.

The final slide. We're not just wanting to do models in this effort, and as Garry mentioned earlier, validation really is of growing importance here. And I know we'll be limited (indiscernible) coastal measurements that are not available in California, but we really see floating lidar as a game changer, and we're seeing the benefits of that in the North Atlantic, already.

But to the extent that the data may exist, then we'll be spending some time doing this work, exploring both private and public sources. Looking for more

state-of-the-art offshore measurements to which we can validate the model further.

So, that's all I have. Thanks for your time. I actually have to run off immediately to pick up my daughter, so I'm not going to be able to --

MR. ALDAS: Okay, thank you. Thanks a lot, Mike, and thank you for spending time to share with us. If we'll have questions, we'll send that to you. Okay, thanks.

The next speaker is Benoit Bizet. I hope I pronounced that okay. Mr. Bizet is the Special Advisor to the Centre for Global Cooperation, a part of the Danish Ministry of Climate, Energy and Utilities.

MR. BIZET: Good afternoon. Thank you very much for the introduction. Thank you very much for inviting me here. As you mentioned, I'm representing the Danish Energy Agency and we are part of the new Ministry of Energy, and Climate, and Utilities.

We are in charge of mandating the -- we've been mandated to the government to apply the energy agreement on offshore wind. And I will be going back to the previous agreement we had. We started in 2012 with the political agreements on several megawatt of installation. And what is the focus on this one? I put them all because they are all part of the same package.

But the main interest of today is the 50-megawatt test scheme, which was a test scheme that has been decided very early in our political discussion in order to move the new technologies for offshore wind, with the main purpose of reducing the LCOE.

So, there's been a kind of a process to get there because you can always have good ideas. But the thing is this scheme was quite costly for the government, so we had to ensure that we will be supporting the proper project. So, we have had a lot of requirement.

And just to give you an idea about the entire cost of the project, it was about -- the one we will award, that you're going to see in the end of the presentation, has been awarded for $19 million U.S. dollars for a period of around 12 years, which is quite a significant amount of money. So, we wanted to ensure that the parameters and test parameters we will select will be the right one.

So, we had some requirement. We wanted to be sure that everybody that would be able to apply will have some requirements to meet up. And they had to, all of them, document some effect, and incentive effect.

So, the subsidy has been such that we do, in Denmark, in other projects we've been doing CFDs. And

we do normally subsidy for what we are about 50,000 (indiscernible) hours.

For that project, we had maximum money for the project, which is about this $100 U.S. dollars per megawatt hour. That would be the subsidy that would be covered for the projects and covering the around 50,000 full-load hours.

We decided for that project to incentivize the idea of developing turbines, not using an old, offshore wind turbine, and just put some new elements on that and get the money. We used the formula that we've been using for development of onshore wind. In the early days, we were supporting onshore wind on the install capacity, and we realized that some people, they were clever enough to put two generators on their wind turbine, even though it will never produce. The amount of megawatt was quite high and then they got high support.

Then, we introduced a formula of the 70-30, which is 70 percent of the subsidy will be based on the rotor size and the 30 would be based on the capacity of the wind turbine.

So, for the wind turbine that is actually set up now, it's going to give $48,700 something, which is actually showing that the 50,000 full-load hours is not

that far from what we use on the different turbines.

We have a very good setup. We want to be also ensuring that we will not support when the price is negative. We don't do that for any of our projects. That's what sometimes they're doing in Germany, but we don't do that in Denmark.

Good. We had, of course, a lot of minimum criteria. We wanted to ensure that the consortium or the company who gets awarded the project will be able to actually commission, and operate, and also maintain the wind farm. So, we had some requirements on the technical and financial capacity because we want also to be ensured that when we give them the licenses, again, they will be able to complete the project.

We have, also, of course, to assess the application we received. We received four different applications and they were having all very much different subjects. Most of them had something with foundations because it seems that it's a part that was very important. And the rest was very much on the turbine, itself.

We want, of course, to be sure that there is a potential for the development and there is a commercial aspect on the project. Because it's not just to give money for a project that will not have an incentive on

reducing the LCOE for offshore wind. So, we had some very strength, what do you call that, requirement on the potential of the technologies that they will install. We wanted, also, them to be technically feasible. We cannot receive any application of elements that seems to be very good but then, in the end, they cannot be realized. So, we wanted to be sure and it has to be documented that it was reliable, and then it should be in full scale.

Full scale just means that it has to be offshore. You see that where we are located 50 megawatts cannot be a real full scale, but for a test scheme it was considered a full scale.

So, the applicants were actually able to propose any kind of size of project from one turbine to the entire pool of the 50,000 -- sorry, 50 megawatts. A lot of 50 something, apparently.

So, on the commercial perspective, we wanted also to ensure that there was some demand from the market on the elements that they were proposing. Because, again, if it's not interesting in the market, then there will not be any idea in subsidizing some elements that will not affect the production.

We wanted to have a diversity on the elements. It's important that they are different elements. Not

only one or two elements, like one on the turbine and one on the foundations.

So, in all, together, we received all these applications. And then, in the end we decided to assess, of course, in one way that was quite reliable. I could not only alone assess whether or not I should choose one or the other, so we hired some consultants. And the trick was to find some consultants that are not involved on any of the other projects. Because otherwise it's biased and then they are not able to help me.

But in the end we agreed, actually, that the three others, we agreed on the same project, so that was a good sign. And then, the potential they proposed in their project was to reduce the CAPEX and the OPEX for, respectively 12.5 percent. The project has been installed for -- now, it's been in operation for more than a year and the results are, of course, yet to be seen. And, unfortunately, changed departments in house. And we haven't yet seen any results from these, but it could be available, and it has to be, actually, publicly available.

So, they are different elements that we've been focusing on. So, the project that has been awarded, the subsidy is a small project of four wind turbines. They

are four Siemens 7 megawatts, with a rotor of 154 meters. And the main elements on the test was a new concept of gravity jackets developed by Siemens, which is the yellow part that you see above the sea. A concrete transition piece, which is a very new way of doing transition pieces, which are normally in steel, too.

And then, of course, because you have concrete bases, you need a bit of a different tower, otherwise you will have too many vibrations on the (indiscernible). So, they developed a slender tower that is able to cope the vibration from the concrete. There is a 66-kilovolt solution which was at the time, actually, some of the few projects that have been testing that is now becoming the new standard, but at the time was

not.

They have different turbine and sensors algorithm in order to optimize the production. And then, the Lidar power curve verification.

This is my last slide. This project has been very much under the -- they all want to look at the work because there were not, at the time, any large-scale offshore wind projects to be testing in the elements. And we've seen that as a very good and positive impact.

And we try to see if it's possible to cooperate and to ensure that if some other countries are subsidizing any project that we are not paying twice for the same elements.

That was it. Thank you,

MR. ALDAS: Thank you for sharing that experience on the test scheme and Denmark experience.

Our last panelist, certainly not the least, is Mr. Jeff Kehne. He is the Chief Development Officer with the Magellan Wind, and he will be sharing with us their perspective on project development for floating foundation.

MR. KEHNE: Thank you. And thanks to the Commission for convening this productive workshop and for the invitation to appear.

Magellan is an early-stage development company based in the U.S. And our California work teamed with Copenhagen Infrastructure Partners, based in Denmark, which has a number of large offshore wind projects under development and under management all over the world. They started in 2012 and now have about $7 billion in assets under management. So, they are the sort of technical and financial muscle behind our efforts here.

We're specialized in the early development, permitting leasing, the U.S. knowledge part of the

offshore wind development for floating technology.

Our other important partner is Stiesdal Offshore Technologies. We've been close to them since they were formed in 2016. And Henrik Stiesdal is the chief, is the senior technical advisor to Magellan. He had meant to be here to talk today but had to be back in Denmark for some commitments tomorrow. And I told him I would cover some of what I understand of the Stiesdal technology from a developer's perspective and what we like about it, and what it says about the path of innovation. I also warned him that I couldn't bring anywhere near the depth of expertise, or any at all of the Danish accent. So, you'll have to live with that.

So, I think this is familiar territory. The opportunity long-term in California, and the challenges here. The challenge, I think, in California -- I think in California for offshore wind, it's sort of like New York. If you can make it here, you can make it anywhere. Partly because of the permitting challenges and partly because of the price challenge.

And the quote here, from Henrik, is about floating offshore wind needing to contend with solar plus storage. I think over the time period we're talking about, it's solar plus lithium ion storage, plus emerging longer-term storage. And I think that's going

to be a driver for the industry, as we develop in California, is to constantly attend to our price competitiveness with alternative resources.

Looking at what's distinctive about the floating projects that we're all working to bring about, you can see the various classes of floating technologies. Part of the floating unique technology here that you don't see highlighted is the moorings. That's becoming very interesting and active, as well, as well as the dynamic cabling.

So, I think when you think about the cost trajectory for offshore wind, for floating offshore wind, it's useful to think about two distinct cost curves. And one is the shared system cost curve. So, we have 8,000 turbines offshore in the world now, roughly. And we have about a dozen floating foundations in the world.

The way that people who study technology think about costs, they think about when the number of units installed goes up by a factor of ten how much does the cost fall? And one estimate for wind power technology has been about 15 percent.

So, going the next 8,000 units on the shared system, if they're 10-megawatt turbines, that's roughly $80 billion of investment. The kind of decisions that a

state like California, even a state as big as California makes about technology improvement in that sphere are likely to be hard to coordinate with what's going on in the industry and hard to move the needle.

On the other hand, on the floating side we have a very -- we're starting from a very low installed base and we have a more rapid, in terms of time, rate of improvement. And I think that that's an area of much more rapid innovation change and price reduction.

This is just showing how rapidly the cost has come down for the shared system technology. And we anticipate that we will continue to benefit from the improvements in the shared system, and we will be better than the fixed bottom world on our foundation side.

Okay, so, here are some of the existing floating foundation technologies. And it's a period of great innovation. If you look at the NREL report for 2018, and look at the table of new floating technologies that are about to come out onto the market, and the existing technologies that are going to be deployed at large scale, it's quite a dramatic change in the level of private investment in this area is quite significant.

Here's what we, as developers, find interesting about the SOT technology. It's the industrialization of the manufacturing process and the savings that that

offers. Henrik's insight was to look to a standardized component that you could take advantage of existing automation, and existing perfection of industrial processes. And he looked to wind towers, which are produced in a volume of about a hundred thousand a year in factories with robot welding, and automatic inspection. So, they're very high quality. It lets you use less steel and it lets you produce the components very quickly.

So, he started with a component that is already industrialized to take advantage of that learning curve phenomenon and join the learning curve farther down.

And what you see here is three different designs using the same component, the same basic component. The first is the very first prototype project, the Tetris Bar, the keel underneath gets lowered to lower the center of gravity and it has the behavior of a spar after deployment, but it's shallow in the port.

The second is a semi-submersible version. The same components, the same key site assembly.

And the third is a tetra-base configuration that allows you to float out a fixed bottom project and lower it to the seabed, so you can avoid the deployment of an installation vessel.

As we think about public investment in bringing

along the floating offshore wind technology in California, one important issue is going to be public investment in ports. And given that we're talking about an area with a tremendous pace of innovation, our perspective is somewhat like the perspective that California has brought to transmission, which is the least regrets strategy. You don't want to find out in ten years that you've over invested in some aspects of port construction that are no longer necessary or useful, or that you've under invested, or committed to a structure that's no longer capable of dealing with the state-of-the-art turbine.

An example would be if you committed to a 300-ton Nacelle and by the time you got to large-scale production, you were dealing with 500-ton Nacelles. Or, you committed to a dredging program with a 40-meter wide channel, and an 8-meter depth, and you needed 50 meters and 10 meters.

Those sorts of considerations I think are important as the state contemplates investment in making offshore wind a reality, particularly given the pace of innovation and the variations among the contenders in the foundation world.

Finally, a point about how quickly this technology can emerge given the level of attention and

commercial interest in the floating foundations. Just as an aside, the GREC report that came out last year, the GREC report that came out last year said that in the business as usual case, total offshore wind deployment in 2030 figures to be 190 gigawatts, up from 23, now. And, roughly, a hundred of that is expected in Asia where floating will play a large role.

What I've got here is in that environment, looking forward to those kinds of numbers, this is what Stiesdal Offshore Technologies was able to do to bring a promising, new foundation technology from concept to deployment in four years. And I think we'll see more of that, more contenders, more options for developers. And more cost reductions, particularly for companies that are serious about working in California, where the price competition will be so severe. Thank you.

MR. ALDAS: Thank you, Jeff.

I think we have a few minutes for Q&A, and I'd also like to transition to our Commissioners if they have questions of our panelists.

MR. GOLD: I just had a question for Gary. So, I was just interested in you were talking about the wake impacts?

MR. NORTON: Yes.

MR. GOLD: And, again, this goes sort of to the

scaling issue. On what if it's a modest size project, you know, the impacts of this question would be silly, but if it's large enough, maybe it's not.

In conjunction with the Lidar buoys, et cetera, are you looking at the impacts on currents, and is it just surface currents, or anything even further afield than that, from the standpoint of really thinking about what the impacts of wakes could be downwind?

MR. NORTON: Okay. And maybe I didn't explain, but when I mentioned wakes, I'm talking about wakes within the wind stream.

MR. GOLD: Right.

MR. NORTON: From turbine to turbine. But then, so --

MR. GOLD: Well, I guess what I'm thinking of, being an ocean guy, is that so many of our localized currents are wind driven. And if the wakes are quite substantial with the scale that we're talking about, is there a potential impact on surface currents?

MR. NORTON: Yes. And with the buoys, it would be trying to -- the meta ocean conditions, characterizing the currents and the waves prior to an installation. And then, actually, I'm not aware of much study of the impact within the wind farm itself of the waves, although, the impacts of the various turbines.

But the modeling that I mentioned, the high-performance modeling, computing would enable that to be studied within the -- as part of the overall impacts and operations within the wind turbine -- within the wind farm, if I'm making sense there.

MR. GOLD: Yeah. Not, it does make sense.

MR. NORTON: It's part of all this multiple of factors that would be looked at, at the same time. So, the answer is yes, getting there. But I'm not aware of any studies, yet, that have been published, for instance on the actual impacts that you're talking about.

MR. GOLD: Yeah, so sort of the wind/sea interface component, yeah.

MR. BIZET: If I can add on that, I think that today we saw, maybe it's your presentation, one of the presentations showed the HornsRev2 windfarm wake effect is one where you see the wake through the part, and you see that the effect is not affecting the sea surface. You will see -- I don't know, you have to see the picture.

MR. GOLD: Yeah.

MR. BIZET: And you will see that it's going to be above the surface, because the turbines, they are very high, and they are clearance of at least 20 to 30 meters above water. So, the water, which is capturing,

is going off towards to make like a conical. But if you see the picture, I will recommend you look at the picture. I don't remember which presentation today showed the pictures, but this very -- it says at the bottom where the wake is affecting the turbines.

MR. GOLD: Okay.

MR. BIZET: Make sense?

MR. GOLD: Yeah. No, I think it does make sense. I just, again, want to make sure that every box is checked. You know, in the case of somebody brings it up, we make sure we have a cogent response, and that sort of thing.

So, I understand what you're saying from the standpoint of physically how they're designed, and such. But again, I think we're talking about a scale that doesn't exist, and so that's why I just want to make really sure as we move forward on it.

But thank you, that was --

MR. NORTON: If I could mention that we're going to release within several weeks the results of a workshop with industry, and meta ocean experts, wind resource characterization experts that characterizes what the key elements are for the gap, the missing elements if you will, in knowledge and what's important. And I know there are aspects of that that touch on the

effects of waves on the wind, within a wind farm.

MR. GOLD: Yeah, and remember, because we are talking about California current just for the rest of the audience, and the fisheries person could have brought this up as well. I mean, we are just very much an upwelling dependent fishery here. And so, if there happens to be, and I hope that's certainly not the case, but if there happened to be any significant impact, that's what we're looking at. Because it really is based on upwelling. And if there's any impact there, that would be a concern. I don't think there is. I'm just saying that we just want to make sure.

COMMISSIONER DOUGLAS: Yeah, I was just going to ask a follow-up question on that. Like in -- so, in Denmark, are you aware of any analysis or studies about whether wind projects affect currents?

MR. BIZET: No, we don't. But I think that I was about to say before that I guess that the climate change might change the current more than the wind turbines. And by definition, you want to optimize your energy yield and you may not -- you don't want a lot of wake. So, you will dispose your turbine so you reduce the wake effect. So, basically, I'm not very sure that there are any studies been done on that because the developers want to reduce this wake effect. And this

wake effect, probably on the large scale, is not going to be 4 to 5 percent, I guess, which is quite insignificant.

And, actually, the new designs on the wind farm are not very square, so they are actually minimizing the wake in a way that it might not (indiscernible) the currents. But no study, to answer your question.

MR. GOLD: And the good news is you know this state is focusing on climate more than anything else, so there you have it.

COMMISSIONER DOUGLAS: I think I don't have anymore questions. It's probably -- Rizaldo, do you have questions?

MR. ALDAS: Sure, I have one question. And this is a question for Jeff, of course others, Gary, and others are welcome to comment. Kind of building on your second-to-the-last slide, as we move forward, if we are able to, you know, move forward with the deployment of wind, offshore wind energy, could you comment on how our infrastructure, particularly the ports are being readied, or what sort of incremental development are needed to make them ready for future deployment?

MR. KEHNE: Yeah, I think that's a really hard question.

MS. RAITT: Turn your mic on.

MR. KEHNE: I think that's a hard question for California right now because the various foundation technologies have very different requirements. One of the appealing aspects of the Stiesdal technology, to us, is that it's rapid throughput at the port, and a small footprint, and no drydock. So, for a small project, you can even do temporary reinforcement of the dock. If you were going to scale up, you would need -- you would sensible want more reinforcement of the dock and a larger lay down area, although it would have to necessarily be right at the key side.

Some of the other technologies have very different footprints. And some technologies, like the very large spars, require different deployment technologies altogether.

So, again, I think it's worth giving some thought to a least-regret strategy if you're not ready to pick a winner on foundations, so that the investment that makes the most sense is investment that works under a wide range of scenarios.

MR. ALDAS: Thanks. Anyone else?

MR. NORTON: I'll mention, it's something I haven't heard discussed either today or in the previous workshop was the fact that the bearing capacity of the

soils close to the key side, the dockside, is very important as well. And it's not just the laydown areas or the draft. But having these turbines, particularly the Nacelles are incredibly heavy. And most ports aren't used to that concentrated amount of weight in one location.

MS. HITT: Just a quick addition from a prior life. It wasn't addressed in this conversation. It was spoken about a little bit earlier today. But I'm not sure that all the presentations on impact or LCOE talked about transmission. So, all of these projects have to be interconnected somehow, right. So, I think that should be taken into consideration, both in terms of, you know, determining your LCOE. The numbers that people present include those or not. And do the different technologies that might be available, how does transmission interconnect with them? How are you connecting it to the grid? Is it more costly or less costly depending on the technology you actually use for the turbine?

MR. ALDAS: Great, thanks. Okay, are there any more questions?

I think I would like to thank everyone. Appreciate your participation. Thank you.

COMMISSIONER DOUGLAS: Thank you. Thank you to

the panel.

So, that was the last panel of the day. I have three cards so far for public comment. If others would like to make comment, the Public Adviser is right over here. And you're welcome to fill out a blue card and come and make comments.

And after we get through people in the room, we'll see if anyone is listening on WebEx and would like to make a comment.

So, let me start with Michael Winkler, with the Redwood Coast Energy Authority.

MR. WINKLER: Good. Thank you. I'm Michael Winkler. I'm the Board Chair of Redwood Coast Energy Authority. That Redwood Coast Energy Authority has a consortium agreement with Principle Power, EDPR, and Aker Solutions to develop approximately 120-megawatt floating, offshore wind turbine installation off the Humboldt Coast. It looks like it's with the restrictions of the military, that's likely to be the first floating offshore installation in California.

Some challenges that we have for a system of the proposed size, that with what I consider moderate upgrades of the transmission system, this will be feasible.

Another proposed project is an onshore project

of about 125 megawatts. When these two projects are built and with existing biomass electricity capacity, we would be up to about 170 percent of electricity consumption in Humboldt. And that gives us the possibility of being zero net as a county. And when we electrify, I think we'll still be within that.

The challenges for our area include transmission upgrades. We have, as earlier speakers said, that from Cape Mendocino to the Oregon border we have the potential of about 15 gigawatts. And that's going to take a substantial commitment in terms of updating the IEPR, and updating other parts of California energy policy, and also providing funding to make that feasible.

Also, we have a potentially excellent port. Probably the second-best port in California, natural port, after San Francisco Bay. But after the decline of the timber industry, we have very degraded port facilities. And so, we're going to need a lot of work and a lot of financing. I don't know if that also would be available from the State of California to make that feasible for the type of large-scale, offshore wind turbine development we're going to have.

People have talked about the Port of Eureka as being a potential West Coast hub for the offshore wind

industry. In addition to other characteristics, we have no bridge across the opening to our bay, so we can handle a fully assembled, offshore wind turbine installation that could be towed out from our port.

I also wanted to comment about something that was mentioned earlier, kind of indirectly related to wind turbines, and that has to do with hydrogen. I worked for an energy research lab for about 12 years, that specialized in hydrogen. And one thing I found very disappointing is that the roundtrip energy efficiency of hydrogen fuel cells is only about 20 to 25 percent. So, this does not compete at all well with batteries, and battery-power vehicles.

So, I think that the best way of looking at hydrogen and fuel cells is rather than a drop-in replacement for fossil vehicle fuels, a better way of looking at it would be as a type of flow battery. A flow battery is a series of electric chemical cells with external reactants.

And so, I think what we're talking about is a low-efficiency flow battery. This could make sense for seasonal energy storage, in which capital costs are important and energy storage efficiency is not important.

So, what I would rather see would be, if

hydrogen and fuel cells are used, that they would be used to balance, do grid balancing and seasonal storage, rather than trying to use as a replacement for gasoline and in powering vehicles directly.

COMMISSIONER DOUGLAS: All right, thank you. Now, let me say, we have a line at the mic, but I also have cards, some of which came in really early. So, let me just -- and, fortunately, not very many. So, if you haven't filled out a card, please fill one out. We will get to you very soon because I only have three more in my hand, four more in my hand.

Charley Lavery, Operating Engineers Local 3.

And there are two mics. So, feel free to move near a mic. If you know you've given me a card, we'll get to you. Keep the comments about three minutes, please, and please go ahead.

MR. LAVERY: Good afternoon. I'd like to specifically bring the words of Jeff Hunerlach, our district representative up in the Humboldt area to the council. He's been working with the industry and working with offshore wind up there directly. He couldn't be here today.

We, Operating Engineers, represent heavy equipment operators, surveyors, construction inspectors, and marine construction workers. We have approximately

39,000 members. And we're very excited about the prospect of developing offshore wind. Not only is it going to generate good jobs here in California, but it's going to help the environment.

We believe that the offshore wind industry should be -- have high labor standards and that we can bring a high road. We can work with the state and work with industry to bring a high road approach to the development of this industry.

Specifically, we are putting out there that we'd love to partner with the industry, partner with the Commission on bringing broad public support for this issue and for the building of offshore wind.

Urge the CEC and the CPUC to take workforce impacts into account when going forward on their decisions on offshore wind.

COMMISSIONER DOUGLAS: Thank you very much. Thanks for being here. Thanks for your comments.

Lauren Cullum, Sierra Club.

MS. CULLUM: Thank you. Hi, Lauren Cullum with Sierra Club California, representing 13 local chapters in California and half-a-million member and supporters in the state. I want to thank the CPUC, OPC, and CEC -- wait, did I forget one? I don't know. But thank all of you guys for putting together such a great workshop on

offshore wind.

Sierra Club believes that offshore wind is an important resource that will help us move towards meeting our state's decarbonization and climate change goals and help grow a new industry that supports thousands of well-paying jobs.

I'd like to reiterate or highlight some of the points or topics that were discussed today that resonate with Sierra Club.

First, offshore wind must advance in an environmentally responsible manner. I'm happy to hear today about the current environmental assessments and studies that are going on, and those that will take place in the future. Avoiding sensitive habitat areas, requiring strong measures to protect wildlife and ecosystems throughout each stage of the development process. And comprehensive monitoring of wildlife and habitat before, during, and after construction are essential for the responsible development of this technology.

Second, the processes associated with developing offshore wind energy, such as data collection and siting, should be as inclusive and transparent as possible. An inclusive stakeholder process, workshops such as this, workshops like EDPR talked about that

involve, that bring together industry and NGOs to work together, and help identify areas of least conflict. This could then provide a more streamlined process for decision making and reflect environmental and other concerns.

In sum, Sierra Club California supports responsibly developed offshore wind energy that will take into account the potential impacts on marine wildlife and ecosystems, and terrestrial, if that -- considering some of the changes that might happen to the transmission infrastructure. As well as a process that allows for the various communities and stakeholders to be informed and given opportunities for input along the way. Thank you.

COMMISSIONER DOUGLAS: Thank you very much.

Danielle Mills with AWEA-CA. Followed by Bruno Geisher with IDEOL.

And if anyone else would like to fill out a card, please do so.

MS. MILLS: Thank you. Good afternoon Commissioner Douglas, Mr. Gold.

I want to thank you for having such a great collection of stakeholders and experts here today. As we've seen, there's so much potential to bring offshore wind to California. And if that potential is realized

and done in a responsible manner, we can unlock hundreds of thousands of jobs that are highly skilled and well paid. One to two billion dollars of customer savings. New pathways to meeting our electrification targets and bringing greenhouse gas reductions to other sectors as well.

Innovation to protect species and minimize other impacts. Significant investments in our port communities and electricity infrastructure, and a host of other benefits.

But this is not going to be easy, as nothing in California is. Bringing this industry to scale is going to require acknowledgement of some of the hard challenges that California's energy market is facing. And it's also going to require thinking through our procurement and our long-term planning processes.

We are currently in a reliability short fall as a state. Some of these resources could come online in the next 7 to 10 years to meet some of that reliability short fall that we have right now.

So, if we continue to have these multi-agency workshops, and engage stakeholders both from industry, and outside of industry, I think we can look at where we are now, and where we need to go as a state to make sure that we fully realize all of these benefits and really

seize the opportunity.

So, thank you for pulling us all together.

COMMISSIONER DOUGLAS: Thank you, Danielle.

Now, Bruno Geisher, with IDEOL. And I'll say, IDEOL's done some good analysis of local content, and also some of the harbor infrastructure here. So, thank you. Go ahead.

MR. GEISHER: Thank you. My name is Bruno Geisher, with IDEOL, a floating technology provider, with assets in operation in Japan and in France. Or, yes, sorry, it's a long time I've impersonated James Brown so --

(Laughter)

MR. GEISHER: So, without undermining the motion that I've heard the last few days about go big or go home, which has value when you're looking at developing something around scale and creating thousands and thousands of jobs. I would like to add some nuance to what I heard about harbor infrastructure upgrades or the need to upgrade harbor infrastructures.

Our company, with its very unique concrete hull technology, and compact concrete hull technology has conducted an audit of all the California harbors. It has been a lengthy work. And we came to the conclusion that, actually, our technology can be built in

California, providing 100 percent local content, without any harbor infrastructure investments, using existing harbor facilities.

So, of course, investments to increase, to accelerate the industry, and to provide competition amongst different players is very important in the drive to reduce cost. But you can already start building things in California locally, with local labor, using existing harbor infrastructure.

The second thing I just want to add is we all want to go big and we all want to see those large commercial arrays to provide the necessary renewable energy to meet the targets that California has set for itself. I would just not undermine the interest of smaller-scale projects in order to expose all the stakeholders to that learning curve.

There's not one country in the world that went from zero to commercial scale, especially in floating. France, Japan, Norway, Portugal, they all started with at least one unit in the water, allowing progressive exposure to governmental agencies, to NGOs, to the DOD, and to everyone else, to the supply chain, to the fishermen, et cetera. So, I would not undermine the benefits of a smaller project before going full scale. Thank you.

COMMISSIONER DOUGLAS: Thank you for being here. Thanks for your comments.

I am out of blue cards. If anyone did not fill out a blue card, but now really wishes to say something, go ahead. Otherwise, I'll turn this over to Heather to see if there's anyone on WebEx.

MS. RAITT: Yeah, my understanding is nobody on WebEx has raised their hand. So, I think we're ready for concluding remarks.

COMMISSIONER DOUGLAS: All right.

MS. RAITT: But no pressure.

COMMISSIONER DOUGLAS: I don't think I wrote a whole lot of concluding remarks. I had questions.

But I'll just thank everyone for -- many people here, it's been a long week because we had the opportunity to participate in the Pacific Rim Conference. And I learned a lot there.

I really appreciated so many of you staying an extra day and participating in our public workshop and helping us build the body of knowledge and information for California agencies, and for the public to engage and understand the status of this issue here, in California.

There's a lot of expertise in this room. There's a lot of work that's been done. And much

remaining to do, both to understand and find ways to take advantage of the opportunities presented by this resource, by offshore wind within the context of our broader climate goals. And with an eye towards everything we need to balance. Cost and reliability, and environmental impacts, and the permitting process, and so on.

There's a lot of science and a lot of research needs. It's really gratifying to hear from so many entities involved in the science and to know that we'll be able to follow up and continue to coordinate. And that is definitely what we'd like to do. There's no reason to duplicate work others are doing. We would much rather build on the body of knowledge that's most relevant and useful to us.

So, this has been a real step forward in achieving that.

Mark, any closing comments?

MR. GOLD: You pretty much covered it all. For me, I appreciate everybody's presentations. I learned an awful lot. Unlike Karen, I don't live and breathe this all the time, so this is a good, deep exposure for me and to really understand the issues surrounding moving offshore wind in California.

I did emphasize before, we're putting together,

finalizing in the next month the strategic plan for the coast and oceans for the State of California. And I've been talking to Karen quite a bit over the last month on what an acceptable target would be for offshore wind.

And so, we'll probably try to put something in there. It will be a little bit forcing. We'll see where it actually gets through the council, itself, which is chaired by Secretary Crowfoot and includes a lot of heavy hitters in the state.

But it seems to be something that there's really an appetite for moving forward to -- there might be disagreement on degree, how to do it, et cetera, but it does seem like an issue's time has come. So, that's promising. And thank you, again, for everything you've provided today.

COMMISSIONER DOUGLAS: All right. So, again thanks. We're adjourned.

(Thereupon, the Workshop was adjourned at 4:16 p.m.)

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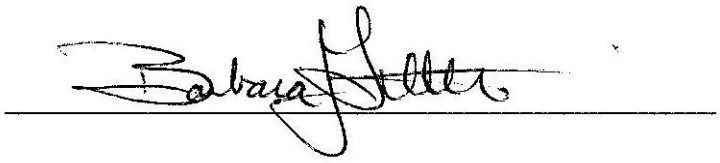

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