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CALIFORNIA ENERGY COMMISSION

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WORKSHOP ON ASSEMBLY BILL 525:

ASSESSING TRANSMISSION UPGRADES AND INVESTMENTS FOR

OFFSHORE WIND DEVELOPMENT OFF THE COAST OF CALIFORNIA

TRANSCRIPT OF PROCEEDINGS

REMOTE VIA ZOOM

THURSDAY, NOVEMBER 10, 2022

1:00 P.M.

Reported by:

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P R O C E D I N G S

1:01 p.m.

THURSDAY, NOVEMBER 10, 2022

MR. BARTRIDGE: Well, good afternoon, everyone. I'm Jim Bartridge with the Energy Commission’s Siting, Transmission, and Environmental Protection Division. Welcome to today's workshop, which is focused on assessing the transmission upgrades and investments necessary to support offshore wind development off the coast of California, as required by Assembly Bill 525.

Next slide, please.

Before we begin, let me go over a few housekeeping items.

First, this meeting is remote access only and is being recorded. The workshop recording will be made available on the Energy Commission's website after the meeting.

Please note that to make the Energy Commission's workshops more accessible, Zoom's closed captioning has been enabled. Attendees can use the service by clicking on the “Live transcript” icon and then choosing either “Show subtitle” or “View full transcript.” The closed captioning service can be stopped or exited out of the live transcript by selecting the “Hide subtitle” icon.

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Okay, today's agenda will begin with a brief overview of Assembly Bill 525 by Rhetta deMesa. And then Melissa Jones will present on the requirements and approach of the transmission assessment required by 525.

We'll then hear a series of presentations on ongoing and upcoming transmission planning studies, starting with the CPUC and their work on offshore wind within the Integrated Resource Planning proceeding, followed by the California Independent System Operator and their annual transmission planning process.

Next, we'll hear presentations by the Schatz Research Energy Center at Cal Poly Humboldt on studies already conducted and new studies underway on transmission for offshore wind.

Finally, we're fortunate to have representatives of the Danish Energy Agency and Energinet, the Danish National Transmission System Operator, who will present on their experience with transmission development for offshore wind in Denmark.

Following the presentations there will be an opportunity for public comment. When we get to the public comment portion of the agenda, we'll be using the raise-hand feature and we'll provide additional instruction for public comment at that time.

I'd like to now introduce Rhetta deMesa to give a few brief -- to give us a brief overview of AB 525.

Next slide, please.

Rhetta?

MS. DEMESA: Thanks, Jim.

Good afternoon, everyone. As Jim mentioned, I'm Rhetta deMesa with the Energy Commission’s Siting, Transmission, and Environmental Protection Division, and also the Project Manager for the CEC's requirement to develop a Strategic Plan for offshore wind energy development required by Assembly Bill 525. This afternoon, I'm going to be giving a brief overview of AB 525 to kick us off.

Next slide, please.

Assembly Bill 525 became effective January 1st of this year and set the analytical framework for offshore wind energy development off the California coast in federal waters. In enacting AB 525, the legislature found and declared, among other things, that if developed and deployed at scale, offshore wind can provide economic and environmental benefits to the state and the nation, advance California's progress toward its statutory renewable energy and climate mandate, increase the diversity of the state's resource portfolio and lower overall costs, and provide an opportunity to attract investment capital and to realize community economic and workforce development benefits in

California.

Next slide, please.

AB 525 tasked the CEC, in coordination with an array of specified local, state, and federal partners, and with input from stakeholders, to develop a Strategic Plan for offshore wind energy development installed off the California coast in federal waters by June 30, 2023. The legislation further identifies priority considerations in developing the Strategic Plan. The legislation states the Strategic Plan shall emphasize and prioritize near-term actions, particularly related to port retrofits, investments, and the workforce, to accommodate the probable immediate need for jobs and economic development.

In considering port retrofits, the Strategic Plan shall strive for compatibility with other harbor tenants and ocean users to ensure that the local benefits related to offshore wind energy construction complements other local industries. The Strategic Plan shall emphasize and prioritize actions that will improve port infrastructure to support land-based work for the local workforce. And finally, the development of the Strategic Plan regarding workforce development shall include consultation with representatives of key labor organizations and apprenticeship programs that would be involved in dispatching and training the construction workforce.

Next slide, please.

In consideration of the legislative findings and priorities identified for the Strategic Plan, the Plan is required to include, at a minimum, the following five chapters, the identification of seaspace, economic and workforce development and identification of port space and infrastructure, transmission planning, permitting, and potential impacts on coastal resources, fisheries, Native American and indigenous peoples, and national defense, as well as strategies for addressing those potential impacts. Information presented and discussed today will be used to inform the required chapter on transmission planning.

In developing the Strategic Plan, AB 525 also requires the CEC to complete a number of interim work products. By June 1st of this year, the CEC was to evaluate and quantify the maximum feasible capacity of offshore wind to achieve reliability, ratepayer, employment, and decarbonization benefits, and to establish megawatt planning goals for 2030 and 2045. And by December 31st of this year, the CEC must complete both a preliminary assessment of the economic benefits of offshore wind as they relate to seaport investments and workforce development needs and standards, and a permitting roadmap that describes the timeframes and milestones for a coordinated, comprehensive, and efficient permitting process for offshore wind energy facilities and the associated electricity and transmission infrastructure.

Next slide, please.

In addition to the interim work products I just mentioned, in developing the Strategic Plan, AB 525 asks the CEC to identify suitable seaspace for wind energy areas in federal waters sufficient to accommodate the offshore wind planning goals, to develop a plan to improve waterfront facilities that can support a range of floating offshore wind development activities, and to assess the transmission investments and upgrades necessary, including subsea transmission options, to support the offshore wind planning goals. Today, we'll be focusing on the AB 525 requirement to assess the transmission investments and upgrades necessary to support the offshore wind planning goals.

Next slide, please.

Finally, I want to highlight that in August of this year, the CEC adopted offshore wind planning goals of 2,000 to 5,000 megawatts by 2030 and 25,000 megawatts by 2045. These goals were established for the purposes of guiding the development of the Strategic Plan, including the transmission assessment.

Next slide, please.

That concludes my presentation and the overview of AB 525. I'd now like to hand it over to Melissa Jones, our technical staff lead, overseeing the transmission assessment.

MS. JONES: Good afternoon. I'm Melissa Jones, the Technical Lead for Offshore Wind Transmission.

Next slide, please.

AB 525 requires transmission planning. California must initiate long-term transmission and infrastructure planning for delivery of offshore wind to Californians.

AB 525 requires the Commission to include a chapter on transmission in the Strategic Plan. Specifically, the Commission, in consultation with the California Public Utilities Commission and the California Independent System Operator, must assess the transmission investments and upgrades necessary, including subsea transmission options, to support the 2030 and 2045 offshore wind megawatt planning goals. The assessment must include relevant cost information for network upgrades and subsea transmission, as well as the extent to which existing transmission infrastructure and available capacity could support offshore wind energy development.

Next slide, please.

In terms of the goals and objectives for the transmission assessment, the availability of existing transmission and the need to develop additional transmission capacity in specific areas of the state needs to be analyzed in the context of offshore wind planning goals that were established in August. Transmission development is a long lead-time activity. And assessing the investments and upgrades required to support the 2030 and 2045 offshore wind planning goals, as required in AB 525, can help inform existing state infrastructure planning. Delivery of reliable, diverse, secure, and affordable renewable energy from offshore wind projects will allow them to be a critical part of a future electricity system that operates with 100 percent renewables and zero carbon resources.

California will need to develop a comprehensive Transmission Capacity Expansion Plan -- excuse me -- to help establish an efficient and economic path for offshore wind development. With the many uncertainties about who will develop projects where and when, this is a particularly challenging but essential task. The Strategic Plan will set us on a path to conduct the necessary transmission planning and provide information that can help inform the needed transmission upgrades and investment to support the planning goals.

This will be especially important for the first phase of offshore wind development as the Bureau of Ocean

Energy Management is scheduled to hold a first ever lease sale for offshore renewable energy off the California coast in less than a month. We will build off the existing body of work, including transmission studies in the CPUC's Integrated Resource Plan, or IRP, and the California ISO's transmission planning process, or TPP. We'll also include work from the Schatz Energy Research Center and other available research. Some of these studies will be described in more detail in the workshop today. We will also initiate additional technical work to feed into the Strategic Plan chapter and to inform other areas required in AB 525, like Permitting Roadmap and seaspace evaluation.

Next slide, please.

Transmission infrastructure includes the cables and network equipment necessary to interconnect offshore wind generation projects. We don't yet know whether projects will be connecting to offshore floating substations and then to substations on land, or if they will directly connect to onshore substations. We will need to better understand the variety of technologies and configurations that may be used by project developers for interconnection. We will explore these with input from the offshore wind industry and others.

In terms of bulk transmission upgrades, in addition to downstream from projects themselves, the existing transmission system in the Northern and Central Coasts are very different, and our analytical approach recognizes these facts.

The existing transmission on the North Coast serves only relatively small local loads. The challenge for delivering offshore wind at significant scale is that the North Coast has limited connections to the major existing transmission paths in California. Additional transmission infrastructure will be needed to deliver offshore wind from the North Coast to the rest of the state. Options that have been examined and are continuing to be examined include overland transmission to connect the Humboldt Wind Area and other North Coast offshore wind areas to the existing transmission in the north central portions of the state.

The possibility of developing subsea cables that could connect directly to the Bay Area from offshore wind projects off the North Coast is also being examined. And there are other possibilities for transmission options that could connect offshore wind resources in Northern California and Southern Oregon and deliver to the broader western market.

In contrast, the Central Coast area already has a robust transmission system that currently serves existing power plants on the Central Coast. This makes transmission planning for the region different than the planning considerations for the North Coast. However, there still is a need for both the at sea infrastructure and the ability to use existing and develop new onshore infrastructure. In addition, there could be potential subsea options to bring offshore wind to California loads.

Next slide, please.

In terms of the tasks and timelines for developing the transmission assessment, as we discussed, we're approaching the transmission assessment by region with separate evaluations for the North and Central Coasts. And we've already initiated a number of work efforts that include reviewing the body of work used for developing the Offshore Wind Goals Report adopted in August, and new studies conducted since then. This research will continue through March of 2023. We're also pursuing contract support for technical work associated with assessing interconnection and subsea cables, the technologies and the costs.

In October, we kicked off the Schatz Energy Research Center study for the North Coast of California and the southern portions of Oregon under a Department of Defense grant, which we will hear more about in presentations to follow.

We're also closely coordinating with the CPUC and the California ISO to take advantage of transmission studies underway for offshore wind, which you will hear more about in the presentations to follow.

Most of the drafting work of the chapter will occur in January through March of next year. We anticipate releasing a draft chapter in April or May of 2023 and holding a public workshop to take comments on it. We will also present the Strategic Plan for consideration at a CEC business meeting by the end of June 2023.

Next slide, please.

To quickly review the key inputs for the transmission assessment, several will inform them. This includes the studies and information from the IRP, the 2020 BOEM-funded studies at the Schatz Energy Research Institute, and additional work they've conducted in 2022. They will also be describing the current DoD-funded study focused on transmission in Northern California and southern Oregon.

We'll also include transmission infrastructure research studies underway, including but not limited to those by the Pacific Northwest National Lab, NREL, the Oregon Department of Energy, and others that may help inform the Strategic Plan.

We will also be soliciting input and feedback from stakeholders, tribal governments, other interested parties, and the public.

Next slide, please.

In terms of public engagement, most of the public engagement for the transmission assessment will be in the form of workshops and webinars. We also have a State Agency Working Group to ensure coordination among the key state agencies involved in transmission. And we plan to continue to work closely with our federal partners.

Additionally, we plan to hold meetings with targeted stakeholders and interested parties, such as industry, environmental NGOs, local governments and community organizations, tribes and tribal governments, fishermen and other ocean users, and others.

Next slide, please.

Today, we will be focusing on the studies done to date and their findings regarding offshore wind, studies underway we hope to draw from for the Strategic Plan, and some experience that's been gained from the experience in Denmark.

With that, I would like to turn to our other presenters. First, I would like to introduce David Withrow from the CPUC. We will then move to Jeff Billinton from the California ISO. And then we'll take a short break and come back for the rest of our presentations.

Thank you for giving me the time today.

MR. WITHROW: Thank you, Melissa. I'm David Withrow. I work on the Integrated Resource Planning Team at the Public Utilities Commission. I'm joined today by Nathan Barcic, who is the Manager of the IRP Team, so he manages the considerable internal deliberations of IRP, as well as considerable stakeholder interactions with all the LSEs in California as we develop this ongoing IRP process.

To follow up on Melissa's excellent context of this transmission assessment for the AB 525 Strategy, I want to do in this short presentation. I want to do three things: summarize the current process and constructive interaction between the CPUC's IRP process and the CAISO's transmission planning process; secondly, review the recent history of CPUC portfolios that have been the basis for the CAISO's transmission planning studies; and thirdly, explain the latest set of portfolios that are proposed for CAISO's analysis during the 2023-2024 TPP cycle, which will commence next year.

Next slide.

So, yeah, just to summarize, this is probably familiar territory but it's good to set the context, the CAISO's transmission planning process evaluates the CAISO transmission system every year to address grid reliability requirements and identify upgrades needed to successfully meet California's policy goals. The TPP is conducted by

CAISO's planning engineers, and their excellent analysis is based upon two key inputs that are provided by state policymakers.

First, the CPUC's IRP process provides to the CAISO the optimal portfolios of generation and storage resources that, based on extensive modeling, the state will need in the future. And, secondly, the CEC provides to the CAISO the load forecast through its IEPR process. These are the key inputs that drive the need for new transmission. And, obviously, the relationship is as the portfolios increase in size and the higher the load forecast, then the analysis is more likely to identify need for new transmission.

I want to emphasize a key distinction that is illustrated on the far right of this diagram. The base portfolio that the CPUC annually conveys to the CAISO, the results of the CAISO analysis of this base portfolio is actionable, which means that if the results of their analysis of the base case show the need for additional transmission development, then the CAISO staff can recommend that certain transmission facilities should be approved by the CAISO Board.

If that happens, if the CAISO Board approves these recommended, specifically new, transmission projects, then those projects would be presumed to be eligible to receive cost recovery through the CAISO's transmission access charge. And resolving how a new project gets financed is a big milestone in the development of new transmission.

The CPUC also conveys to the CAISO in each TPP cycle one or two portfolios for sensitivity analysis. These sensitivity portfolios are not necessarily optimal, or it may not even be feasible. The results of the sensitivity studies in the CAISO's analysis are really for information. They're not actionable, but they do provide often useful directional guidance that can help develop future portfolios and could offer good information specifically for this AB525 strategy report.

Next slide.

I want to call attention, too, the PUC, with these portfolios, conducts a busbar mapping process, which is the process of refining geographically coarse resources to be mapped to specific substations. This exercise was first conducted as a proof of concept in the 2018-2019 TPP cycle. It was formalized into a joint effort by a working group comprised of PUC, CEC, and CAISO staff. And it's now been immortalized in a methodology document that's posted on the PUC website and is subject to stakeholder vetting at any point, as well.

So now I just want to have a quick high-level review -- next slide -- of the PUC portfolios that the CAISO has been analyzing over the first -- over the recent years.

Specifically, at a high level, on the far left, the 2020-2021 portfolio, note that it included only about 12 gigawatts of nameplate capacity of resource needs. And if you see the escalating growth of these portfolios, if you look at the third bar for the 2022-23 TPP that's being studied now, this includes more than triple the amount of the 2020 study. The 40 gigawatts are being studied, nameplate capacity are being studied, for this current TPP cycle. And if you look at the final two bars on the right, the proposed ‘23-24 TPP cycle, we're talking 85 gigawatts of nameplate capacity by 2035, so a tremendous escalating growth. There's much greater resource diversity, as well. New resources are being added, including offshore wind. And this graph particularly just shows, in recent years, the tremendous escalating growth of the portfolios under study by the CAISO.

MR. BARCIC: David, if you don't mind me putting a finer point on a couple of those items?

MR. WITHROW: Please.

MR. BARCIC: I really do want to underline the trend here that this slide is showing that David just described, of the growing portfolios and the size of the new proposed base case, especially by 2035. Clearly, you should note the end years that are noted in each of those headers along the X-axis. They do progress in time, so that explains part of the growth in nameplate capacity, but not all of it. This is a sign that things are getting more ambitious, so to speak.

What we also want to note is that on that last slide that David was highlighting for the busbar mapping process, as he mentioned, it's been about four years that we've run the process. And this is the first year that we've actually invited at an earlier stage stakeholder input on the busbar mapping itself at the stage of ruling. We had some stakeholders that were pretty vocal with us saying, hey, we'd like more insight into where you're mapping things. Can you please, you know, provide us more visibility? And we're really trying to cater to that by moving some things around in our own schedule while also trying to keep the timelines that we can transmit to CAISO on time.

But generally speaking, we think this shows pretty, you know, strong growth of our planning processes ambition, like I mentioned, in terms of the commitment to resource build. And I'll also note that this portfolio that's reflected in the right two columns of this slide is actually, more or less, already in CAISO's hands as a sensitivity that we transmitted in the July 1st letter signed by CPUC and CC commissioners. A portfolio very like this is already being studied, and I think preliminary results for it will be in hand soon over at CAISO.

But thanks, David.

MR. WITHROW: Next slide.

So now I just want to do a quick high-level review of these recent CPUC portfolios that the CAISO has or will be analyzing over three TPP cycles.

This 2021-2022 TPP cycle was just completed earlier this year. In February, the PUC had conveyed to the CAISO the reliability and policy-driven base case portfolio that meets a 46 million metric ton greenhouse gas emissions target by 2031. The decision also conveyed a policy-driven sensitivity portfolio that included a large amount of offshore wind resources to improve transmission assumptions. And the CAISO's 2021-2022 Transmission Plan, which was posted earlier this year, showed the results of all this analysis which include -- which led to the CAISO's Board's approval of $3 billion in new transmission projects that are needed to ensure grid reliability and meet state policy goals.

Again, the Transmission Plan also analyzed constraints and transmission implications from 8.3 gigawatts of offshore wind in the North and Central Coast regions, providing a lot of informative analysis from that sensitivity study, which I think Jeff Billinton will discuss a little bit later.

Next slide.

For the 2022-23 TPP cycle, which the CAISO is currently analyzing, this is based upon the Commission's preferred system plan, which the Commission adopted in February of this year. This is a key portfolio, a key part of the IRP cycle, because it incorporates not only our modeling but incorporates the IRP plans of the 40-plus LSEs as they lead off of our planning goals as well.

So this portfolio adopted a 38 MMT target for greenhouse gas emissions by 2030, which drops to 35 MMT by 2032. The base portfolio for this year's TPP includes 1.7 gigawatts of offshore wind in 2032.

As Nathan mentioned, CAISO was also asked to analyze the sensitivity portfolio with a 30 MMT emissions limit and using high electrification demand assumptions. And this sensitivity portfolio, which is under study right now, includes 4.7 gigawatts of offshore wind in 2035. So again, CAISO's analysis is ongoing. They'll have a draft transmission plan by the first quarter of next year and will bring it to their board probably in May of 2023.

Next slide.

Now for the next TPP cycle, 2023 to 2024, which will start next year, the PUC staff has proposed, through an ALJ ruling on October 7th, the three portfolios to be analyzed by the CAISO in this TPP that begins next year. The recommendation for the actionable base case will likely be the portfolio with a 30 MMT emissions target in 2030 and a high load assumption using the CEC's additional transportation electrification scenario. This actually drops to 25 MMT by 2035.

As Nathan mentioned, this is the -- this base case for next year is the sensitivity case for this year. It includes 3.1 gigawatts in the Morro Bay area and 1.6 gigawatts of offshore wind resources in the Humboldt area in 2035.

Furthermore, in some of our correspondence with the CAISO, public correspondence, and in the ALJ ruling in October, the CAISO --- the PUC is encouraging the CAISO to identify and improve transmission needs in this current 2022-23 TPP cycle cycle to get a head start on transmission development.

Also recommended for next year's TPP cycle are two complementary sensitivity portfolios designed to identify transmission needs associated with offshore wind. We'll get to them in just a minute. But, again, this year’s -- this coming year's focus is a lot on offshore wind transmission development.

MR. BARCIC: And, David, I think on a process point, somewhat coincidentally --

MR. WITHROW: Please.

MR. BARCIC: -- we do have reply comments due today on the ruling and the portfolios that David has been describing here. So thanks for all the stakeholders that are contributing to that and maybe still trying to submit.

MR. WITHROW: Next slide.

So this is the base portfolio, again, for next TPP cycle, which is basically the sensitivity portfolio for this. This TPP cycle, again, this includes all the resources but, again, to highlight 3.1 gigawatts of offshore wind is selected in 2030 and 1.6 gigawatts of additional offshore wind selected by 2035.

And the next slide, I think, yeah, it just shows it in numerical fashion, the amount of resources by year as a good reference source.

Next slide.

This summarizes the nature of the two sensitivity portfolios that CPUC staff has recommended for the next TPP cycle. Both portfolios still optimize around the same 30 MMT by 2030 greenhouse gas target and the same high electrification load forecast, but they're using different mixes of resources to identify key transmission information. The first sensitivity is what we call the additional offshore wind sensitivity portfolio.

The purpose is to refine and update transmission capability and upgrade assumptions relevant to offshore wind resources, including -- which includes the AB 525 planning goals and updated resource costs and potential assumptions accounting for changes and as well as the higher load scenario. This sensitivity basically forces in 13.4 gigawatts of capacity of offshore wind resources by 2035. This is, as I understand it, a linear extrapolation of AB 525 planning goals. So it is consistent with the AB 525 planning goals of 2 to 5 gigawatts by 2030.

We're also using higher density assumptions for resources based on recent NREL studies. And the allocation to these regions are 5.4 gigawatts in Morro Bay region, 3 gigawatts in Humboldt, and up to 5 gigawatts in either Cape Mendocino or Del Norte areas, which could well become wind energy -- be designated wind energy areas in the near future.

The second sensitivity is a limited offshore wind sensitivity portfolio. In this case, we're artificially limiting both offshore and out of state wind to 2 gigawatts each through 2035 to sort of highlight a potential scenario where resources are slow to develop. This could help, the philosophy behind this sensitivity is it could help identify least regrets transmission upgrades that would be beneficial across a broad range of resource mixes. Whether offshore wind goes fast or development goes fast or whether it's at a slower pace, this could help identify transmission upgrades that are needed regardless.

Alright, next slide.

I think this graphically shows the color coded amounts of resources and again, 3.4 gigawatts of offshore wind by 2030 and another 10 gigawatts are forced in by 2035.

In the next slide, I think we have the, yeah, the numerical mix -- the numerical megawatt amounts. And compared to the other sensitivity cases, additional offshore wind sensitivity case compared to the base case, you can see there's incrementally much more offshore wind and less of other resources, including solar and battery.

In the next slide, yeah, I think this again graphically highlights the limited sensitivity, the limited offshore wind and out-of-state sensitivity by resources.

And then in the final slide there, I think by numerical megawatt amounts. Again, much less out-of-state and offshore wind assumptions, more assumptions of other resources to sort of highlight transmission implications from that.

I think that concludes most of it.

Nathan, you want to add anything else?

MR. BARCIC: Nothing from me. Thanks for having us.

MS. JONES: Great. Thank you very much, David and Nathan.

And now Jeff Billinton from the California Independent System Operator will give a presentation. Thanks.

MR. BILLINTON: Thanks, Melissa. I'm assuming you can hear me. It's Jeff Billinton. I'm Director of Transmission Infrastructure Planning at the California ISO.

Do you want to go to the next slide, please? And the next one.

So as kind of as David notes, so kind of tagging on as David with the ISO's transition planning process, what we've studied in the cycles previous to the one we're currently under, and then kind of where we are in this year's transmission planning cycle and we'll go forward, the ISO conducts -- we conduct an annual tariff-based transmission planning process, and we're assessing the reliability, policy and economic driven transmission needs. Currently, the transmission plan horizon is ten years. What we're looking at in the future is to extending that possibly out, but the current transmission planning process is a ten-year basis.

And as David indicated, the key inputs that we take into our transmission planning process is from the CEC, the load forecast, as well as the portfolios that we use to assess and use like in the base portfolio for one of the reliability or policy or economic-driven transmission. And then as David also indicated, we do some sensitivity studies and then we'll walk through some of those as we're going forward.

The other is in May of this year, the ISO, we undertook and we issued kind of the first 20-year transmission outlook. And this was based upon a portfolio that was provided through the CEC's SB 100 process with collaboration with the CEC and CPUC to develop that portfolio that we used as a starting point for that 20-year analysis. And it's really used -- being used to help kind of refine the resource planning, scope some of the challenges that we face, as well as to look into that longer term horizon while we're looking at the projects that we're approving in the ten-year horizon.

And as David indicated, the projects that are part of that base portfolio and process, if we're seeing those needs on that base portfolio, we recommend approval to our Board in the form of the transmission plan in the annual cycle and bring forward and subject to the board's approval then those proceed to development.

But in the ten -- 20-year outlook, if we're looking at some of those alternatives that we're looking at in the near term, is there things as we look at those alternatives that we should be giving consideration in that longer term horizon? And in the last year's transmission plan there was two projects that were identified that way looking at what was needed in year ten or by year ten, but also as we look further, what alternatives would address those needs plus some of those longer term needs?

If you want to go to the next slide?

And so as we talked about, and then David talked about, we did in the 2021-2022, as a special -- or as a sensitivity portfolio and sensitivity studies, we looked at 8.3 gigawatts analysis, and I'll show the breakdown again, as well as an outlook really looking at an additional 12 gigawatt in the North Coast area. And then also in the 20-year outlook, we looked at and was identified in that starting point scenario, which is consistent with the SB 100 was about ten gigawatt. And a lot of that analysis was based upon what we had done because they were done in parallel time period frames the 2021-2022 transmission planning process.

Next slide, please.

So this just gives a breakdown, and people are familiar with, we looked at, in that sensitivity, 1.6 gigawatt in the Humboldt area, and at the time looking at

4.4 gigawatt in the Diablo Call Area potential, and 2.3 gigawatt in the Morro Bay. And then as they indicated, we did an outlook assessment looking at larger. We didn't get into the detailed assessment that we did in that kind of base of the sensitivity. But we looked at an additional 6.6 gigawatt in the Del Norte, so that's north of the Humboldt area, just kind of south of the California-Oregon border, as well as 6 gigawatt in the Cape Mendocino. And so that gave a total in that outlook we're looking at about 21 gigawatt of offshore wind.

Next slide, please.

So as we look at the Central Coast area, and like I said, we had about 6.4 gigawatt in the portfolio from those two identified at the time call areas or potential call areas. And what the analysis indicated was in that Diablo 500 kV system, we could accommodate approximately 5.3 gigawatt of renewables connecting to Diablo. And the assumption at this time of the studies was Diablo was retired, and so looking at 5.3 with Diablo's extension to 2030, you're still looking at the area capacity could be in that 5.3, but with Diablo there, it would be about 3 gigawatt of wind that could connect in that area.

And then beyond the 5.3 of resources connecting into that Diablo area, we would need additional transmission. And we looked at really three alternatives, either building a new line, 500 kV line from Diablo to Gates, or looking at the sea cables that could go from Diablo down into the southern, in the L.A. Basin area, or an alternative of Diablo up to the Moss Landing area with a sea cable.

So that's for the Central Coast area. And what we looked at in the key point from there was that the 500 existing system could accommodate about 5.3 gigawatt of generation in that area.

Next slide, please.

And then when we look at the North Coast and we're looking at Humboldt and Humboldt being in the area, it basically is 1.6 gigawatt, we looked at three alternatives, the first one being basically two 500 kV lines from Humboldt to a station called Fern Road that was approved in previous cycle for dynamic reactive support to be added to the bulk system. And so looking at 500 kV from Humboldt to there, approximately 120 miles.

And then what we found was, is with that, we'd also need further reinforcement of the 500 kV backbone that in a lot of ways goes down by the I-5 internally from Fern Road down to the Vaca-Dixon and Tesla (phonetic) area, so as part of that alternative of the lines coming in, reinforcement of the backbone as well.

If you go to the next slide?

This one, for an alternative, we really looked at kind of a sea cable coming from Humboldt, using basically HVDC-VSC, which would be voltage source converters, and looking at that, bringing DC from Humboldt down into the San Francisco and the other greater Bay Area, and then looking from that Bay Area to transmit that to stations within the greater Bay Area in the load center areas.

And if you go to the next slide?

Then the third alternative that we looked at was looking at, basically, an HVDC bi-pole using classic or the LLC-type technology for the high voltage -- or for the HVDC, and that bringing -- could be overland, could be undersea cable from the Humboldt area down into the Collinsville substation, and this is one of the substations that we approved last year. One is we're looking in the future this way, but also for other needs that were identified in last year's transmission plan but bringing that down to the northern portion or kind of the north portion of the greater Bay Area.

If you go to the next slide?

When we looked at the outlook type and the outlook scenario, it was really about 14.4 gigawatts of offshore wind in the North Coast area, and as indicated, that would be really from the Humboldt area, the Del Norte north, and the Cape Mendocino area south of Humboldt. And to look at the capacity that's needed, this, when we're looking at it, is we’re really looking at -- we're probably looking at a hybrid-type combination of transmission to get the power from the North Coast area to the load centers and integrating that within the California ISO system. And so we're looking that you would need the two, basically, two 500-gigawatt DC lines, like what we had in the one alternative. You would need two HVDC classics in size, which are about 3 gigawatts each for each bi-pole, as well as you'd need about two VSC-HVDC lines, which would be in the about 2,000 megawatts each.

And so to get 14-gigawatt out of that area, there is significant transmission that would be needed to bring it to the load centers, as well as to integrate it into the ISO bulk electric system.

Next slide, please.

And then as I indicated, we undertook this year to do, or as of last year and this year, to undertake -- to do the first 20-year transmission outlook, and the link is there. It was finalized and posted on May 22nd at the following location.

If you go to the next slide, please?

This is an indication, again, similar to the map and what we looked at, in that starting point scenario that was docketed in the SB 100 and provided to the ISO for this

20-year outlook and, like I say, was developed in collaboration with the CEC and the CPUC. We’re looking at a 10-gigawatt type scenario and looking at, say, 4-gigawatt in the north from the northern area and about 6-gigawatt in the Central Coast.

And as we recognize, and then the discussions as we're going forward, there's the two current call areas in the Morro Bay and Humboldt area that BOEM is going through the process. And on December 6th the lease auctions will be occurring. And so this is what -- we're looking at it, this scenario, for the 20-year outlook.

If you go to the next slide?

So in the south, really, as we looked at it, as we looked at kind of the larger, there’s -- and how we would interconnect in the Central Coast, we looked at it in terms of two potential interconnection points. And with the 6-gigawatt, you would need kind of the two as we're looking at it, either connecting into the Diablo substation or into the Morro Bay area and having to create a new 500 kV gigawatt kind of interconnection into that line between Diablo and Gates.

And so as we look at those different alternatives, if we're looking at Morro Bay, the limit would be around the 3,000. So if it was expanding, it, by itself, couldn't increase or couldn't incorporate more because you're looking at a single line between Diablo and Gates. Whereas if the megawatts are connecting into the Diablo area, you've got three lines coming out of that substation and capabilities, and working with PG&E, the potential of interconnecting into Diablo with expansion of the Diablo 500 kV while the Diablo nuclear power plant is operating and being able to get cables up to there.

So that's in the south as we look at it.

And in the north, really, what we look at is we're looking at 4-gigawatt is that there's a need for basically two of the alternatives that we've identified in the 2021 transmission planning process, as well as there's a need to integrate and interconnect between the two. And this is a key point as we look at for the northern coast, as we look at, one, deciding what is a preferred alternative for Diablo and, two, the longer term. And needs that we have, need some of that sequencing of after Diablo, what would come next and where and how?

And that's one of the things as we're looking at what would be a preferred alternative for the Humboldt area? And as you look at it, it's 1.6 and it's in the middle between the Del Norte or the Del Norte or the Cape Mendocino, which are the larger of the Call Areas potential for what megawatts could be from those areas.

And so as we look at Humboldt, what is the preferred alternative that would meet the needs of Humboldt at the 1.6, 2-gigawatt range? But then what would be needed in the longer term and so that whatever we're choosing fits into that longer term development of the expanded capacity for the potential in the North Coast, or also, in terms of if in that area it stalls and it's deferred longer, that alternative can stand alone by itself, interconnecting the wind into the ISO’s system in a reliable and operating fashion?

So that's kind of as you're looking at it, but we identified, really, that you would need for, in the 20-year outlook for around the 4-gigawatt, you would need approximately two of those alternatives that we're looking at, plus interconnecting them so that they're not just radial and they're integrated together.

And the other thing is, too, as we look forward in the longer term is, is there a potential, if there's development of offshore wind towards the Oregon area, is there a potential of interconnecting which then makes a parallel DC type path, parallel to the existing AC path in the central portions of the border of Oregon and California as the backbone of the system?

And then as we look at it, as well, is there, with those Call Areas, any potential of an offshore-type grid? And as we look at that, some of this is the depth and floating platform substations and technology where those are the things that will need to be looked at.

So that's, as we go to the next slide, that's really what we had looked at in the 20-year outlook.

And then as we move to the 2022-2023 transmission planning process that we're currently in, this slide, and this just really indicates the same as what David had talked about, but as we're looking at the load forecast, you can see year over year the loads have been increasing. The green line really was, effectively, earlier what was adopted by the CEC as their baseline forecast for the 2021 IEPR.

In July, as we worked through it, working with the CEC, as well as CPUC, like David indicated, the CEC adopted a scenario of a high transportation. And that's actually what we're using as the baseline in our transmission planning process for this year's cycle, as well as, as David indicated, that's a driver for the 2022 -- or 2023-2024 -- IEPR and the portfolios that are used. So the load has been increasing.

And as David indicated, the generation portfolios that we have, have been increasing from the 2022 10 gigawatts. 2021, which was approved by our board in March had about 27 gigawatts in an over ten-year period. The current planning process has 40 with the sensitivity that

David indicated as to 86 gigawatts. And then, like he said, indicating in terms of in the 2033 and the 2035 time period for the portfolio that is very similar to the draft and proposed for next year's transmission plan. And then the 20-year outlook had 120 gigawatts in it over the 20-year period.

And as you look, as we're getting to, particularly, this year's sensitivity and next year's, we're getting on that kind of path now of really looking at somewhere in the 7 gigawatt per year of interconnection resources that are required to get to that requirement. And also, then, continues on, so it's not like earlier with the near term. And then to get to 2040, we're on that path now of identifying what is needed for resources and then for ourselves, identifying what transmission is needed on that path to the 20-year timeframe, or 2040, with 120 gigawatts.

And if you go to the next slide?

This really just summarizes the same as what we had. It just shows the mix of the resources, similar to what David’s graphs have, and shows, really, as we look at this year's portfolio with 40 gigawatt there is 1,700 megawatts, the majority of it in the base portfolio. The majority of that is in the Morro Bay area, but there is -- and I believe it's about 120 megawatts in the Humboldt area, not as a resource adequacy or deliverability, but as an energy-only being assessed in this year's cycle.

And then as we look at the sensitivity portfolio, that increasing the offshore wind, as David indicated, as well as the out-of-state and resources all along, and how that transitions to really what kinds of portfolios as we get to the 2040 timeframe to meet the state goals.

And so as we're going through it -- so we'll be doing the -- we're doing the base portfolio for 2032 as part of our studies. And if we identify transmission needs that are associated with that, those would be projects as policy, or if they were reliability needs, but a lot of this will be based upon the policy needs of what transmission are policy-driven that we would need to take to our Board for approval.

And in addition, we're doing the sensitivity study for 2035 based upon the portfolio that's identified here. And we'll look through as to is there anything -- is there potential of needs that we're seeing in that near-term that we may want to be approving to look into the longer term, as well.

And so that's where we are right now.

If you go to the next slide?

We're at the stage right now, we did our reliability analysis. We provided the results to stakeholders on August 15th. We had a stakeholder meeting on September 27th and 28th on the reliability needs and have taken comments on those. And we'll be having a stakeholder meeting November 17th, so a week from today, looking at the preliminary policy and economic results based upon the base portfolio, as well as what we're seeing in the sensitivity study. And so we'll be presenting those results on November 17th, like I said, a week from now. The market notice for the meeting has gone out today, so you can find that on the ISO's daily briefings in that market notice if you're not subscribed to our -- those briefings.

So that's kind of where we are right now in the process. Like I say, we'll be presenting the results of that analysis, the preliminary results of both the policy and economic study assessments based upon those portfolios, like I say, the base and the 2035 sensitivity, on next Thursday on November 17th.

So I think that concludes what I've got for presentation, and then we can move on. And this is just my contact information if need be.

MS. JONES: Great. Thank you so much, Jeff, and sorry for mispronouncing your name.

At this point, we're going to take --

MR. BILLINTON: No worries.

MS. JONES: Okay. At this point, we’re going to take a five-minute break, so let's say we're back at 2:05. Thanks very much.

(Off the record at 1:59 p.m.)

(On the record at 2:05 p.m.)

MS. JONES: Alright, welcome back, everyone.

We are now going to move on to our next presentations. First, we're going to have Arne Jacobson, and from the Schatz Energy Research Center, who will present on a number of their studies. Also, Jim Zoellick will be joining him.

So go ahead and start, Arne. Thanks.

MR. JACOBSON: Thank you very much. Pleasure to be here as part of the session.

Maybe if you could advance?

So one of the things that we'll focus on in our presentation is a study that we're just at the beginning of, which is looking at transmission requirements in relationship to the potential for offshore wind development at a fairly large scale in Northern California and Southern Oregon, and looking at that, a number of those options, together as a grouping. And so we'll spend a little bit of time talking about introducing that very briefly, then spend a bit of time talking about how that builds on some prior work, and then return to a focus on this particular study and the scope and some notes related to scenarios that we're setting up for it. And as noted, I'll be presenting directly with my colleague, Jim Zoellick.

Next slide.

So this current study that we're working on is based on a contract that we have with the California Energy Commission. And it involves collaboration between the California Energy Commission, the Oregon Department of Energy, and the U.S. Department of Defense. And in terms of the project team, on our side, the Schatz Energy Research Center at California State Polytechnic University at Humboldt, or Cal Poly Humboldt, is the lead. And we're working very closely with partners, including Quanta Technology, the National Renewable Energy Laboratory, Mott MacDonald Engineering, H.T. Harvey & Associates, and Conaway Geomatics. And really pleased to be working with such a talented team.

Next slide. And maybe advance one more as well?

So I think it probably goes without saying that part of the motivation here is the very large wind resource on the North Coast of California and the Southern Oregon coast and the potential that both of these regions have to contribute to climate and clean energy goals in the respective states.

Next slide or advance.

The transmission capacity is a significant barrier for offshore wind development in these regions. And so we're interested in understanding what the parameters and possibilities are here.

Next slide.

So the objective of this particular analysis is to assess alternatives for transmission for multiple large scale offshore wind development scenarios involving sites between Coos Bay and Cape Mendocino. The three areas that are shown here include the Humboldt Wind Energy Area, which is, of course, proceeding to a lease auction early next month, as well as the Brookings and Coos Bay areas that have been identified by BOEM, but are in an earlier stage in the possible leasing process.

Next.

We'll also end up considering the possibility of offshore wind in additional areas, primarily looking at the area offshore from Del Norte County, as well as offshore from Cape Mendocino. There aren't defined areas or officially defined areas there and the rules of action there are just indicative, not based on any particular analysis. But we are in the process of working to define what wind farms could look like in those areas as we consider scenarios.

Next. And one more. Yeah.

So this work will build on prior analysis by our team, as well as by others.

If you could advance maybe twice?

So one of the things that we'll be looking on is -- or building on is the analyses that have been done related to the Humboldt Wind Energy Area, including two separate studies, one by the Schatz Center, jointly with Pacific Gas and Electric, which involved results that were published in 2020 and 2021, as well as the California ISO studies that Jeff just -- Jeff Billinton just mentioned. Those studies looked at a full buildout of the Humboldt Wind Energy Area with installed capacity on the order of 1.6 to 1.8 gigawatts and ended up with a range of estimated costs. And I'll talk a little bit more about those studies subsequently.

Following that, our team, working together with Quanta Technology and NREL, carried out a study to try and understand the potential for initial development of offshore wind in the Humboldt Wind Energy Area, trying to work within the existing transmission infrastructure, just with the idea that transmission upgrades could take some time to materialize and wind developers may be looking to do something in the interim to get started.

And so that work indicated that something on the order of 150 megawatts of offshore wind capacity could be developed without upgrades in the Humboldt Wind Energy Area. That result is somewhat sensitive to assumptions about load growth and a few other things, but something on that order.

Next slide or next advance.

In addition, we'll be drawing from some studies that have taken place or are underway in relationship to offshore wind development on the Oregon Coast. And they're primarily looking at work by Pacific Northwest National Lab and NREL. And some of the work that's been done to date indicates that something on the order of 2 to 3 gigawatts of offshore wind could be interconnected along the Oregon Coast without significant upgrades to transmission infrastructure.

Next slide.

So as has been mentioned, BOEM is holding a lease auction on December 6th, which will include the Humboldt Wind Energy Area, as well as the Morro Bay Area. And various estimates have indicated that a full buildout could be something on the order of 1.6 to 1.8 gigawatts. The area is divided into two lease blocks, and so that would be two different developers, the installed capacity for two different developers combined, if it were to reach that full upper bound.

Next slide.

As we've noted, transmission capacity is quite limited. And the terrain along the existing transmission routes is fairly rugged.

Next slide.

So this slide shows the transmission infrastructure in the region. I wouldn't say that Humboldt County is an energy island, but more something of an energy peninsula in terms of having very limited connections currently to California's main grid.

Maybe you could advance two or three?

The regional load is concentrated in the Humboldt Bay Area and the average load is on the order of about 100 megawatts. Local generation is needed to power -- to supply power in the region. And there's -- the primary role for supporting load in the region or for ensuring stable operation of the grid in the region falls to a 163-megawatt natural gas-fired power plant, which is the Humboldt Bay Generating Station. And there are additional generating sources in the region, including some biomass plants and a few small hydropower plants, but the natural gas plant plays that primary role.

Next.

And, of course, the major transmission corridor is run north-south in the Central Valley, fairly far inland.

Next slide.

So that setup can be represented graphically, as is shown here. And so the two main transmission lines that currently connect the Humboldt region to the main transmission corridors are redundant 115 kilovolt lines, one running roughly along the Highway 299 corridor and one running roughly along the Highway 36 corridor. And then there's two additional 60 kilovolt lines, which are mainly there to support communities along the way.

Next slide. So maybe you can advance two more?

So in terms of looking at a full build out, as I mentioned in 2020, PG&E and the Schatz Energy Research Center identified several overland and undersea transmission alternatives. We were looking at an estimated 1.8 gigawatts of installed capacity in the Humboldt Wind Energy Area. And the California ISO conducted a fairly similar -- or a study with a fairly similar set of assumptions. They assumed a 1.6 gigawatt of installed capacity in the Humboldt Wind Energy Area. And the cost estimates for transmission upgrades for those two scenarios were, or under those two studies, were fairly similar.

Next slide. And maybe advance? Yeah. Thank you.

So for the PG&E and Schatz Center study, assuming 1.8 gigawatts of installed capacity, we looked at four different transmission alternatives. One was an alternative that involved an overland route initially to the east and then to the south, connecting through the Round Mountain substation and then eventually down to the Vaca-Dixon substation. We also looked at a route that we called the southern route, but it essentially followed a south-eastern route that would find its way down to the Vaca-Dixon substation as well. These are, of course, not exact routes. They're basically just lines drawn between points.

In addition to those two overland routes, we looked at two undersea cable routes. One was a near-to-shore route and one was a far-from-shore route. And the estimated cost for upgrades for those various alternatives are shown here. So we are looking at costs on the order of $1.7 billion to $4.4 billion, with the somewhat higher costs associated with the undersea cable route.

Next slide.

Just talking a little bit more about the undersea cable alternatives that were studied, we, of course, looked at the near-to-shore and far-from-shore. In doing those analyses, we considered technical, environmental, and geologic constraints. This work was done in partnership with Mott MacDonald Engineering. The areas that are shown in black on the map were essentially no-go areas for undersea cable. Those are primarily subsea canyons that need to be avoided both for geophysical and also for ecological reasons.

In addition, there were areas where major mitigation would be required, those are shown in red, and those primarily correspond to marine protected areas. The red lines also correspond to existing subsea cables, primarily telecommunication cables.

Not shown in this analysis, because they weren't there at that time, are some additional fiber optic telecommunication cables that now come into Humboldt Bay. Those were installed more recently than this analysis and would also have to be considered in relationship to developing any undersea cable routes.

And so the routes that were -- or the corridors that were identified here were developed to minimize the amount of mitigation that would be required. And, I guess, in looking at those routes or thinking about those routes, the near-to-shore routes, I think, are -- involve challenges associated with the canyons themselves and avoiding those canyons, as well as the marine protected areas. The far-from-shore route avoids some of those challenges but ends up involving subsea cables in very, very deep water on the order of 3,000 meters for segments of that route.

Next slide. And maybe I'll advance two more, and maybe one more after that?

So I'll just summarize this quite quickly because Jeff Billinton just presented on this, but just noting that the California ISO conducted an analysis for a somewhat similar set of scenarios and ended up with estimated cost ranging from $1.2 billion to $3 billion for the 1.6 gigawatts of installed capacity in the Humboldt wind energy area, so somewhat similar cost to the prior study that we did with PG&E.

Next slide.

So those analyses were looking at, a full build out of the Humboldt wind energy area. We, as I mentioned, also conducted analysis related to identifying options for developing offshore wind within the bounds of the existing transmission infrastructure, or with just modest investments and upgrades, to try and understand the economics, both the cost and the revenue associated with those sorts of options. And this is work that was done jointly with Quanta Technology and NREL.

Advance.

So we analyzed transmission requirements for multiple offshore wind development scenarios in the Humboldt Wind Energy Area with wind farms up to about 500 megawatts.

And advance. And maybe two -- maybe one more? Yeah.

And so we ended up conducting revenue analysis for selected scenarios within that, as well as assessing the wind farm economics.

Next slide.

And so in terms of conclusions -- if you could maybe advance all the way down to the bottom there? Yeah.

The, I think, main conclusions coming out of the assessment of the small -- the study of a small potential project is that a small project can be built without transmission upgrades if it's interconnected on an energy-only basis rather than on a full deliverability basis. Going beyond an initial project would require fairly significant investments in transmission infrastructure.

The recommended size for an initial project might be on the order of 140 to 150 megawatts. This result does end up being sensitive to assumptions about load growth, as well as about other generators that might be present in the region over the coming -- over the period between now and when the system is installed.

The economics of developing that kind of a project of that scale are challenging, especially in the absence of federal tax incentives. This analysis was done before the Inflation Reduction Act was passed, and that certainly addresses some of the concerns, but the project economics are nonetheless going to be challenging for a project of that size. Adding storage can help improve project economics.

We also looked at a very preliminary way at hydrogen generation from curtailed or low-cost power. And there may be some applications where that could be potentially viable, as well, at the -- for a project of relatively small scale. But our sense or our assessment was that because of the challenging economics, developers are -- perhaps may be interested to develop this type of a project, but as a starting point for scaling to something larger in the anticipation of transmission solutions coming into play in subsequent years, in the not-too-distant future.

Next.

And so I now want to pass things over to my colleague, Jim Zoellick, to talk a bit about the current study that we're undertaking and some of the parameters associated with that one.

So take it away, Jim.

MR. ZOELLICK: Great. Thank you, Arne. Can you hear me okay?

MR. JACOBSON: Good.

MR. ZOELLICK: Thank you. So, yeah, I'm going to cover the next five slides here that will complete our presentation and just go a little bit into more detail, not a whole lot, but a bit more detail about the objectives and scope of our current study.

So the first two slides here really kind of reiterate what Arne said at the start of our presentation. So we'll be examining an array of transmission alternatives for large-scale offshore wind development, basically from the Cape Mendocino area to the south, which is kind of the bottom of the map that you're seeing there, and then as far north as the Coos Bay Call Area in Southern Oregon, so covering both Northern California and Southern Oregon. And we'll be looking at the offshore wind development from, primarily, five areas offshore, the Humboldt Wind Energy Area, which the auction, as people have talked about, is in about a month, December 6th, and then the two call areas that have been defined by BOEM, the Brookings Call Area and the Coos Bay Call Area.

And then if you can go to the next slide, please?

And then also, as Arne mentioned, these two hypothetical call areas, well, I guess they're not call areas yet but sort of notional areas off of Del Norte County in Northern California, so that's the one just south of the Brookings Call Area, and then further south, the Cape Mendocino area, and those areas being some of the best wind resource, but certainly for Cape Mendocino being some of the most remote as well.

And we will be working with the team at the CEC, Scott Flint and others that are working on the seaspace analysis, in particular, for those two hypothetical areas. The others are already sort of defined in terms of their geographic location, but the Cape Mendocino and Del Norte are not. And I know the work that Scott and his team are doing is really trying to look at a bit of definition for those two areas. So we'll be working with them and kind of taking their lead, probably, for the what we -- you know, the assumptions we make when we're looking at offshore development in those two locations.

Next slide, please.

So also as Arne talked about, and his focus was a bit more just on the Humboldt, you know, Humboldt Bay area and the Humboldt Wind Energy Area, but really for this study that we're embarking on right now, so looking at Northern California and Southern Oregon, it's the same story along the coast. There's a little more transmission infrastructure in Oregon, but really, as this map shows, the major transmission infrastructure runs north and south along the I-5 corridor, or largely and even a little bit further inland.

So the map there on the right is basically showing those two call areas and the Humboldt Wind Energy Area, and then existing transmission infrastructure. The color of the lines is the transmission line ownership, though I think there may be some slight adjustments there to be made.

And then the size of the lines is indicative of the voltage, and therefore the capacity of those lines. So the smallest sort of thinnest lines, it looks, primarily, in blue and red there, and maybe some purple, are as small as 50 to 60 kV and 115 kV, a little bit fatter. And then the biggest ones going up to 500 volts AC. And that real fat line to the far right there, I believe, is the Pacific DC intertie that is this high voltage DC line coming down from Bonneville.

So, yeah, so, you know, the real -- I think one of the real challenges here is how do we interconnect this very substantial offshore wind resource, you know, aiming toward the 25 gigawatts by 2045 that's part of California's policy goals? How do we get that to the load setters?

And as Arne mentioned for Humboldt, the load is really quite modest, and that's the case along the entire coastline, which explains why the transmission infrastructure is so modest. You know, its basically the main power flow is up and down that I-5 corridor, and then these smaller lines feed the modest load on the coast. The system was not designed to, you know, access coastal resources and shift that power into the main transmission backbone and then on to the load centers.

So that's really, you know, the focus of this study, and I'll say a little bit more about a few of the other aspects, but really the focus is on transmission and looking at a set of alternatives and, as Arne said, a set of alternatives that's an integrated approach to developing offshore wind at scale from Cape Mendocino all the way up to Coos Bay. I think that's about it for that one.

Next slide, please. Great. And you can -- if you can kind of -- there, perfect. Thank you.

So this just goes a little bit deeper, this slide and the next, into our scope of work and the tasks that we will be completing. This is going to be a pretty fast study. One of the main -- sort of impetus for this, not in its entirety but a big impetus, is to develop this information of looking at these various alternatives as input to the AB 525 Strategic Plan, which is due in June. So we're looking to get this study done, you know, the results of this prior to that June deadline. I think our final report is due in July, but really the results of our study are aiming for prior to the deadline for the 525 Strategic Plan.

And so, you know, we're trying to accomplish a fair amount in a short period of time. We're just getting started. We just got ourselves and our subcontractors under contract and had our kickoff meeting very recently. So we're just ramping up. We're, essentially, in tasks one and two at the moment. We're compiling and assembling all the data we'll need, generation, transmission, infrastructure, energy storage, electrical loads. Quanta Technology will be doing the transmission analysis. It's talked about there in -- under number three, power flow and production cost analysis. They'll be accessing the WECC Anchor Data Set for this study. And so right now we're assembling that data.

We're also gathering existing studies. So, you know, I know Jeff Billinton talked about the transmission planning study that CAISO had done. Pacific Northwest National Labs has done some work and is doing work currently that's kind of in parallel with what we're doing. NREL is also on our team and has done some previous work, just in the process of getting a BPA cluster study.

So we're trying to, you know, pull together all of the work that's been done to date so that we can build on what's been done and not duplicate it unless we decide there's a good reason to do so. And yeah, so, you know, we'll be putting this information together. We'll be developing maps to -- you know, for presentations and reporting and so forth, but also all of the data that we gather on existing infrastructure, as well as any proposed, you know, for instance, if there was a new proposed transmission route or an upgrade to it on an existing route, perhaps an expansion of a right-of-way, that sort of thing, all of that kind of information will be in GIS format and part of our scope is to provide that to the California Energy Commission.

And then my understanding, and folks at the Commission could clarify this, but is that that will be made available through the Offshore Wind Gateway and Data Basin, and so that work is in process.

Really the next thing, once we've got the baseline data in place, is to start to develop what the scenarios are that we'll be able to evaluate. And obviously, they're limited based on scope and budget, and especially timeline. But we'll be looking at a range probably between about 5 to 25 gigawatts. Likely, at least what we've discussed so far with our Core Steering Group, is likely focusing on that, on the mid-range there, probably 10 to 15 gigawatts.

We'll be looking at offshore wind development from any of those five offshore wind areas and/or combinations of those five areas at various scales. We'll be looking at undersea cable routes, undersea cable, you know, sort of backbones that tie multiple areas together and then perhaps, you know, a single onshore cable landing, or perhaps multiple onshore cable landings. We'll be looking at various overland transmission routes, as well as perhaps undersea cable route, too, such as -- that was discussed, that was looked at in a previous study for us and CAISO, as well, down to the San Francisco Bay Area or could be in some other direction, perhaps, as well. So, you know, we'll be working to define what those scenarios are based on because the work has been done to date and what people think is the most important options to look at.

And then Quanta will be doing the power flow analysis to determine what upgrades are needed over the existing system and what the cost of those upgrades would be. And then probably with a down select from ten scenarios for the power flow, we'll be looking at production cost analysis for six to seven, which will provide some additional information in terms of, you know, an 8760 (phonetic) look at the resource and the load profiles and constraints on the system and perhaps the need to curtail the resource and how that might impact wind farm revenue. And then that production cost analysis also will develop -- will provide, you know, sort of economic benefit, revenue potential from these developments.

And then our partners at NREL are developing the offshore wind development and operational costs for the cost analysis. And then they will also be taking all the costs and the revenues and looking at the levelized cost of energy and sort of doing some cost benefit analysis.

Next slide, please. Great. Thank you.

And so this is our last slide, other than our contact information.

So I mentioned there, you know, that the focus is on the transmission assessment. But, you know, we wanted to make it clear that we’re not -- that that's not being done in a vacuum or being done without acknowledgement and, you know, adjustment for many -- the many other issues that need to be considered when we're talking about the development of these resources and how we interconnect them into our existing infrastructure and where new infrastructure may be located, et cetera.

So certainly -- and I know, you know, the folks at the CEC doing the seaspace analysis and probably other aspects as well, transmission and so forth, you know, looking at things like existing uses, whether it's of the ocean areas or the overland areas and, you know, so conflicts with existing uses, concerns from local communities, environmental considerations, you know, certainly, obviously, things like, you know, marine protected areas, national parks, areas with endangered species, all those sorts of things, it'll be a high level. This will be based on, you know, existing information from existing studies.

A couple of other partners are H.T. Harvey and Associates, and they'll be doing the permitting and environmental sort of review of these various scenarios, again, at a very high level.

And then Mott McDonald is going to be looking at some of the undersea options, and so providing, you know, more information about potential conflicts, potential issues, which may influence both what scenarios we choose to evaluate through the transmission analysis, you know, task, or what the final recommendations are based on both the cost and benefit analysis for the transmission analysis but also these other, you know, constraints and things that need to be considered that go beyond just the pure sort of physics of the wind power and the wind energy market.

And also, certainly, part of what another big piece of this is military mission compatibility. And, you know, I think largely, part of what motivated this study of the focus on Northern California and Southern Oregon, in part due to the to the vast resource available here, but also the fact that there are a lot of issues with regard to DoD operations from Central California and Southern California for development of resource in those locations.

So, yeah, you know, our anticipated timeline is some preliminary results by even late March into April, and then sort of final results probably late May-June, with a final report by July of next year.

And that's all we had for you, but I'm sure we're able to answer questions at the appropriate time. Thank you.

MS. JONES: Thank you very much, Jim and Arne.

We are now going to move on to our next presenter, who is Jeppe Lundbaek from the Danish Energy Agency. He and Peter Markussen from Energinet will be speaking about experience in Denmark with transmission.

MR. LUNDBAEK: Thank you very much for this kind introduction. And, also, thank you very much for being part of this very interesting session today. I'm Chief Advisor at the Danish Energy Agency. And I'm presenting here on some Danish lessons learned on grid connection related to offshore wind farms. And I'm doing that because we collaborate internationally with a number of countries, one of them being the U.S., where we have partnerships with BOEM and California Energy Commission and some other partners.

And also I would say that I have been working for the last five years on the offshore wind farm, which is the latest tender in Denmark. So through this presentation here, I hope I'll be able to give a little bit of an idea of how we work in Denmark on what I would call a planned transmission or integrated transmission. So it's a setup where we really tie in how we work with offshore wind farm planning and transmission. And that's also why my colleague Peter Markussen from Energinet, the Danish GSO, will present immediately afterwards.

Next slide, please.

So if I can first give you an idea of how we work in Denmark and where I come from?

As you can see here, the organization is so that we have nine centers at the Danish Energy Agency. It's actually sort of a combination of what BOEM is doing and what the CEC here in California is doing. And it also needs to be explained that in Denmark we have a more simple setup for offshore wind than in the U.S. We have what we call a one-stage tender model, where, in the U.S., you have a two-stage model, similar to the one in the U.K., where you first need to win a lease right from BOEM at federal level, and then you get a PPA offtake at state level at a later stage.

This is something we do in one stage in Denmark. And that's done through the Danish Energy Agency, which is a government agency under the Ministry of Climate, Energy and Utilities.

So, basically, the responsibility of my agency is doing most of the things that BOEM and the CEC is doing. So we do the regulation on offshore wind, maritime spatial planning, site selection, solicitation of tenders or solicitations of offshore wind farms, and permitting, also, of the wind farms. And then what we were talking about today, we do grid planning of offshore wind farms in a close tie together with the TSO. We are about 800 people working at the Danish Energy Agency, and the TSO has an even larger organization.

Next slide, please.

Just to give a little bit of background to some of the listeners here that are maybe not so familiar with Denmark, I'll just briefly give you an introduction to the Danish Energy and Climate Policy targets.

So what you see here on this slide is, first of all, that Denmark is a very small country compared to the U.S. and to California. So Denmark is approximately the size of New Hampshire and Vermont combined in area. And population-wise, it's similar to Massachusetts where we're about 5.6 billion people.

If you look at what is the status on the energy system in Denmark today, it is so that we currently have 53 percent of our electricity being renewable, renewably produced. And we have three percent wind power that is being curtailed and that's mostly because we have some bottlenecks on our interconnectors with neighboring countries. It's not good to do any curtailment at all.

And we also have a very high security of supply, even though we have a very renewable-based system. So even with a lot of wind and solar, we only have about 20 minutes where somebody is out of power in Denmark per year. This is the highest in Europe.

If we look at the targets, we have quite some ambitious Climate and Energy Policy targets. So by 2030, in seven years, we should be 100 percent green electricity. And also in 2030, we should have reduced our greenhouse gas emissions compared to 1991 levels by 70 percent. And the long-term goal is being climate neutral by 2050.

Next slide, please.

When we look at the current Danish energy system and energy mix and performance, it looks like this.

Can I have the next slide, please? Yeah. Thank you.

So this is the one showing the Danish energy mix and what it looks like today -- or as of 2021. We have 4.7 gigawatt onshore wind and 2.3 gigawatt offshore wind, and PV solar at 1.4 gigawatt, and some thermal plants, 6 gigawatt. And we also have, which is an important feature, interconnectors to a number of countries, and that adds up to 7 gigawatt. So we have seven interconnectors, Sweden, Germany and Holland are being built to the UK. And as you can also see here, the peak demand is 7 gigawatt. Yeah.

And then if we look at some Danish power system records on wind and solar, we've had months in 2022, we’re at 79 percent.

Oh, sorry. You went for the next slide too early. Could I have the slide, “DK Wind and Solar Driven System?” One back, please.

MS. JONES: Oh, I see it.

MR. LUNDBAEK: You see it?

MS. JONES: Yeah.

MR. LUNDBAEK: Okay. I don't see it.

MS. JONES: It’s --

MR. LUNDBAEK: Okay.

MS. JONES: -- right there.

MR. LUNDBAEK: Sorry. Okay. Yeah. Thanks. I'm sorry. It works a bit slow on my computer here. Great. Yeah.

So I was just saying that here are some records showing the performance of the Danish system. So we've had months where 79 percent of electricity was renewables. We've had a day in ‘19 where we had 130 percent. And we have also had an hour where we were up to 166 percent.

And how can this happen? That's because of our interconnectors where we exchange energy with neighboring countries. And this is done in a very market-based approach. So we exchange energy in accordance with the energy prices, the electricity prices in neighboring countries, so we can export if we have enough resources and prices are higher in a neighboring country and vice versa. And this creates quite a robust system. And it's important to have a lot of resources to rely on when you go into a very renewable-based system like this.

Next slide, please.

So just a quick view at what are the Danish plans for buildout of offshore wind. As already mentioned, we have 2.3 gigawatt offshore wind at the moment. This does not sound like a high figure but it's split over 15 offshore wind farms, and the first one was built in 1991, so wind farms have been growing in size. And it's not until the last five to seven years that you see wind farms coming up in sizes of 1 gigawatt and more. So I would say we learned a lot of hard lessons in building these 15 offshore wind farms.

Currently, we also have 1.4 gigawatt under construction. And we have 9.2 gigawatt planned up to 2030. And after 2030, we have the energy islands being planned.

So we have one in the North Sea, which would be an artificial island 100 kilometers from the coast of

Jutland. You can see that on the right-hand figure. It will be built in two phases, a first phase of 3 gigawatt and a long-run phase of 10 gigawatt.

We also have in the eastern parts of Denmark, near Bornholm in the Baltic Sea. We also have an energy island planned for 3 gigawatt wind, which I think Peter Markussen from Energinet will touch upon later. The long-term target is more than 35 gigawatt in 2050 as we have a lot of room in the North Sea and a relatively large sea territory compared to the size of the country. And so this will be one of our main sources or the main source of energy that would be offshore wind.

I should also mention that this is not floating but bottom-fixed. We are fortunate in Denmark that most of our sea territory is less than 50 meters deep, so we can use less costly bottom-fixed motor piles for our offshore wind farms, which helps drive down the price. And we do have a little bit of sea territory in the eastern part of Denmark, near Bornholm, where it's deeper where we could be using floating if that should come into play.

I think the key takeaway here is that, as you can see on the graph, we are actually standing in front of plans for increasing offshore wind fivefold in the next seven years, so we are also in a hurry in Denmark.

Next slide, please.

So this was a little bit of background to the system in Denmark and the size and what we are aiming at.

So now turning to how we do offshore wind in relation to grid connection and transmission, I'll provide some words on that in the next slides.

So on this slide you see the Danish process in a nutshell, which is what I would call centrally planned transmission for offshore wind, or to a high extent a very integrated setup when you plan offshore wind tenders and do transmission planning.

All our offshore wind farms, they start with a political mandate, so there will be a political agreement. I'll be using the case of the offshore wind farm as the latest one that comes out of our 2018 political agreement, where our parliament, looking at how to achieve 2030 targets, decided that 2,400 megawatts at that time should be based on offshore wind.

This mandate is passed on to the Danish Energy Agency, where we get the order for planning for offshore wind. Then the Danish Energy Agency is passing this message further on to TSO to start planning for the required grid connection for these megawatt offshore winds. And that's where an order will be sent at the beginning of the tender process or solicitation process for an offshore wind farm. And at the end of this tender process, the business case, the investment decision for investing in the grid will be approved by our Minister.

This also means that already, from the outset, there's a very tight partnership between the Danish Energy Agency and Energinet. So we have two dedicated teams working together on planning all this.

As also shown on this slide, part of the setup is that we always promise guaranteed grid access as part of our offshore wind solicitations. And this is something that is agreed in the tender process between the bidders and the TSO, when should first power be delivered, and this is then written into the concession agreement which is the contract between the winning party of a bid and the Danish government.

It is also so that with this guaranteed grid access comes an obligation for the TSO that if they should be late, then there's no guarantee for this grid access. So that means that the winning bidder will actually be compensated for that. This is written into the contract and it will then, if the TSO should be late, it is so that you will calculate the kilowatt hours that could have been produced and these would be compensated based on the electricity prices in this period. This is something that helps drive down prices for offshore wind in our tenders because it reduces the risk premiums in the face of bidders. So we think that this is a key step or key feature of our tenders.

On the last bullet here, you can also see that the concession winner developer of our tenders would be subject to a penalty if they're not building the wind farm according to the agreed timetable, and this is besides having, you can say, the economic incentive to be building the wind farm quite fast once you've won the tender. Then we also nudge winning bidders to build the wind farms on time so we don't get late in the queue competing with other countries in Northern Europe.

Next slide, please.

So this slide here is a busy slide and it's hard to read, but it actually shows the governance and decision-making process and what we call one-stop shop in Denmark. And this is definitely much more easy to do in Denmark because of the way we have set up the regulation of offshore wind. So this one-stage model I explained before, that we play both the role of BOEM and what is being done at state level with the offtake.

Nevertheless, we also need to do a lot of coordination in Denmark. So what you see here is how all the line ministries coordinate and where the Danish Energy Agency and our ministry is sort of the one-stop shop or the lead in all this. So everything is being cleared across line ministries, for example, the Department of Defense or the Danish Maritime Authority on shipping lanes and stuff like that, or it could be the Environmental Protection Agency in terms of permitting the onshore part of the grid and so forth, this is all being cleared at one clearing house at the Danish Energy Agency as part of the setup.

On the right hand side, you can see how the process works. You can see up and down. So we have a dedicated Energy Agency Project Team. And I have been leading this one for our latest tender, and that's where we coordinate with Energinet, the TSO. But otherwise, all decisions being made in the tender goes up to the political parties when we need to clear some of the higher decision points. Otherwise, we have the responsibility to push the project forward.

If I should give some examples of what is being cleared in the process going upwards to the ministry and to the political parties, it could be the subsidies or support scheme for such a tender. It's also the specific location of the site. It's issues like the cost of the grid connection and the timetable for building the onshore wind farm and the grid connection. This is all tied into this process.

Next slide, please.

So this slide shows how we at the Energy Agency select sites for offshore wind based on what would be the most favorable sites in terms of wind resource and seabed conditions. This, I think, is very similar to what is going on in the U.S. with BOEM and authorities here in California.

You can see here on the lefthand side some sites that we explored prior to picking the offshore wind farm site. And on the righthand side, you see the grid, the onshore transmission grid and distribution grid in Denmark. And then the idea is to ideally pick sites where you have a combination of a good wind resource and good seabed conditions, and also a relatively easy planning and permitting process. And finally, some ideal grid connection.

So could we find places where we need less transmission upgrades? And where would be the ideal cable corridors? Where would we have good landfills and so forth? And that looks very similar to some of the stuff we just saw from the Schatz and from Jeff Billinton at CAISO. So I think this is quite a straightforward process.

Can I have the next slide, please?

I would like to emphasize that one thing we believe very much in is market dialogue. We learn a lot by talking very, very closely to developers and potential bidders. What I'm showing on this slide is sort of the front page of -- this is a 20-page primer for market dialogue, invitation to dialogue, for the offshore wind farm project. And as part of this dialogue, we discuss timetable conditions for prequalification, the subsidy scheme and award criteria, penalties, and as I show here on the screen, number seven here, the grid connection. So this is an opportunity for us, quite early on in the process, to show and align expectations with developers on how is it actually that we intend to grid connect, in this case, the Thor offshore wind farm and what would be the process?

So you can see, this is a basic layout of the wind farm, the offshore substation, export cables, the point of connection or point of interconnection, as you call it here, and how it connects to the overall transmission grid.

What we find is that, through a robust market dialogue with developers, we can actually have a better informed project, less risk of running into trouble later, and also less risk -- or less risk premiums because developers, they have more transparency on the setup.

Next slide, please.

On this slide, I'm just showing you how it looks when you look into what we call the electronic tender platform for the offshore wind farm.

So as part of a tender process or solicitation of an offshore wind farm, the prequalified bidders have access to all the documents, roughly 20 documents, describing all the features of this project. I just mentioned a few of these. But, otherwise, this is something everybody can have a look at. It's available to everyone. It's in English. It's both in Danish and English. But because most of our bidders are also companies from outside Denmark, actually, we have all documents in English.

But three key documents here. One is the draft consistent agreement on the obligation to establish an offshore wind farm and connect it to the grid, where all the specifications and the terms are lined up prior to bidding, to providing a bid from all bidders.

We also provide all the permits you need. You need three permits offshore, and they are provided as what we call model permits, so they are in draft form but they will look very much like what you actually will be facing after you’ve won a tender.

And in terms of grid connection, we provide a number of grid connection agreement documents where grid connection interfaces are being described and where you can get a good understanding of exactly how the grid connection should take place.

Next slide, please.

So I have a bit of a sore throat here, so excuse me for being a little bit coughing here.

On this next slide here, it's a bit of an overview of how the tender documents are showing the offshore cable corridors and the landfall, and also the point of connections, and also exactly where the onshore substation would be situated. And normally we will have cleared a cable corridor up to the substation, because that's where you can get into trouble with landowners. So we have described the rights of way, and this is defined exactly what happens so that bidders can be comfortable in going forward with this project.

At this stage, the TSO/Energinet will have made a cable corridor where they try to avoid most conflicts with landowners. There's also some land parcels that need to be bought. Some of this will be bought just when the tender has been concluded. And it's also specified in the tender conditions what will happen if landowners need to be compensated. And also, if they will not sell their land, then we have some expropriation rules that we can use.

Next slide, please.

On the next slide here, I'm showing how some of our more recent learnings in Denmark is concerning where we locate the point of connections -- point of interconnection.

So until 2018, it has been shown that the TSO has been building the onshore substation and export cables. And after 2018, we found it more optimal for developers to build the grid forward to the point of interconnection onshore. The reason behind this is that we found, through analysis, that it's actually so that the developer can do a better optimization, a cost optimization of the whole offshore wind farm and the grid up until the onshore substation.

So in this way, you can say that the offshore substation asset can be optimally designed together with the wind farm and the export cables and their dimensions, and the way they are being run temperature-wise and things like that, can be designed in a more integrated way because the developer owns this whole asset, instead of having a TSO owning the offshore substation.

So previously, the point of interconnection was in a switch gear out on the offshore substation, and that is now moved until, as you can see here, there's two options in option one and option two. So it can either be in a zone with some kilometers of the shore or it could be going forward to the transmission grid. This has something to do with if the part of the grid onshore should be used for other producers, because then it would become what we call a collective grid in Denmark and then it has to be owned by the TSO. If it's just a regular connection going up to the transmission grid without any other producers coming on this cable, it can be owned by the developer doing the offshore wind farm. So there are two options of doing this in Denmark, and it depends on what would be built onshore.

Another reason why it makes sense for the developer to build the offshore substation and the onshore substation is also that in case the developer would like to build some storage, PtX or green hydrogen production or batteries, this can actually be done prior to the onshore substation where you would need some tariffs that would make that more costly. So there are some other features here that makes it good to do it in this way.

Next slide, please.

So this slide shows the timetable from A to Z on building a 1 gigawatt offshore wind farm, like the Thor Offshore Wind Farm in Denmark. In our view, this integrated setup is important if you would like to save on speed, and also cost de-risking this whole project. So you can say, by using this integrated setup, you can actually have the TSO and the developer building a grid in parallel.

And as you can see, it takes about eight to nine years from when decided in parliament to build a wind farm until it's fully grid connected and in operation.

Actually, there's also room for building it faster than that, but that's where the penalty will kick in at the end of the fourth quarter in 2027 if the offshore wind farm in this case has not been built before that.

You can also see in this slide how there is a section on analyses and surveys. This is where we do all the pre-investigations, bird (phonetic) save surveys, all the geotechnical surveys offshore, and then the tender process itself. And then finally, how part of the timetable is on the side of the developer.

I will not go too much into detail, but this timetable is actually something that is being discussed in Denmark at the moment, that it should be even faster than this because we are basically doing a lot of offshore wind. But, for now, it takes some eight or seven, eight, nine years from decision to fully operational, depending on how fast the developer will build the wind farm.

Next slide, please.

And here, just a few words on what the future might look like in Denmark. So this slide is showing the energy island in the North Sea in Denmark. This is not exactly how it will be. This is sort of a hypothetical case, even though some of the things on the map are as they would be.

So the location of the energy island, you have these two areas, Area 1 and 2, green and yellow here. And you, also, you can see the offshore wind farm that is being built at the moment. The argument I would like to make here is that, as in many other countries in Europe, and as you also see on the U.S. East Coast, connecting many offshore wind farms in the same region can create a very busy shoreline and some trouble with all these interconnections they have to go on shore.

So if you envisage that we should build the 10 gigawatt, as we are planning for the offshore -- or the energy island in the North Sea in Denmark, if you look at the lefthand side, if we should gradually connect these wind farms, we would have a lot of cables coming in, and on shore we would have a lot of, probably, landowners that would not be very happy.

The other way of doing this is what we are intending to do on the righthand side, building this energy island, which would be similar to a meshed grid. So the idea is to connect, in the first phase, 3 gigabit to this island, and later up to 10 gigabits, and then that we have these two or three interconnectors, one to Denmark, one to Holland, and one could be going to Norway. So this will ultimately be a powerhouse in the North Sea, both producing offshore wind well out of sight, 100 kilometers from the coast, but also being able to deliver electricity to a number of countries.

So in this way it's possible to source large wind resources in an optimal way. It's easier to export to other countries and then we will have less cables going on shore and, thus, less trouble with landowners. We also, of course, get some optimization on cables. And there's also something about using HVDC cables when you go long distance and using fewer cables, so you can optimize the economic business case.

And then I have just two slides more. So the next one, please, on cost and financing.

I will just show here that here are some developments on our three latest tenders of offshore wind in Denmark. And I think the relevant point I would like to make is that you see a declining curve, so downward trend in costs over time. So there are some learning curve effects as a maturation of technology, and also of the supply chain, and this is something I'm sure you will be seeing in California as well.

Now obviously, you are starting with floating so it's a less mature technology, you also have a less mature supply chain. You'll probably, like us, start with some higher prices and then they'll probably be driven down over time. And that is what should be the comfort zone, that, on average and over time, you'll drive down prices through market volume, through maturing the supply chain.

If we look at what it has cost Danish ratepayers here, you can see that the Horns Rev 3, 400 megawatts, back in 2015 was $6.00 U.S. per year. Kriegers Flak in 20 in 2016 is a 600 megawatt offshore wind farm. And this even has an interconnector through it connecting Germany and Denmark. It's $1.40 U.S. per year. And the latest one, surprisingly to us, we had a zero cent bid. And, actually, it is so because it's paid over a contract for difference that works two ways, that the Danish state will earn money, so we get net payments for offshore wind in Denmark these days.

And this shows you how it can be when you have a mature market, a good supply chain, ports, transmission and everything really being meticulously planned and everybody's ready to do what they need to do, and you can remove risk premiums and so forth.

This also, of course, shows that we have electricity prices in Scandinavia and in Northern Europe that will support the business case in itself, so we don't need to pay any subsidies, and that is why it says zero U.S. per year here.

So I think this is hopefully something that could be comforting for California, that in the longer term you would hopefully be able to see a downward cost curve like we have seen in Denmark and elsewhere.

Next slide, please.

So the final slide is just summing up with some key takeaways and Danish lessons learned and when we look at transmission and offshore wind.

So we have learned that well planned and early identified points of connections and ownership boundaries provide transparency for bidders and this helps reduce risk premiums. We also believe that well planned cable corridors being exposed to robust market dialogue and environmental processes that are really informed will provide a good buy-in from all stakeholders and developers, and also help reduce local resistance and possible appeal cases.

Also the point I made earlier, this guaranteed grid access as part of the tender is something that we've had very good experiences with. And the TSO in Denmark has delivered really well and has never been too late, so we have not been able to -- or we haven't had to pay any compensation. And this, of course, because the planning process has been robust.

I would also say that in terms of saving time, this integrated planning process transmission offshore wind is very important and can reduce the timetable by working in parallel processes.

And all this adds up to what I would call a transparency and de-risking, and that all helps remove risk premiums from developers, resulting in lower bid prices and, ultimately, lower ratepayer costs, which I would assume is important both in Denmark and in California.

So with these words, I would say thank you very much for presenting.

On the final slide you can see my contact details, if anybody would like to get hold of us. And otherwise, thank you very much for having the opportunity to participate.

MS. JONES: Great. Thank you so much, Jeppe.

And next we're going to turn to Peter Markussen to finish out the day, followed by public comment.

MR. MARKUSSEN: Yes. Thank you very much. My name is Peter Markussen. I work for the Danish Transmission System Operator and it's a combination of the ISO, as you know in the U.S., but then also the transmission owner. And we build and maintain the transmission grid in Denmark as well.

So please show the first slide. Yeah. Take the next one as well.

So we have the responsibility both for gas and electricity grid in Denmark, and we have the day-to-day security of supply responsibility with our control center, but we also do the long-term planning. We are owned by the Danish Ministry of Climate, Energy and Utilities. We are a nonprofit organization and then work for the Danish society.

As you can see on the map to the left -- or to the right, we are well connected to our neighboring countries, Germany, Sweden, Norway, also Holland. And we are also building a new interconnector to the U.K., Viking Link it’s called. It's around 500 miles long, 750 kilometers. It will be the longest HVDC cable in the world, 1.4 gigawatts. So it is -- of course, we don't have the same sea depth in Denmark or in the North Sea as you have on the West Coast of California, but still it is possible to have long offshore cables, HVDC.

Just, you know, for information, we do more than 30 crossings when we are now building this interconnector. It will be up and running next year. And it has a cost of around $2 billion. We are building it together with National Grid, the British transmission owner, and we share the costs 50-50 and the earnings as well.

We have integrated around 50 percent of renewables. And the way we have done it, it has been through our transmission grid with the flexibility to our neighboring countries, but it is also done with flexibility in our district heating where we use electricity for heating but also produce electricity together with heat. So the two main sources for our flexibility is transmission and the consumption used for district heating.

So next slide, please.

So what is the challenge we look at? And if we start looking at the figure to the right, you will see the challenges is the same as we also heard from California ISO, that emissions are increasing so it is quite difficult to plan because you actually really don't know how much you need to build to. And here it's showing that in 2030, then last year we expected to build 8 gigawatt of solar and 6 gigawatts of offshore wind, but now it has increased to 18 gigawatts of solar and 8 gigawatts of offshore wind. And if you look towards 2040, then it is also almost a doubling of solar and offshore wind capacity. So it is quite a challenge for us to do that planning.

But a way of doing it is to speed up our planning processes and do a number of scenarios and sensitivities analysis just as California ISO is doing. But to accelerate, but still also our focus on reducing costs and risks and uncertainty, well, acceleration, we have three things we are looking at. One is the offshore wind tender size. Like I said, we have gone from smaller wind parks and are now up to 3 gigawatt. It is also speeding up decision process both, for example, environmental assessment and stakeholder dialogue, but also with proactive grid planning so that the grid is ready when it is needed.

And then it is parallel buildout. What we have done earlier is one offshore wind park at the time, but now it is more wind parks, and we actually also have open-door projects where developers can come up with their own project proposals for areas where there are no plans for public tenders.

To reduce costs and risks, now we are looking at different connection possibilities with, for example, hybrid onshore grid connection where we might make a grid connection available of around 1 gigawatt but the developer is allowed to build more and then, for example, combine with consumption, maybe for hydrogen. It can also be storage, or it could also be a combination of offshore wind and solar where the different profiles, production profiles, then you can optimize the grid connection.

This is also a development of a mixed offshore grid where we are not just connecting the offshore wind but building backbone, as has also been the proposals on the California West Coast.

And then it is also a direct line from offshore wind to hydrogen, say to reduce our dependency on natural gas, especially from Russia, but also to reduce the CO2 footprint from using fossil fuels. There is a very ambitious strategy for using hydrogen in Europe, and also in Denmark, so this is also something we see that will come quite fast.

Then to reduce uncertainty, then market dialogue is very important, as also mentioned by Jeppe. But we are also looking at a new tariff and connection payment structure to make it more simple for more cost transparent by the developers, but also others then that wants to connect to the transmission with new consumers, so they know what the structure is. And also that they actually pay a higher share of the costs for connecting.

So historically, it has been to transport electricity to consumption that has borne the cost in our transmission grid. But now it is actually the production that are initiating the need for new transmission. So then it is actually also just fair that the production is paying a higher and more real share of the costs.

Then it is also important to take supply chain issues into account. Green transition is all over the world. There is a very fast increase in the need for new cables, overhead lines, converters, wind turbines. So this is also something that needs to be taken into account. And this can be done through market dialogue, but it can also be the way that you do through your tenders, for example, to split it up or to have more fixed date that makes it possible for the developers to make their contracts earlier.

And then it is cooperation on technology development, especially HVDC technology, and multi-terminal HVDC setup, HVDC breakers. It is new technology and we need to have cooperation with both manufacturers, the developers, with universities to be able to do that. So these are some of the tasks that we are working on.

So to give two examples, then please move to the next slide.

One is the Energy Island of Bornholm where we want to connect the 3 gigawatt of offshore wind. It is an existing island around 150 kilometers from the Danish shore but a bit closer to Sweden, but we want to connect it to Denmark, but also to connect it to Germany. It has been decided to build it, and the development is ongoing. And we are looking at the cabling routes and, also, looking at the sea bottom to see how that looks, and doing environmental assessments to reduce the risks for the potential developers that hopefully can get their bids in, in two years' time.

The big picture in the middle here is a visualization of the HVDC onshore connection. It is around 70 hectares, I guess that would be around 200 acres, so it is quite a large area that when you do these converters on this Island of Bornholm, there has been some protests for this. But generally they just think it is good that they can see that things are happening on this island. They would like to be a green island. There will be a new part of the port being built out and also, of course, a lot of jobs when we do this.

So the next slide, please.

And when we look at the investment we expect it to be around $67 billion Danish Kroner investment, that is around $10 billion dollars for both infrastructure and wind turbines. At the moment the socio-economic business case is not positive, so there is a need for some kinds of subsidies or other kinds of support. And this is a cost benefit analysis because this is something we need to do. We need to build out offshore wind to get the renewable electricity that we need.

It looks like the electricity infrastructure will be neutral and can be established without a negative cost. And also, by decision by the politicians, it should be tariff neutral for the consumers.

Of course, there is a lot of uncertainty here in this business case. There is a dependency on the development of electricity price, and also the HVDC technology development. But there is now a business case that has been approved, so we are moving on with the project.

Just to the right is an illustration of how the business case could look but we cannot show any numbers because we need to keep it confidential before we start our tenders. Normally you have the cost with the CapEx-OpEx.

Then the last part of the project income is what we call congestion rent, and that is that we at TSO, we get a share of the price difference between the different market areas when we transport electricity. That is one way of paying for transmission. It gives us a good financial incentive to establish transmission between different countries because then we get this congestion rent that can be part of the financing. Then there will be income, also, from balancing and reduced curtailment and other benefits.

The socioeconomic benefits will be the consumer rent with an expected low electricity price, but then also negative producer rent. There will be -- security of supply, in general, will be improved. And then there can also be other benefits as, for example, improved competition in the electricity market. There will be jobs, and also seeing a better environment in general.

Next slide, please.

And also discussions that are going on and changes. Actually, each time we do a new offshore wind park is the allocation of costs and who has the responsibility. Where, let's say, earlier we have had the responsibility for doing the offshore connection but it was paid by the developer, where we then made a budget and there was supplies to hold that budget, otherwise we would be penalized, the two newest offshore wind parks, Thor, that Jeppe explained, and on (indiscernible), that's the developer who will do the onshore connection and pay for that. And we then do the external grid extension.

Then for the Bornholm Energy Hub, again the offshore substation connection will be the developer. We will do the internal grid extension. But then we have the HVDC grids that we will build and operate but it has to be paid for by the developer, or at least be used by the developer, would be paid by a tariff, that is the expectation.

And then the HVDC grid will also be used to transport electricity from Denmark to Germany. And it can also be used for balancing. So there we, as TSO, will use it and, of course, we will then pay our share for the use of the transmission grid.

So this is the setup we are looking at.

So the next slide, please.

This is the Energy Hub on the North Sea where we started with connecting 3 gigawatt, but it can be up to 10 gigawatt. And the North Sea wind power can then be part of a mesh grid in the offshore with up to 300 gigawatt of offshore wind potential. So this is a very large and ambitious setup.

And also, then the location of this is around 100 kilometers from shore, so this will be HVDC as AC will be a large transmission loss and not competitive with HVDC. What we need to be careful with here is, of course, the sailing groups, but it will also be unexploded objects from the first and second World Wars. There is also a challenge here in the North Sea. So that is part of the things we are looking at, at the moment.

So the next slide, please.

So when we look at this energy island, then we also do it in three phases where we will start with the 3 gigawatt offshore and we will then build 3.4 gigawatt transmission. So the plan is to build more transmission that is actually needed for the wind. And the same is actually also the case for Bornholm, so that you have this interconnector possibility and redundancy if there is oxygen (phonetic) in the HVDC link.

We will then expect to build the second or the third phase in 2030s, around 2040. We are still not sure how it will be connected and what countries it will be connected to but we will see.

And then to the right there is a picture of how the island could look. And then please notice that we are actually foreseeing that the HVDC platforms will be located on their own platforms, and then on this island, that will then be for the offshore wind transformers. And this island will be an artificial island established on the kessongs (phonetic) on the sea bed that will be around 20 meters deep and will be around 100 kilometers from shore. But in the future it might also be able to be used for maybe producing hydrogen offshore and transport that to onshore as hydrogen is actually cheaper and maybe easier, also, to move.

We expect commissioning in 2033 of the first Energy Hub in the North Sea tie lines in 2031. And we expect to have a positive socioeconomic business case, no need for support, but that is the expectations today.

So next slide, please.

So just to say that the one more thing is to look at the offshore grid. We, of course, also look at our onshore grids. And we can see that we have a number of potential overload cases. And we do, you know, also a number of sensitivities to try to find out what is the development we should do anyway, for example, to maintain security of supply, and also the reinvestments in our aging grid.

But we also look at different -- other tools, for example, on the tariff where we would like to have consumption to locate where we have a lot of production, and also to have production where we have a lot of consumption. We are also looking at the potential for these establishing direct lines if possible. Overall, our grid is financed by the tariff, our internal grid.

On the map, I will then also just mention that on the west coast of Denmark we are, at the moment, building a new 400 kV line to be able to integrate a lot of the renewable electricity we will see from offshore wind, but also from onshore and solar in the western part of Denmark.

So next slide, please.

And then finally, I mentioned hydrogen. And that is, actually, something that really can help us integrating offshore wind, and also do it efficiently and hopefully reduce costs. So at the moment we are able to integrate 5 gigawatt of offshore wind in western Denmark. It would be quite costly to connect the next 5 gigawatt. So maybe there it may actually help us and also improve our utilization of the existing grid if it is connected as hydrogen, either as hydrogen produced onshore or hydrogen produced offshore.

We see the technologies there for doing it onshore. The first two projects in western Denmark of 1 gigawatt each, they are already very far in their planning and expected very soon to take their investment decision. And we also have 1 gigawatt in the middle of Denmark, 1 gigawatt, and they have already started digging in the ground to establish a 1 gigawatt hydrogen production plant.

And then there will also be a need for hydrogen infrastructure. So as both a gas and electricity transmission system operator, we are looking at possibilities for doing that, both using existing grid but also using -- you know, establishing new grids. We don't have the law behind us to do it yet but we, of course, hope we will get it. And then there will be a large demand for hydrogen, especially in Germany in their energy intensive industry where they would use the hydrogen, but we also foresee that it will be used to produce ammonia to fertilize. It could also be used for e-methanol to be used in the transport sector.

So the last slide, please.

Thanks for your attention. And just to mention, it is quite late in Denmark but I hope you are still up and full of energy. So thank you very much.

MS. JONES: Thank you, Peter. Yeah, I was noticing, it's well past midnight where you are, so thank you --

MR. MARKUSSEN: It is.

MS. JONES: -- for hanging in with us. I appreciate it.

So I want to thank all the presenters, David, Jeff, Arne, Jim, Jeppe and Peter. That concludes our presentations for the day.

We're now going to move into the public comment portion of the agenda. And for this I'd like to invite Dorothy Murumi from the Public Adviser's Office to provide instructions for public comment and to help call on raised hands. Thanks.

MR. BARTRIDGE: Dorothy, are you with us?

MS. ANDERSON: It’s possible that her screen froze.

MS. MURIMI: Hello, can you hear me?

MS. ANDERSON: There you are.

MR. BARTRIDGE: Perfect. Thank you.

MS. MURIMI: Apologies. Technology has -- my screen has frozen momentarily. So as I'm getting that up, let me read instructions for everybody. And thank you, everyone, for your patience.

So once again, thank you, Melissa, and hello, everyone. For the record, I'm Dorothy Murumi, and I'm with the CEC's Office of the Public Adviser, Energy Equity, and Tribal Affairs.

We are now beginning public comment. This is an opportunity for attendees to give their comments. Each person will have up to three minutes or less to speak. Comment times may be reduced to ensure we are able to hear from everyone.

To make public comments, individuals on the Zoom platform should click on the raise-hand icon. And for those calling in by phone, press star nine to raise your hand and star six to unmute. When you're called upon, I'll open your line or we'll open your line. Please make sure to unmute on your end. For the record, state and spell your name, give your affiliation, if any, then begin your comments. We'll show a timer on the screen, and we'll alert you when your time is up. All comments will become part of the public record.

I'll give this one moment as I go in the order of hands raised. Just a moment, please.

Actually, Hilarie, if you can unmute the first person?

MS. ANDERSON: Sure, no problem. Give me just a second. We have Liz -- and I'm going to apologize if I misstate your last name -- Klebaner. I'm going to unmute your line.

MS. KLEBANER: Hello. Good afternoon. Are you able to hear me?

MS. ANDERSON: Yes, we are.

MS. KLEBANER: Thank you. Good afternoon. I'm Liz Klebaner, outside counsel to Enveric (phonetic) Development Partners. I would like to thank the CEC, the CPUC, and CAISO, and the other presenters today for their work to support offshore wind generation in California.

Enveric develops transmission to accelerate the deployment of renewable energy across North America, and specializes in the design, development, financing, and construction of large-scale electric transmission systems. Enveric's transmission expertise includes the design and development of shared open access subsea transmission systems for offshore wind. Enveric is pleased to identify itself as an industry stakeholder under AB 525.

AB 525 expressly recognizes subsea transmission as an option to alleviate congestion. The law directs the Commission to include all relevant information on the cost of subsea high-voltage transmission, and to make cost findings in the state's Strategic Plan for offshore wind. The Commission should interpret the phrase “all relevant information” to require an exhaustive and objective assessment of the cost of subsea transmission. Such an assessment should include a comparative analysis of overland and subsea options, and that cost comparison should take into account the actual development costs and lead times for overland transmission projects in California.

On the North Coast, most mileage along any overland route would pass through very high severity fire hazard zones. There, overland transmission would also traverse environmental justice communities, tribal, and state park and forest service lands. The California experience is that such impacts have been found to be unacceptable, requiring both undergrounding and extensive rerouting to mitigate the aesthetic, recreational, parkland, and community impacts of overland transmission. We've seen this in Chino Hills, at the ends of Borrego State Park, the city of Jurupa Valley, and the Tri Valley area in Northern California.

Cost assessments that rely on overland routes with no likelihood of surviving the environmental review process are not relevant information for purposes of AB 525.

All relevant information on the cost of subsea transmission should also include a review of procurement models capable of encouraging innovation, cost containment, and the efficient scaling of offshore wind generation on the North Coast. One example is provided by a New England State RFI, which considered a networked modular buildout of transmission capacity.

Another example comes from Texas and its designation of competitive renewable energy zones, which enabled the proactive development of transmission to connect 18.5 gigawatts of wind power to load centers. These or similar models should be considered in the Strategic Plan.

Thank you for this opportunity to comment. On behalf of Enveric, we eagerly anticipate reviewing the draft transmission chapter.

MS. MURIMI: Thank you, Liz.

Next, we'll have Timothy Jefferies.

Timothy, your line has been unmuted. Please state your name, give your affiliation, if any. You may begin. MR. JEFFERIES: Thank you. My name is Timothy Jefferies. That's T-I-M-O-T-H-Y, Jefferies, J-E-F-F-E-R-I-E-S. I'm with the International Brotherhood of Boilermakers. I would like to thank the CEC for this forum.

My question is kind of twofold, maybe. So the contractors, I don't know if 525 covers -- would the developer be from California? But more importantly for me, will the workforce be from California? Will it be a local skilled and trained workforce? And so I would not like to see units built outside of California and then brought into California. I'd like to see California's workforce a part of this one forward.

Thank you.

MS. MURIMI: Thank you, Timothy.

Next, we have an individual who's named Zoom User. Please state and spell your name for the record. Your line has been unmuted. You may begin your comment.

MR. JACOBSON: Thank you so much. My name is Dan Jacobson, D-A-N, last name J-A-C-O-B-S-O-N, Senior Advisor to Environment California. Just wanted to make three quick points. And I'll be sure to cede most of my time back to the commission.

The first is just a thanks to the folks from Denmark, both for traveling out here, they've been out here for the past couple of days, and for those that stayed up well past midnight. There's a lot to learn from these other countries that have gone ahead of California in terms of developing offshore winds. And it's no surprise that, for the group that just came back on the fact-finding mission, that they learned so much from many of these same individuals who we met with, consulted with, and had the opportunity to learn a lot. So just a thanks to them for their great presentation.

The second is just also to echo, this was a really informative set of presentations on transmission from all the parties here in California, from the PUC and from the CAISO.

There is one thing I think we need to think about when we think about transmission, which is that we tend to think about it just in a straight sort of dollar cost, but transmission provides so many more benefits to the grid for California, that I want to make sure that there's a way to incorporate those thoughts into it.

So whether it's the, you know, the carbon that's being reduced, whether it's the really greater diversity that more transmission allows us to bring into California, which makes for a stronger grid, which makes for a more reliable grid, which helps to create an insurance policy against the volatile fuel prices that we're seeing on natural gas and so many of the other fossil fuels, that, again, it's easy to just sort of look at the dollar amount and to say, gee, that could be expensive.

But I think what we have to envision is the grid of the 21st century, you know, 2100, but 2050 and think, how do we get that? And the new transmission projects that we're looking at right now have a great opportunity to bring us there.

And finally, the one other thing that I want to talk about transmission is that when we talk about subsea cables or bringing the transmission over ground, is that in what areas will these transmissions be brought into? And based upon that, what opportunities are there to retire early existing fossil fuel plants? And oftentimes when the PUC looks at their basins, they have to see what energy is coming into that. And so if we can work with the PUC and look at ways to use the transmission that's coming in from offshore wind to help retire fossil fuel power plants, that continues offshore wind's win-win situation.

So thank you very much for your time, and I'll cede the rest of mine back.

MS. MURIMI: Thank you so much.

I'd like to make a last call. Oh, I see one more participant.

Amy Jester, your line is unmuted. Please state your name for the record, and then you may begin your comment.

MS. JESTER: Thank you very much. Can you hear me okay?

MS. MURIMI: Yes, we can.

MS. JESTER: Excellent. Hello. Thanks so much to the California Energy Commission for hosting this meeting and for the informative presentations that were offered by all speakers. I am Amy Jester with the Redwood Region Climate and Community Resilience Hub, which is located in Humboldt County.

It's absolutely critical that the North Coast transmission buildout include direct electrification benefits for our rural and tribal communities. Energy access on the North Coast is a significant equity issue. This is California's most diversely populated tribal region, and the region will act as a key hub for the West Coast offshore wind industry. That means that we must ensure that this community that will be a critical host node for the offshore wind industry directly benefit from the electrification build out of offshore wind.

Thank you.

MS. MURIMI: Thank you so much.

I'd like to give one last call for any commenters. Again, for those calling in, press star nine to indicate that you'd like to make a comment, and star six to unmute on your end. And for those on Zoom, go ahead and use the raise-hand feature. It looks like an open palm at the bottom of your screen. I'll give that one more moment. Again, the raise-hand feature, looks like an open palm.

Okay, seeing no more comments, thank you everyone for participating in public comments today. As a reminder, we are also expecting written comments, which are due December 1st. And that concludes this public comment period.

Now I'd like to turn it back to Jim Bartridge for any closing remarks.

MR. BARTRIDGE: Thanks, Dorothy, and thanks to everyone for participating in our workshop today as a reminder, and Dorothy just said this, but comments are due December 1st.

I'd also like to thank David Withrow and Nathan Barcic for discussing how offshore wind is being considered in the PUC's IRP process, and Jeff Billinton for the work you've done and are doing going forward to evaluate offshore wind resources in the CAL ISO's transmission planning process.

Also, many thanks to Arne Jacobson and Jim Zoellick for highlighting the offshore wind transmission studies and activities occurring in the North Coast region, as well as the overview of the new study funded by the Department of Defense.

And finally, many thanks to Jeppe Lundbeck from the Danish Energy Agency and Peter Markussen from Energinet. It's been extremely valuable hearing your experiences with transmission to connect offshore wind generation, and we appreciate and look forward to our continued collaboration and partnership with you.

And finally, to our workshop attendees, thank you for joining us this afternoon. We look forward to your continued engagement and participation as we move forward with the transmission assessment that will be included in the AB 525 Strategic Plan. So thanks again to everybody.

We are adjourned just before 4 o'clock. Take care.

(Off the record at 3:58 p.m.)

CERTIFICATE OF REPORTER

I do hereby certify that the testimony in the foregoing hearing was taken at the time and place therein stated; that the testimony of said witnesses were reported by me, a certified electronic court reporter and a disinterested person, and was under my supervision thereafter transcribed into typewriting.

And I further certify that I am not of counsel or attorney for either or any of the parties to said hearing nor in any way interested in the outcome of the cause named in said caption.

IN WITNESS WHEREOF, I have hereunto set my hand this 5th day of December, 2022.

MARTHA L. NELSON, CERT**367

CERTIFICATE OF TRANSCRIBER

I do hereby certify that the testimony in the foregoing hearing was taken at the time and place therein stated; that the testimony of said witnesses were transcribed by me, a certified transcriber and a disinterested person, and was under my supervision thereafter transcribed into typewriting.

And I further certify that I am not of counsel or attorney for either or any of the parties to said hearing nor in any way interested in the outcome of the cause named in said caption.

I certify that the foregoing is a correct transcript, to the best of my ability, from the electronic sound recording of the proceedings in the above-entitled matter.

Martha L. Nelson

MARTHA L. NELSON, CERT**367

December 5, 2022