Jobs and Economic Development Impacts of Offshore Wind
November 20, 2013

Coordinator: Thank you all for standing by. All lines have been placed on a listen-only mode throughout the duration of today's conference. Today's conference is being recorded. If you do have any objections, you may disconnect at this time. I would now like to turn the call over to Ian Baring-Gould. Thank you. You may begin.

Ian Baring-Gould: Hi, this is Ian Baring-Gould from the National Renewable Energy Laboratory. I want to thank you all for joining us for our call - or on our webinar today. This is our standard monthly series of webinars for the stakeholder engagement and outreach activities of the wind program under the Department of Energy. And pleased today that we get to have a series of presentations on a new tool that the DoE has worked to develop with NREL. And that's an expansion of the job and economic development impact model that we have that focused on fixed-bottom offshore projects.

And we have three speakers today that are going to be talking to us about this model and then some analyses that we have done recently to look at the economic impacts of offshore development in four regions of the United States. So the first - (Aaron Smith) - is going to give us a kind of an overview and update of the offshore wind energy market. So a quick presentation updating - a presentation that some of you might have seen a couple months ago.

And then Suzanne Tegen is going to present an overview of the offshore model. And then finally, (David Keyser) is going to talk about the four regional studies that we've completed. And so, without further ado, I'm going to have (Aaron) come up. Just want to remind everybody that we do a Q&A

through the computer systems. So if you have a question, just go to the little Q&A at the top of your screen, hit that, and at that point you can type in a question to us.

We'll probably hold all of the questions to the end of the session because multiple people might want to answer there. So, just to start off with (Aaron Smith) is a - actually I should point out that all of these three people are NREL folks who have been working on this. (Aaron) is an analyst in the offshore wind program here at NREL where he specializes in market analysis, technology characterization, and techno-economic model development with a strong focus on offshore wind project.

(Aaron) graduated with honors from the University of Vermont with degrees in economics and political science. So (Aaron), do you want to take us off with an update of the offshore market in the U.S.?

(Aaron Smith): Sure. Thanks, Ian. Get this presentation up. Okay so I've got about ten minutes to give a brief summary of the developments in the offshore wind market and some of the motivation for looking at job and economic development impacts. So the offshore wind market to date - 'cause largely been focused in Europe and Asia - at the end of 2012, there was about a 4,600 megawatts install with European installation representing about 95/97% of the total with 4,300 megawatts.

There is a lot of offshore wind under development - about 4.5 gigawatts under construction at the end of 2012. 4.9 gigawatts have been contracted over 21 gigawatts approved globally. And then the total pipeline really exceeds 200 gigawatts. Within the U.S., we have identified as part of other work funded by DoE with - in concert with the Navigant Consortium.

We've identified about three gigawatts of project that are advanced in the United States. And those projects are looking like they'll start to come online in the 2015 time frame. So for offshore wind projects, today we're really moving from a shallow-water industry developed relatively close to shore and in sheltered waters into much deeper waters much further from shore. And really the Europeans are leading us off but if we look at some of the wind energy areas that have improved by the - or that have been scoped by the Bureau of Ocean Management, we see that those are also in deep water and far from shore.

And this introduces several technical challenges for offshore wind projects. If we look at the resource map of the United States, we can see that it's a mix of shallow, mid-depth, and deep water, which has implications for technology choice. We'll get into some of the regional characteristics a bit later. Speaking of technology choices, this figure shows some of the different sub-structure technologies that might be used as you move into deeper water.

So you can see, extended from a monopile, which is basically a simple steel tubular structure that's driven into the ground over to space frame-type structures like tripods and jackets and into floating structures which we think are probably the most economical solution beyond 60 meters of water and maybe even pushing towards 50 meters of water. If we look at economic trends, the capital cost of offshore wind projects did rise pretty significantly from the early commercial-scale developments to current developments.

And there are a number of reasons for that increase. A lot of it's related to the increase in macroeconomic cost related to high demand during the - right before the recession. There are also exchange rate fluctuations. There's a move to more - technically challenged sites that was highlighted in an earlier slide. And we've basically reached a point where it seems like there's

beginning to be an inflection. A lot of the cost for recently approved projects - projects where an investor has made an investment decision that will start to come online in the 2014 to 2015 timeline seem to be dropping off compared to the projects that we've - are under construction currently.

And we view that as a pretty good trend for the industry. In terms of U.S. project costs, we do expect them to be largely consistent with the European structure. Initially, we might see slightly higher costs just because we have not yet developed the infrastructure that Europe has developed through deploying about 4.5 gigawatts of offshore wind. However, we do expect those differences to disappear as we develop our own domestic infrastructure.

So there are a number of technology challenges for offshore wind projects in the United States that might also contribute to costs that are different from in Europe. So first is we really have a lot of deep water in the United States. And this deep water is sort of concentrated in the Pacific Coast, in the Great Lakes, and then in the far northeast. And really if we're going to bring offshore wind to these areas, we are going to make sure that deep water offshore technologies are technically feasible and reviewed as such by banks and investors and that this confidence developed.

And then there's - in the Great Lakes, there's also freshwater ice which could be a fairly large technological challenge. And then in the Southeast and along the Atlantic Coast, we have exposure to tropical storms, hurricane-force winds which are really not an issue for the European projects but are certainly going to be an issue for us in the United States. And the Department of Energy, through its advanced technology demonstration project, is really funding demonstration projects that are beginning to address these issues.

And then in conjunction, we're also involved in the development of industry-wide standards that are being updated to address these issues and reduce risk. In the United States, we have a situation where in order to make projects economically attractive developers are combining a mix of federal policies and state-level policies. These combinations are a real indication - or a real driver of why we need to look at jobs and economic development impacts because in order to receive state-level incentive, states are very interesting in understanding the potential economic benefits that could be associated with bringing those projects to their states.

And in some cases, the states are actually tying the award of incentives to the ability of projects to deliver net benefit to the states. And so that's really the motivation - part of the motivation for the JEDI efforts here at NREL. And with that, I'll turn it over to Suzanne. And I'd be happy to answer any questions during the Q&A session later.

Suzanne Tegen: Thanks, (Aaron).

Ian Baring-Gould: Great. So thank you (Aaron) for the presentation. Our next speaker - as I mentioned - is Suzanne Tegen. And then we're going to jump into (David Keyser's) presentation. Suzanne is going to focus primarily on the JEDI model itself and David is going to go into the analyses of the four regions. I'll do both of their introductions at this point so that they can kind of flow seamlessly into the different presentations. Starting with Suzanne, Suzanne manages the Wind and Water Deployment Section here at NREL which is a relatively large group under which the stakeholder engagement and outreach activities fall under.

She comes to this as a policy analyst who has done a great amount of research in wind deployment issues such as radar wildlife, grid integration, public

engagement. She has done lots of work on economic - understanding economic impact including jobs and was one of the key people in the development of the JEDI software - or the JEDI model that the - that we're building on here. Has written quite extensively on the economic impacts of small wind, utility-scale wind, offshore and community wind projects and then has done more recently some very great work in looking at the domestic workforce for wind technologies and future training needs.

Before joining us here at NREL in 2004, she worked for the Center of Resource Solutions in San Francisco and then did a stint down in Antarctica where she started up their recycling program which is kind of fun. (David Keyser) is also a Research Analyst here at NREL with experience in constructing and using economic impact models and demographic modeling, regional economic assessments.

He currently manages the JEDI program which includes a whole suite - I think we're up to 15 - different JEDI models looking at different technologies. And (David) is the manager of that suite of tools. Prior to joining NREL, (David) served as an economist for the state of Colorado where he constructed near and long-term economic forecasts, annual employment estimates, and economic base analysis for Colorado counties with a broad focus on looking at oil, natural gas and other extraction activities.

(David) holds a Bachelor's and a Master's degree in economics from Colorado State. So he's another fellow local guy. So without further ado, Suzanne and (David).

Suzanne Tegen: Great. Thanks. So I'll start us off here. And as you've now heard, NREL developed a new JEDI tool for offshore wind projects this year. We used data from the Navigant Consortium to publish the report for DoE on offshore wind.

The JEDI models are built on kind of a backbone of Implan, which I'll talk about a little bit later. And we - as we always do - to develop the JEDI model, we talked to U.S. experts in this case on offshore winds. And as they always are, the JEDI model was peer reviewed.

For the analyses in the different regions, we collaborated with local experts and had the results also verified by the local experts in each region. As you'll hear, when (David) gives his part of the presentation, there are different concerns in each area. And as (Aaron) also just kind of pointed out with the kind of large circles, different concerns like icing, you know, in each - different region of the U.S. The regions that we looked at were the Southeast, the Great Lakes, the Mid-Atlantic, and the Gulf of Mexico.

And in each of them we did collaborate with the locals. In the Southeast and the Mid-Atlantic, we worked very closely with professor Jon Miles and Dane Zammit and (Michelle Kramer) from James Madison University. And they co-authored the Southeast and Mid-Atlantic studies with us. For the Great Lakes, we worked with professor David Loomis from Illinois State University and got a lot of assistance there from the Great Lakes Wind Coalition as well.

For the Gulf region, we did the analysis internally. And our analyst who worked on that project (Francisco Flores-Espino) talked in detail with offshore wind and also offshore oil and gas contacts in the region. So we used regional contacts there too. So here's a little bit of background and a little bit about the model. All the JEDI models - well actually, I'll start at the bottom here and then I go from the most important one.

So you can visit the website on the bottom at nrel.gov/analysis/JEDI - that will give you - that will take you to all of the JEDI models including this one. There we have some user guides for different models. We also have caveats

about using the model and then reports and other details that are important to JEDI model users. And then this - the next bullet up here - Implan. Implan is a group based in Minnesota. You can get to their website if you just - if you look at implan.com

Is it Wisconsin?

Ian Baring-Gould: Yes, they're in Wisconsin.

Suzanne Tegen: They're in Wisconsin. Sorry, they're in Wisconsin now. They moved. Great choice. http://implan.com/ - I'm from Wisconsin. That's why I said that. So that's - as I said before, that's kind of the backbone or the scaffolding of the JEDI model. Implan gets their data from the Bureau of Labor Statistics, the Bureau of Economic Analysis, the U.S. Census, and from other places. And if people have questions about that, we can answer those in the Q&A section.

The defaults are based on real-world projects - or input from project owners, developers and engineers or other experts. And of course, there are no real-world projects in the U.S. in the ground - in the water yet, but we do have - we have talked to developers who are planning to put projects in the water. And we've also talked to project developers and project owners in Europe. So when you open a JEDI model, you'll see that you need - you kind of have a high-level project information part of the model where you need to enter the cost of the turbine and everything.

And then you'll also see the defaults we have built in. And you can choose to either use those defaults that we already have in there or you can put in your own information into that model. And of course, the better the input, the better the output as with any input-output model. So for the specific model here, we - the default cost information as I said comes from the Navigant Consortium.

And Navigant published a paper called - a report called Offshore Wind Market and Economic Analysis. It's the report for the Wind and Water Power office at the Department of Energy.

And that's a great one. It's also given presentations on that that you can probably find online if you're interested. Some of the defaults from the JEDI model are also based on a representative project in the Atlantic. The jacket substructure is our default. And the default is also in 25 meters of water -100 nautical miles from port, 50 nautical miles from transmission. And so these are things that you can modify, but if you do, you need to be sure that the cost - you also input the cost there.

But we only have the jacket substructure right now. And that's kind of the biggest constraint as far as that model goes because as Aaron showed you, there are a lot of other substructures that you can have. There are a lot of - like the monocle and other ones. So you can probably look at another structure. You would just really have to make sure - you know, maybe work with us or make sure that the costs are correct for those if you put in your own default there - if you put in your own cost there.

So as far as interpreting the results and also some of the model caveats, JEDI results that you get are not going to be gross results. They're going to be gross results - not net results. And what this means is that JEDI gives you an estimate of the number of jobs that your project will support. So we're not saying where those jobs came from.

Were those jobs from people who used to be in the oil and gas industry? Were those jobs for people who used to be unemployed? So we're not saying any of that. We're just looking at the estimated number of jobs that this - that could be supported by the project that you're talking about. The model doesn't

factor in the far-reaching impacts from development like changes in utility rates, greenhouse gas emissions, property values, public health.

There are a lot of things that the model doesn't do. This is a, you know, free model and it's easy to use. And so it's relatively simple. And there are much more complicated models out there, but JEDI doesn't do these things. JEDI also doesn't estimate impacts from supply-side changes such as technological improvements or price changes or changes in taxes or subsidies or the incentives that (Aaron) sent you.

But the analyst - so who - the model user can put this into your - you can put this into your analysis pretty easily. And we can talk with you about how to do that. But I mean you just run the model for each year and then you can assume incentives or not. JEDI doesn't of course evaluate a project's feasibility or profitability. You don't want to use it when making stock market decisions. And while it doesn't - or can't be responsible for how the model is used, applied or results are interpreted, obviously.

So a little bit more here, JEDI models use an input-output - it's their input-output model. And they use - they'll give their results in a single year and then you can just add the years together if you want to run a scenario over a period of time. JEDI scenarios that are portrayed as occurring over a period of time assume that the economy has the same structure over time and that relative prices don't change, technology doesn't change, you know, unless the user makes those changes.

So in your specific analysis, you could make those changes throughout the years that you're looking at.

David Keyser: But I'd like to add to that. If you - you can specify those changes in JEDI, but you're specifying those changes for the specific offshore wind project. What this is saying is that the whole rest of the economy, what's modeled by the input-output model itself doesn't change over time.

Suzanne Tegen: Right, great point; thank you. The results that you see in the JEDI model are in full-time equivalence. So that's the number of people working a 40-hour work week. You'll also see earnings. So that's the income from that work - the salaries and wages and benefits. You'll see gross output which is a measure of total economic activity. And this is not the same as GDP which is a value of production.

We can talk again about these economic specific terms during the Q&A if people are interested. So here's a visual representation of that category of the model. So the first category is project development and on-site labor. And this is what you think of when you think of the people who are working on the project - the people who are building the project or maintaining and operating the project. We've got captains, we've got crane operators, we've got the truck drivers, their managers and support staff, anybody working on siting, marine engineers.

And then the second category that you'll see is the largest category. This is the whole supply chain. This is all of the equipment, the turbine, and the module, this - so the whole supply chain. And you can see some sort of here of the examples of the supply chain. It also includes the property taxes, banking, accounting, financing, that kind of thing.

The third category is called induced impact. And - so these are - this is money spent in the local area on goods and services from increased revenue from the first two categories. So when you've got your construction workers coming to

do construction on the project, they're going to be staying at a hotel - local hotel. And so we're not counting everything that happens in that hotel during that time.

What we're counting is the fraction of - from that - of those workers that need to work more because of the construction project. So it's just going to be a fraction of - it'll be the full-time equivalent, if that makes sense. And so here, we're going to talk about the regional case studies and David Keyser is going to take over from here.

Ian Baring-Gould: Before David jumps in, a quick reminder, if people have questions, go up to the top of the Q&A, select that, and then type in a question that you have for folks. Thank you. David, go ahead.

(David Keyser): Alright. Thanks, Ian. As Suzanne mentioned, we did four case studies - one for each region for - around the United States. Well not for each region, but each case study represents a different region around the United States. And each of these case studies is set up in a fairly similar manner. Each one looks at scenarios and potential offshore wind deployment between the years 2020 and 2030.

And each one looks at potential costs within that region for those associated levels of deployment. And then each scenario looks at local supply chain development. So as there is deployment of offshore wind within a region, each study says well what kind of additional manufacturing capacity for example might feasibly be correlated with that deployment over time within that region?

And so how might the portion of a project that can be sourced within a region change over time? And really the reason that we do these - that we do these

case studies; there are two big reasons for this. One is because we're interested in looking at these economic impacts from offshore wind. Obviously, we don't have it in the United States yet. So it's certainly an interesting intellectual exercise.

And then another reason is also to look at the JEDI model and look at the costs that are in there. As Suzanne mentioned, these came from the Navigant Consortium. They're largely focused on the Atlantic region of the United States. And so we really want to ground-true these numbers with people in regions around the United States and really get a feeling about whether - how reasonable those numbers are.

The first region that I'll talk about is the southeast Atlantic region which, as Suzanne mentioned earlier, this analysis was largely conducted by James Madison University. And James Madison in this region found by working with other groups that the actual information in JEDI model - the project defaulter fairly similar to what might be reasonable to expect in the - in this region, which is to be expected since we'll be really looking at the Atlantic.

They also found that there could reasonably be some fairly decent supply chain growth in that region especially because the offshore wind industry has some fairly strange infrastructure requirements at ports. And there are several large ports that are in the southeast region that are very well-suited to be used for the offshore wind industry, especially in Virginia - Charleston, Baltimore would be - Baltimore's not in the southeast. What am I thinking? But, Savannah - getting turned upside down here.

So there are several large ports in the region that could be suitable for offshore wind manufacturing hubs. And the other factor that indicates the region - there might also be some decent supply chain growth in that region is the presence

of land-based wind manufacturing there already despite a lack of significant land-based wind deployment. And the reason why that's significant is because it really kind of shows that the region could be friendly to manufacturers and a place where producers would want to locate their facilities.

For this scenario, it's somewhat different from the other scenarios in that James Madison came up with five different deployment scenarios. For the sake of time here, I'm just going to focus primarily on the first three. And these are fairly consistent across all of the case studies. And I'll just mention right now that I'm going to come back to all four case studies and compare them with each other as well as some other results from the literature at the end once I'm done going through all of these.

So I will come back to it. I know it's a lot of information that I'm going to be going through here. But basically the first three scenarios are a low-deployment scenario with associated higher cost. And the reason costs are higher on your low growth is just because there are higher transportation costs and logistic costs that are associated with low growth of the regional supply chain. So it's assuming that most of the more specialized components would be imported from overseas, primarily Europe - actually, almost exclusively Europe.

The second scenario is the moderate growth scenario. This is identified as the most likely case to actually happen within a region. And so it has moderate growth. And I'll show you some actual numbers here in just a second. This is just kind of characterizing it - moderate growth with a moderate level of regional supply chain growth and - with moderate costs.

And then the third scenario that I'm going to focus on is the high growth scenario with lots of supply chain growth and it's been associated to lower

costs. And the actual deployment numbers that (Jamie) - you came up with - are actually starting in 2015. That's why you see 2020 capacity between 95 and almost a gigawatt and extending out to 2030 where the growth - the cumulative capacity ranges from about 1.7 gigawatts to almost 10 gigawatts.

And then the construction costs over that time period range from a high $5400 a kilowatt in 2020 all the way down to 3900 by 2030. And these are in 2010 dollars I believe. And then the local content scenarios, in 2020 the percentage that can actually be sourced in that region ranges from about 20% to about 28%. Remember, that's largely materials - things like materials and workforce.

And then by 2030, that ranges from 29% all the way up to 75% under the high scenario. And that's assuming - that 75% is assuming that some of the more specialized components are actually being manufactured in a region. And growth over time in the number of jobs supported - you can see that it is a fairly linear trend. This study actually does look at specific potential offshore wind sites.

And so it's not really a perfect line looking at linear growth over time. But you can see that basically the high scenario supports the most jobs - that's scenario C. And then the low scenario supports fewer jobs. And the number of jobs supported on average ranges from about 16 FTEs per megawatt up to 31 FTEs per megawatt in scenario C. Scenario D is the scenario that, you know, you can see that it goes all the way up to 34 FTEs per megawatt.

And I don't really want to talk about - don't want to dwell on this but really that's basically assuming so many efficiencies. And that's the reason why it went up high. If you have other questions about that, I'd be happy to talk about it in the Q&A session. But again, I'd like to kind of keep this brief. And

then the average number of jobs annually supported over that time period from construction ranges from about 420 a year in scenario A to about 5,800 in scenario C.

O&M scenarios for the southeast Atlantic are fairly similar. They don't require the same kind of specialized infrastructure investment to the same level that construction does. And so these scenarios are really mostly influenced by the scale of what's actually constructed. And so the number of annual jobs on-site for these range from about 70 in scenario A to a little over 420 in scenario C. And those jobs will be ongoing after the period of analysis which in ends in 2030.

The second study which was done along with the Great Lakes...

Suzanne Tegen: Wind collaborative.

(David Keyser): ...wind collaborative and Dave Loomis from Illinois State University. The Great Lakes are probably the most different out of the regions that we looked at from the Atlantic area. There are several reasons for this. Just intuitively that water in the Great Lakes is not saltwater, whereas in the ocean it is. And so the freshwater in the Great Lakes isn't - it can freeze as (Aaron) mentioned earlier. And that can significantly increase prices not just in terms of accessing turbines but also the spray can get up on the turbines.

And so then there are maintenance issues with that and performance issues. But at the same time, freshwater is not as corrosive as saltwater. And so that's something that can actually reduce costs. The other issue with the Great Lakes which really makes them a lot different from the oceans is that the water depth can vary greatly from site to site.

Now, the offshore wind JEDI model at this point is a fixed-bottom model. And so the result of that is we're overwhelmingly focused on potential deployment scenarios in the lower Great Lakes versus the upper Great Lakes which are quite a bit deeper and have quite a bit more variability in water depth. And so the water depth can vary quite a bit in the Great Lakes which is kind of limiting with the version of JEDI that we have right now.

The other factor about the Great Lakes that's a little bit different is that the wind sites are usually a little farther from shore and farther from ports and sites off the coast of the U.S. That adds to cost as a result of increased travel time and logistics. And then just the general logistics of the Great Lakes -they are cut off from the oceans. The only way you can access the Great Lakes from the oceans well then those practical ways going up the St. Lawrence Seaway.

And vessels that are larger than about 80 feet wide can't make it up those St. Lawrence Seaways, so that really limits the number of ships that are available to actually install these offshore wind projects or even just transport equipment. I know at least one ship that is available that can do this, but it certainly limits options. So overall the Great Lakes are more expensive or anticipated to be more expensive than the Atlantic despite some of the factors that push cost down.

And so there are three deployment scenarios. And you can see these are fairly conservative and these are only based on deployment that's in fixed-bottom and overwhelmingly in the Great Lakes. But these scenarios range from 1 gigawatt in the low scenario in 2030 up to 5 gigawatts by 2030 with construction costs basically starting off the same at about $6,600 a kilowatt - dropping anywhere from 50 - from about $6,000 a kilowatt in 2030 down to about $4,600 a kilowatt by 2030 in the high-deployment, lower-cost scenario.

And in those scenarios, the local content would vary by 2030; the supply chain growth would vary by 2030 with not a whole lot of growth in first scenario. Going up to a gigawatt really isn't enough to really cause significant - we don't really think it's enough to cause significant supply chain growth up to about 60% by 2030 under scenario C.

And I would also like to add with these numbers, we're only looking at supply chain growth that might be attributed to this deployment. So if there was some kind of floating technology that had extra deployment in the Upper Lakes for example, those numbers would probably be higher if there was deployment on the Canadian side of the lakes. Those local content numbers would be higher.

So we're only looking at the specific scenarios. And you can see that the first two scenarios - scenario A and scenario B - little bit closer. Although scenario A is barely flat. There's not a whole lot going on in that. Scenario C with the highest deployment supports the largest number of jobs over that time period with about 400 being on site in the lower case up to about 2,300 on site constructing those jobs in the higher case.

And the total number of construction FTEs per megawatt ranges from about 14 in the conserve - most conservative scenario up to about 25 in the high-deployment scenario. And in terms of O&M jobs, the number of on-site O&M jobs ranges from about 40 to 240. And those would be ongoing after 2030. There are a lot of different factors that set the Gulf of Mexico aside from the Atlantic that make it a lot different.

It certainly has the highest potential - or it has very high potential in the 30-meter depth. And so that actually results in a decrease in anticipated construction costs. And I should also mention as I did with the other scenarios

that analysis was largely conducted in-house by Francisco Flores Espino, an analyst here at NREL. So the water off the coast in the Gulf of Mexico, it has a high potential for shallow-water deployment, which is something that contributes to lower construction costs.

Probably one of the most interesting - well at least interesting to me - features of this region is the presence of the oil and gas industry - offshore oil and gas industry. There are a lot of similarities between the offshore oil and gas industry and offshore wind deployment just in terms of expertise of labor force in terms of infrastructure that would be necessary to manufacture components.

And so there's a lot of capital from the oil and gas industry that could possibly use - be used by offshore wind. There's also a tremendous labor force in that region that - the offshore wind industry you could take advantage of. And so the question is, does the thing contribute to cost reduction as a result of this infrastructure and these workers already being in place? Or does it result in increases in cost as a result of competition with the oil and gas industry?

And the indications from people who are actually experts in the industry and working in the industry in that region is that it probably wouldn't result in cost increases result of competition just because of the cyclical nature of the oil and gas industry. And the amount of planning involved with offshore wind projects could actually - they could actually work well together to help smooth out cycles in the oil and gas industry. The third major factor that sets the Gulf of Mexico apart from the other regions of the United States is that there's more extreme hurricane exposures than there is in other areas.

And so even though you may have hurricanes along the Atlantic sea board, there's more risk in the Gulf of Mexico which would increase anticipated

equipment costs. But right now, there's research going on in that area. And so that's kind of an unknown. So overall, the hurricane resilience would increase costs. The oil and gas infrastructure would lead to decreases in cost.

And then the other thing that I forgot to mention earlier is that there is a potential to actually deploy offshore wind in this region in state waters which are closer to shore. And so that would result in decreases in cost for high-voltage cables which would be fairly significant. So the NREL scenarios for deployment in that region range from a gigawatt in the low case by 2030 up to 5 gigawatts by 2030 with construction costs decreasing from a high of $5,000 a kilowatt down to about $3,600 dollars a kilowatt by 2030.

And that high scenario is associated with fairly rapid local content. Again, this region already has some of the manufacturing infrastructure in place. It already has a work force in place. And so that's why that high local content scenario is so high. It's up to 80% over that time period. And the low scenario is down to 62%. Even that's higher than some of the other scenarios because of that infrastructure that's already in place or that could be easily modified.

I'll skip this slide. And so the number of jobs in this scenario - the number of annual jobs ranges from about 670 on-site jobs supported annually for - that's associated with that gigawatt of deployment up to about 3,200 on-site jobs supported annually. And that's with the higher-level of deployment - that 5 gigawatts. And so the number of on-site jobs - total jobs which include the supply chain jobs and the induced job ranges from about 27 jobs per megawatt in the low scenario up to 29 jobs per megawatt in the high scenario.

And again, these are more grouped more closely together than you see in the other scenarios. And that's because - and I think, you know - and we're certainly happy to talk about this more later on - but this is largely due to the

presence of the infrastructure in the region already. In the O&M scenario, the number of ongoing jobs after 2030 on-site ranges from about 30 in that low case up to about 160 in the high case.

As with all the other scenarios, there's not a huge amount of difference between each of these scenarios other than the actual size of the installations - the megawatts that are actually deployed. The last region that I'll go over is the Mid-Atlantic and then I'll compare all four again in the last couple slides. The Mid-Atlantic is really where offshore wind JEDI was focused when the default project costs were developed.

And so researchers at James Madison University actually did find that project costs and wages were similar to JEDI defaults. As with several of the other regions, there are several large ports well suited to become offshore wind manufacturing hubs. As I mentioned earlier, Baltimore - only in this case, I'm actually referring to the correct region. So Virginia is also included in the Mid-Atlantic.

It's in the Mid-Atlantic and the southeast. And so certainly there's some extensive import infrastructure in Virginia that could be used. And then Port of New Jersey is another potential port that could be modified for use by offshore wind industry. New Jersey is already offering incentives for deployment off the coast in that region.

And so it's likely that there will be some deployment over there already by the time these scenarios start. And you can see deployment scenarios in this region are fairly aggressive. By 2030, the low scenario - under the low scenario, deployment is about 3.2 gigawatts up to the high scenario which is about 16.8 gigawatts which is essentially saying that all electricity growth in that region is filled by offshore wind.

And so that's a - more of a ceiling-type of scenario. And then cost in the region range - cost in the region by 2030 range from about 5500 down to 4200 by 2030. And then supply chain growth over that time period ranges from 42% in the low scenario all the way up to about 79% under the high scenario basically taking advantage of the infrastructure that's already in place and aggressive growth over that time range.

Let's skip this slide. And the number of on-site jobs over that time period - the people that are actually on the boat doing the construction work ranges from about 840 annual average jobs under the low scenario up to a high of about 6,200 annual average jobs in the high scenario, which actually comes out to about 16 full-time equivalence per megawatt in the low scenario up to about 25 FTEs per megawatt in the high scenario.

And the number of ongoing annual on-site jobs by about 2030 ranges from 140 in the low scenario up to about 850 in the high scenario with 400 - just over 400 being the most likely case. For all of these jobs - for all of these scenarios, these jobs are fairly well-compensated. The highest compensated are the on-site jobs. These are really the most - these are the jobs that really require the most specialized skill sets.

These folks are on average around $130,000 a year in most regions. That jumps up to about $140,000 a year in the Great Lakes. Wages are a little bit higher in that region. The supply chain job, those are - those earnings are around $60,000 dollars which is about average in the United States. And then the induced jobs, those earnings are a little bit lower - about $50,000 dollars. That's anticipated.

Those are jobs that are largely lower-earning positions - things like retail and positions like that. These scenarios are actually fairly consistent with a lot of what's coming out of the literature right now. You can see the - most of the estimates in literature report these jobs as full-time equivalence per megawatt. There are a couple of studies that were conducted earlier in the decade.

You can see it in the second table - global insight including carry both have significantly lower numbers. And I think that can really be attributed to expectations at that point in time of capital costs and really labor intensity of installing offshore wind facilities is significantly lower than what it's turned out to be as demonstrated by projects in Europe. And so you can see the studies that are later on in 2010 and 2012 per the assessments ranging from a low of about 17 FTEs per megawatt in Bloomberg up to a high of 39 FTEs per megawatt, which was published by Hagerman in 2010.

And so the number of FTEs per megawatt in the scenarios that we analyzed ranged from a low of 14 under the very most conservative scenario which is not a whole lot going on in the Great Lakes with very low supply chain growth. - that's the most conservative scenario - up to 31 FTEs per megawatt in the Southeast. And so our - so the estimates from JEDI I think are very much in line with what's recently come out of the literature looking at these scenarios. Do you want to...

((Crosstalk))

Suzanne Tegen: So this is Suzanne again. We are going to be coming out with an NREL technical report that details the information about using the JEDI model as well as giving you more detail on all four regional scenarios. And we will also continue to support the offshore wind JEDI model like we do with all our JEDI models with technical assistance. So that's - there's a website - or

there's an e-mail address on all the JEDI models that you can click on that will get you to a JEDI support e-mail.

And we would be happy to assist you. And we look forward to seeing your analyses too. Don't hesitate to let us know what you all come up with. This is the end of this part of the presentation. And I think Ian will be taking - or guiding the question and answer period if people have questions.

Ian Baring-Gould: Yes, will do. Thank you - thanks to all three of you for the presentations. Just a reminder to everybody, again, if you have a question, go up to the Q&A tab on the top of the screen, hit that, and type in your question. We do have a handful of them. So we'll dive into those. One kind of technical question - probably to you, Suzanne, does the JEDI model account for non-local jobs? And so how does that work if part of the supply chain is not local?

How do you count that and break that out?

Suzanne Tegen: Yes, great question. The JEDI model right now is focused on - the default will be focused on a state. And so it'll give you the jobs within that state. And what we did, and what you can do for other analyses is you can focus on a region. But you do have to talk to the model creator for that - Marshall Goldberg - and it's not - it doesn't present very much of a cost, but there is a little bit of a cost to have him get the JEDI model to focus on a whole region.

You can also focus on a county. So we can go both up and down. There - we also have a national JEDI model, but the JEDI model that's available publicly right now that you can download is focused on the state. And so we're really looking at in-state jobs and we're really not looking at out-of-state jobs or out-of-state wages or anything like that or international or anything like that.

But that's a great clarifying question; thank you.

(David Keyser): Right. And the local content numbers that we talked about in the case studies, those are really focusing on what can actually be sourced in the state. And not just sourced in the state, but also really produced in a state. When we look at manufactured content, and anything that is specified as not coming from the state or not coming from the region, isn't included in the analysis results at all.

Ian Baring-Gould: Okay is there - so there's no other place in the model that says, well 75% came from outside of the region, that will be this many jobs just outside of the region?

(David Keyser): No it doesn't do that. Because those jobs could come - you know, if you're looking at the Mid-Atlantic, you might be getting material that's shipped in from California or you might be getting material that's shipped in from Denmark. Either way, the model just ignores it.

Ian Baring-Gould: Great. A couple of questions in regards to floating JEDI. So from (Jean Thirstin); will you develop a floating wind structure ability within the JEDI model in the near future?

Suzanne Tegen: We would like to but we are - right now, there are analysts and researchers at NREL who are compiling data on costs for floating structures and - of components for those structures. We don't right now have it in our funding to do this - do another model, but we would like to and we're being asked to by numerous agencies and organizations. And so I guess the answer is we hope to in the near future.

Ian Baring-Gould: Great. A question from (John Andrade) - I probably just butchered your last name, (John); apologies. He's looking for any analyses in the New England

area - Mass, Rhode Island, Connecticut, Maine - specifically relating to the - kind of the Cape Wind and/or the Deep Water projects. Understand that one of the reasons that we did not do analyses in that region was because we don't have a floating model and you would need one in those spaces.

But can you talk a little bit more about that. And then are there any other studies that either three of you know about that do look at job impacts in the northeast.

(Aaron Smith): I know that - this is Aaron - I know that each of those developers has produced studies that seek to examine the net benefits of their projects. I think that (Keith Wing's) study might have been studied - it was at the Global Insight study. Anyways, you can definitely find a few that are publically available or alternatively, I guess we could probably provide a list of the studies that we know of.

I'm not exactly sure if in Deep Water Wind if they have published something, but I'm confident that Cape Wind has.

Suzanne Tegen: And there are - I mean, other regions of the country too - California, Oregon - they definitely are looking into studying these types of things. But again, we just don't have the floating offshore model right now.

(Ian Bergingold): Great. Thank you. A question from (Bruce Hamilton), how is local content defined? And in the case of these analyses, is that the same as regional content?

(David Keyser): Yes, thanks for that. Yes local content is the same as regional content in this case. And we define it - or the people who do the research on these studies define it based on what can reasonably be purchased and produced within a

region of analysis. And in the case of all of these case studies, this was determined by going out and working with local groups and seeing what's already there and really trying to develop an understanding of how the offshore wind industry might take hold within a region - not just the on-site staging, but also manufacturing and down through the supply chain business services, things like that.

Ian Baring-Gould: Great. Again, if people have questions, just go up to the Q&A tab. One last one, which to a degree is a loaded question and that is does NREL believe that offshore wind projects will be operating in the United States by 2015. And if not, what year and by which regions - or in which region?

(Aaron Smith): So, you're asking us to predict the future, huh?

Ian Baring-Gould: Yes, I guess.

Suzanne Tegen: Looking at our crystal ball here...

(Aaron Smith): Yes, I mean, I think that we will see one or two projects - maybe even three projects installed by 2015. And the reason for that is that the ITC is scheduled to expire this year. And so in order to qualify for the ITC, developers have to place orders for components this year. I think there's a 5% clause where 5% of the project expenditures have to be made in the year that the ITC is available in order for the project to qualify for an ITC.

And so there have been indications by both Cape Wind and Deep Water Wind that they are going to try to qualify for the ITC. And they're confident that they can qualify for the ITC. And to me that really suggests that we will have at least some - you know, one of those two projects, if not both - operating or

under advanced construction by the end of 2015. But, you know, in terms of whether it actually happens, I don't know.

It's taken a long way for the industry to get to where it is and it - there could certainly be more hurdles in front of us. But we're - I don't know, hopefully that answers the question.

(David Keyser): That would - if the flooding had been much worse in September, the NREL Wind Lab in Boulder could have been the first offshore in the United States.

Ian Baring-Gould: Very true, very true. That's all the questions that we have. So again, I'd like to thank the three of you for your presentations. I want to point out to everybody that we have two very exciting webinars coming up. The one in December is the Round 2 of the Western Wind and Solar Integration study.

So I'm sure most people are familiar with that. This one really took a very strong look at issues of plant ramping on the fossil fuels side as well as integration costs. And so it certainly is very viable to - for anybody who has interest in how the grid operates and how the plants that make up the grid operate when we start installing high contributions of renewable technologies onto that grid and whether the costs as well as the environmental impacts of renewables on that grid - it is again focused on the west.

But at least for the West, it definitely answers that question that more than one of us has heard that installing wind onto the grid actually causes more greenhouse gas emissions than if you don't. So hopefully this study is the nail in that coffin. And I would encourage everybody to attend if you can. The webinar in January is the one that we got froze out of - frozen out of.

And that's one property values with Ben Hoen coming in and re-giving - or giving his presentation on property values which again is another one of those

high impact issues. Again, the study's showing that there really is no long-term effects on housing prices. But we'll get all the details from Ben in January. Lastly, just wanted to say that all of these - that this webinar, as all the other ones are posted on the website windpoweringamerica.gov - takes us about seven days to get out there.

We do not post the actual presentations for technical reasons, but I'm sure the authors will be happy to talk to you about providing their presentation if you would like just the presentation materials as compared to the webinar. So lastly, and thank you all for spending a few extra minutes with us. Special thanks to the Department of Energy that funds the webinar series.

If you have any questions, comments or ideas of webinars that you would like to see in the near future, please don't hesitate to contact any one of us - either Patrick Gilman at the Department of Energy, myself, or Suzanne and we'll be - we'll answer any questions that you have. And we'll work to fit your topic ideas into the webinar chain. So thank you again. And until next month, have a fabulous Thanksgiving. And please, again, don't hesitate to reach out if you have any questions or comments.

Thanks again, and have a great day.

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