Economic Impacts of Offshore Wind: Market, Manufacturing, and Jobs
November 19, 2014

Coordinator: Welcome and thank you all for holding. I would like to remind all parties that your lines are on a listen-only mode throughout today's presentation. Also the call is being recorded. If you have any objections, please disconnect at this time. I will now turn the call over to Mr. Patrick Gilman.

Patrick Gilman: Thank you very much. Thank you, everyone, for joining us today. I'm really excited to be here to moderate what is the first in a series of webinars that we are hosting regarding some work that we've been doing in the offshore wind space. Tessa, next slide, please. So I'm Patrick Gilman. I'm a manager in the US Department of Energy's wind and water power technologies office, and today we have a number of presentations for you about economic development in offshore wind.

Wind, you'll hear a little bit of an intro from me followed by a presentation from Bruce Hamilton on—from Navigant on their offshore wind market report, followed by Patrick Fullenkamp from the Global Wind Network and finally last but not least, there's Suzanne Tegen from the national renewable energy lab talking about some work that she's been doing on regional economic development scenarios associated with offshore wind.

We will have Q&A at the end, assuming we can get through all of our presentations on time, so ask a question please, click on that Q&A button at the top of the meeting window, type your question in the box and click ask. So next slide, so I'm really excited to bring you this webinar series because we've been working for several years on a number of efforts that we think are really critical to enabling the US to access this massive offshore wind resource that we have in this country.

And about five years ago through 2011 I had the opportunity to work with our partners at the Department of Interior and a number of folks in DOE as well as with external stakeholders like yourselves to develop the national offshore wind strategy, and that strategy which was announced in 2011 by Secretary Ken Salazar from Interior and Secretary Steve Chu from Energy was of two objectives.

The first is to reduce the cost of energy through the development of advanced technologies, and second, to reduce deployment timelines and uncertainties associated with deployment, and next slide, please. Over the past three years plus, we've made some really critical progress. We've invested you know, a few hundred million dollars in taxpayer funds in order to make this happen in test facilities, that 15 mega-watt dynamometer we have down in Clemson, Massachusetts large lake test facility to develop innovative technology announced to FOA in 2011, 19 projects focused on helping to enable the next generation of offshore wind technologies that will be necessary to reduce costs.

I'm sure all of you have probably heard of our demonstration initiative in which we have $168 million that initially to seven projects to help them through the first stages of project conception and design and now down to three projects where we will see hopefully at the end of 2017 three demonstration facilities, one in Oregon, one in Virginia, and one in New Jersey so that the country can learn lessons from real steal in the water.

And finally FOA, you know, funding opportunity that we will be talking about primarily through this webinar series on reducing market barriers to (unintelligible) and that opportunity covered everything from siding and permitting to infrastructure needs, resource assessment, operations and

maintenance. Today you'll be hearing about some of those investments. Next slide, please.

The point of this webinar series in you know, this session today as well as a couple of future sessions are twofold. The first is we want to give everyone a chance to sort of see what we've been doing to implement that national offshore wind strategy that we all put in so much work on and show that the investments that we've made over the past several years are really starting—that are coming to fruition now, you know, and are making tools available that we feel like can really help bring this industry forward.

The second is to showcase research results, and both—that includes both the research that we funded through the investments that I just talked about as well as other developments that other parties have made and sort of following in the same line that together I think will help move the industry on a more sustainable path. Next slide, please. So this is the first in that series on—with respect to the offshore wind webinar series.

Particularly on December 2 we're going to have one looking at some investments we've made looking at transmission and grid studies associated with offshore wind, and then in January we're going to be talking about design conditions for hurricane mid-ocean environment, some of those conditions that are really going to be important for the US to sort of understand as we deploy these technologies.

And also invite you to look there, this is part of an ongoing series of WINDExchange webinars that we run every month, third Wednesday, and we have those coming up on distributed wind on recycling and repowering, and then on citing considerations. Next slide, please. To get more information on

any of these webinar series, I encourage you to reach out to the people listed here, (Freeman Cleef) is our stakeholder engagement and outreach director.

Ian Baring-Gould who leads this efforts at the national renewable energy lab with Suzanne Tegen who is dual-hatted both as presenter today and as well on the WINDExchange webinar. So without further ado, who's our first speaker, which I believe is Bruce Hamilton.

Bruce Hamilton works for Navigant consulting, and for the past several years has been leading an effort under funding from the Department of Energy to produce a national wind—a national offshore wind market and economics analysis summary, which along with our sort of flagship land-based wind focused report that Ryan Weiser and Mark Bolinger do at the (Unintelligible) national lab, as well as the new distributed wind market report, helps us to give some market intelligence to the whole country to understand what's happening in these sectors and the opportunity that they represent, so without further ado, Bruce.

Bruce Hamilton: Okay, thank you, Patrick. All right, I think I have control. I'm going to flip to the next slide, if I can. And I'm apparently not able to do that. This is a delay. Okay, looks like—there we go, okay. A little bit of a delay. There's our disclaimer. Okay, as Patrick mentioned, we've been producing this report known as the offshore wind market and economic analysis report since 2011, so we've just issued the third annual report and the structure of this presentation roughly follows the structure of the report.

So that'd be—that would be—the report was authored by a consortium of companies that we have called the Navigant consortium and you can see around the circle the various companies and organizations that were contributors. Tetra-Tech ocean and coastal consultants, Vestas was a earlier

contributor. Enrel in particular, they contributed to the costing efforts as well as the development of the offshore wind jobs model that Suzanne will talk about later in this webinar.

The Great Lakes wind collaborative and AWEA, both as trade organizations, helped with both on the data collection as well as the outreach, and Green Giraffe energy bankers, which is a financial boutique consultant based in the Netherlands. And of course it was all sponsored by the DOE, Patrick Gilman and (Michael Hahn) in particular have been our guidance—our main contacts.

Okay, so these are the four chapters of each of the reports. There's a pretty significant discussion of what are the trends in the global offshore wind industry, both from the market and the technical points of view. Then looking a little more closely at the US projects as we have a tracking—we have a list and a way of tracking the projects that are in major advanced development, and then the section on policy, developments globally in the offshore wind area, and then finally economic impacts where is mentioned the cost impact where we have some updated numbers that I'll talk about.

Okay, so just looking from the big picture, the global offshore wind market has about seven gigawatts installed. More than half of those are in the UK, about 80% are in Europe. They are—in 2013 there were 1700 megawatts. That was a record year. In 2014 we expect 2300 megawatts, again, a record year, and you can see there are none currently in North America. That's soon to change.

As far as technical trends go, kind of a general summary would be that everything is getting bigger, so this chart shows the average turbine size is getting better. We're also seeing, you know, total plants getting bigger. We're also seeing each of the components getting bigger in terms of higher towers,

longer blades, larger foundations, and also if—along with the larger plants comes further control and deeper water.

So those are the general trends. So you can see as far as turbine size goes, thee was a slight dip in the average size last year, and that was due mainly to the increase in the Asian market, which is generally smaller sized turbines, but we expect that to continue its upward trajectory. In the US you can see, which is the far right column, almost all of the plants that are in planning phases will be using the larger five or six megawatt size turbines with the exception of the three that are mentioned, cape wind and a couple others.

Okay, so this chart here shows the—this is the shore across the X-axis and the water—average water depth on the Y-axis, and you can see the bubble sizes represent the megawatts relative size of the plant, and it's no surprise that as projects get further from shore, they get into deeper waters. The plants also generally get larger the further out you go, and you can see those—you know, the current plants, they're all in the 25 meters and less range.

The newer plants are a little bit deeper, and then those that are planned are a couple that are actually beyond the limit of six foundations which is about 60 meters, and you can see, well, there's two floating projects on this chart, the one that's a two-megawatt wind float in Portugal, but then actually three, the Maine and then the Oregon principal power project which is off the chart, and it's actually 365 meters.

And I think there are a total of four floating projects in the world right now currently in operation. Okay, another significant trend is cost, and we'll talk more about this, but you can see the generally increasing trend over time. Actually took a dip in 2013. We had a slight increase. The average cost of reported capital costs was just under $5200 per kilowatt. So the reason they've

been increasing was due to the plants getting further from shore and have increased complexity and higher risks associated with that, which we call our higher contingencies and financing costs.

But going in the other direction is the technology advancements that include improvements in materials and generally more of an industrialization of manufacturing techniques, so we are expecting that the—those factors will dominate in the future and that costs will actually continue to decrease. Okay, so now that's sort of the big picture from the global industry development point of view, and as far as US development goes, we have defined projects in advanced development as having met one of three criteria.

One is they would either have a lease in hand or a PPA in hand or have completed geophysical studies, and so we kept track of the projects that have met one or more of these criteria. This year there are 14 that are on the list. There are various stages and we'll show you the list in the next slide, but here you can see that they are generally in the northeast, although they are in all of the five major regions, the northeast, southeast, Great Lakes, Gulf, and the Pacific.

And you can see that the green are the—within federal waters, which are generally three miles—greater than three miles out, and the purple are in the state waters. In Texas the—that line is more like 10 miles rather than 3, so most projects you'll find in Texas will be under state jurisdiction. All right, and you can see by state, you know, Virginia leads the way. That's because of the single large project that is being planned that I'll talk about.

So those next two slides show a lot of detail, which I'm not going to get into very much, but just to point out the projects, they're sorted here by the announced completion date over on the right column, and you can see there

are potentially four of them that would be completed by the end of 2016, and in fact some of them, the smaller ones may even be completed in 2015.

Block Island in particular and Cape Wind are two that have actually started construction. They're both—they did that in order to meet the deadline required to receive the investment tax credit by the end of 2013. And I think it's likely that you know, Cape Wind for example will have a good portion of its foundations and turbines installed in 2015 and then the final connection be in 2016.

You see on the bottom half of this page are the three projects that have been awarded the advanced technology demonstration awards that Patrick mentioned, the $47 million each, you know, the ones in New Jersey, Virginia, and Oregon. And on the next page you can see some more, and these are in various earlier stages of development. I mentioned the 2000 megawatts in Virginia. That's the one that's second from the bottom.

That's not a well-defined project at this point, but you know, dominion has announced that it will be a project up to that amount, so that's where that number came from, but they do have a lease for a pretty significant project up to that amount. And so you know, this number of 14 projects is one that's steadily grown. I think in the last year's report it was 11 and the year before that it was 9.

Okay, if you do—if you take them and you plot them as according to what their predicted commercial operation dates are, you can see they'll be about 3700 megawatts by 2021, you know, and around under three gigawatts by 2020. So you know, recognizing that not all 14 projects will be built and you know, they may not be built according to their projected schedules, but it gives you a feel for the total activity.

Okay, you know, in area policy there were active developments at all levels. This slide shows a listing of policies that according to our knowledge haven't been used in other jurisdictions, either in Europe or in different states or in actually related technology such as onshore wind to be successful and therefore are expected at—you know, they could also be effective in offshore wind, you know, the first one being the ITC which could be just the plain extension by a number of years or an idea that's been floated is to have it only be effective for a set number of megawatts in this case 3000.

That's at you know, more certainty for those that make it with—you know, within the first—that first 3000 megawatts. And again I'm not going to go through it all, but you can see that there are a number of things that have been used at the state level. Offshore wind carve outs of RPSs, New Jersey and Maryland being the best examples of those, and then in other states such as Massachusetts whether it's been just PPAs that have been essentially forced upon utilities.

Or I should say bargained with the utilities, and also at the state level various transmission incentives. So I think the message here is that there's no one size fits all. There are certain things that either or could be used, you know, to—mainly to address the cost barrier, and so there are ongoing efforts in many states to do one or more of these types of policies, and the next slide shows what's been done within the last year at the global level, both UK and Germany, which are the two largest markets globally.

Both had regulation clarity last year, and so there were in both cases questions regarding existing policies which were causing developers to slow development until those uncertainties were cleared, and in both cases that sort

of the gridlock has now been broken, so we should expect a large I guess resuming of those projects, particularly UK round three.

And US, a mixed message there. The PPC and ITC as most people know, it did expire at the end of 2013, but it continues to be discussed as a potential extension or reinstallment I guess, and Patrick mentioned again the DOE advanced technology demonstration program, and also (Unintelligible) has been very active and I think there's a slight coming up that is more details on the competitive lease sales that they have planned.

And at the state level, Maryland has been leading the way with some regulation that was passed in 2014 and in New Jersey, there's been some activity at the board of public utilities, actually in the wrong direction for efficient energy, because if the proposal is rejected due to not having it justified economically, you know, with the net benefits to the state. So that's—and that's one of the projects that was approved by—was awarded the advanced technology demonstration project award.

Okay, here's the (Bowen) slide showing that there have been three successful leases awarded already, one in Rhode Island and Massachusetts, one in Virginia, and one in Maryland. And there are at least three more that are planned and they continue to be scheduled, so there's New Jersey, another one in Massachusetts, and another one in Delaware, excuse me, Maryland planned.

Okay, and I think there's just one more slide which summarizes the cost. I mentioned that we did basically it's a bottoms up look at what a standard offshore wind plant in the mid-Atlantic would cost, and the bottom line is $2.86 billion for 500 megawatts which comes out to $5.7 million per megawatt, and that's down 11% from the same corresponding number that we

did three years ago, and that's down because of a slightly different definition of what the reference plant is, which is due to you know, using jackets or (unintelligible) instead of jackets, HPAC instead of HBTC.

But that's all consistent with the trend that I mentioned earlier of costs coming down. Okay, so I think I'm going to forego the steepest summaries (unintelligible) in favor of time, but this—and by the way, the report and all of the reports we've done are available on both the DOE an the Navigant websites, and available at no charge. Next slide.

Patrick Gilman: Fantastic. So next up we have Patrick Fullenkamp from the Global Wind Network. Patrick leads offshore wind supply chain development for GLWN which is a network of over 1700 members. He has 30 years' experience in the automotive sector and international supply chain engineering and manufacturing, project management and logistics and has started manufacturing facilities in a number of countries around the world. Patrick's going to be talking about a study he did for us on the offshore wind supply chain. Patrick, go ahead.

Patrick Fullenkamp: Okay, thank you, Patrick. I will be reviewing the work GLWN did on behalf of the US Department of Energy project, and it was titled US Wind Energy Manufacturing and Supply Chain, a Competitiveness Analysis. The purpose of this project was to obtain a greater understanding of the key factors determining wind energy component manufacturing cost and pricing on a global basis in order to enhance the competitiveness of US manufacturers and reduce installed system costs.

And for those American manufacturers that might be on this call, the—you can benefit by using this following information as a benchmark for your own operations. Next slide, Tessa. Okay, this project included 22 manufacturers in

the US, Europe, and Asia. This was a limited snapshot study in 2013, not a full comprehensive study. The US manufacturers in the middle of the country are primarily supporting current land-based wind farms.

Europeans on the other hand are located in the coastal regions according to the current offshore projects, and most of the China suppliers were located by water ways to support either land-based, offshore, and/or export. The key message from this map is the US will have to develop a new coastal manufacturing base for the US offshore wind market starting out along the Atlantic coast.

And again this is a great opportunity for new high-skilled jobs, manufacturing jobs, in the coastal regions. Next slide, three of the components of the study were powers, blades, permanent magnet generators, which make up 54% of the wind turbine costs, so those are the three primary contributors. The other jacket foundation which would be part of the balance of plan that's shown there on the top right, that makes up 50% of the camp ex of the offshore wind farm.

This compares to a total wind turbine which would make up 35% of the project camp ex, or for these three components, 18% for the towers, blades, and PM generator combined. So they were significant cost contributors. Next slide, please. To achieve a true apples to apples global comparison of cost, GLWN developed detailed manufacturing drawings in standardized component specifications based upon the five megawatt end rail model.

I conducted 22 full day onsite reviews to validate the cost and understand the process steps on the incoming material to the final part ready for shipment to a customer. I walked the process from beginning to end to understand the cycle time, the leach, the process steps, and also the operator hours. The cost

breakdown and analysis and value stream mapping were conducted, and I will review the results in the next slides. So, the next slide, please.

Okay, this is the cost breakdown bar chart summary of the four major product categories by regions, US, Europe, and China. And I will get into the detail of the towers and blades on the next pages, but looking at this slide you get the visualization of the diversity of cost by product type, five global regions, and then also by the different cost breakdown categories. And each bar chart is broken down starting here from the bottom of that bar chart to the top.

The categories are material, that's in the median blue. Labor is in red. Burden is in green, and again labor and burden will all go together, and you have SG&A, sales, general, and administration, that's dark blue. Engineering is in orange, and then logistics to the port of New Bedford, Massachusetts, and this would be the first new US wind marine terminal port and that's shown there in light blue. And we use that to use that as a common final destination point for all these different products to equalize the study.

And then on powers there was a tariff tax implemented in 2013 and that shows up in the same color. Next slide, please. Okay, this is the schematics of the tower, and to understand the size of the companies in this study you can see the combined data of the five plants visited with annual power sales, with the annual tower capacity by plant, and then also towers built to date.

And these were major suppliers, and they were—there were seven detailed manufacturing drawings that went to each one of these suppliers, and you can see the key dimensions and the mass listed here on this particular slide. Next slide, please. Okay, this chart on towers shows the aggregated cost breakdown. The top left chart shows the regional cost breakdown in the major

categories of material, labor, burden, SG&A, engineering, logistics to the port of New Bedford in Massachusetts, profit, and tariff tax in the case of towers.

The top right shows the further breakdown of the material cost drivers. Those would be major components, would be steel plate, door frame, phalanges, paint, pasteurs and weld wire. The bottom right shows the labor breakdown by the 17 classic steps, and I do not show the other cost categories, but we have them detailed and they are in the full report. Towers are the largest cost contributor at .7% of the wind turbine.

And from a regional cost breakdown chart, you can see the material is over 50% of the cost of the tower, breaking material down further in the top right chart you can see that steel plate accounts for 62% of the material. The—an R&D project here would be to optimize the material and size of the plate, the larger the better, to reduce the mill cost and the manufacturing process, weld length and time.

You've also got weld wire size and delivery systems could also be optimized, and just from my 30 years in automotive as I went through each one of these plants, powers and all the other plants, but specifically in towers I could see opportunities to reduce labor and burden 30 to 50%, and that would be done through flow, through design, and quick changeover. And I have started reviewing and making the proposals to the US power manufacturers.

The next slide would be the value stream map and the value stream map tool shows the information and material flow from a customer order poll to the delivery. Once the manufacturing plant gets the order, it sends the material and delivery requirements to its suppliers. The purchased material is then sent from the suppliers to the plant and it goes through each plant process step.

The parameters for each step are documented as shown in the pop-out, and as the part works through the process, value-added—cannot value added time can be documented shown at the bottom of this chart, so overall this tool enables the identification of various wastes and improvement opportunities for domestic suppliers with a look across all global suppliers. Six Sigma and other tools can be applied to improve the process.

And this tool is used widely in the automotive industry. Next slide, please. Okay, this is the schematic of the blade, and you can also see the combined data of the seven plants visited with annual blade sales, annual blade capacity and blades built to date. These were major suppliers and there were 12 detailed manufacturing drawings which were sent to all suppliers. You can see the key dimensions and the mass listed.

Next slide, please. Okay, this is the cost breakdown chart for blades. The top left is the full blade cost breakdown by region and category. The top right is material cost breakdown, and bottom right is burden cost breakdown. And again, the burden and the labor pretty much categorically percentage wise by each process step are the same. And blades are the second largest cost driver at 20% of the wind turbine costs.

Material is 45% of the cost of the blade, of which resin, carbon, glass, and foam accounted for 90%. This is a chemical process and we need material improvements that provide material costs and process time reductions. Also blade design and analysis that maximize power output and minimize material usage, and we can leverage automotive and aerospace knowledge with wind turbine blades, also.

In the next slide is the value stream map for blades, and this is similar to the power value stream map with 19 process steps. The highest labor driver step is

shown in the pop-out which is shell layout, top and bottom. Next slide, please. Okay, in summary the global competitiveness scoring is based upon a limited snapshot study shows that the US leads the process technology and lowest total process man hours in towers, blades, and generators.

Germany leads on foundations, and China does have the lowest produce costs on towers, generators and foundations, and that does not include logistics, so in-house manufactured cost is less. The US is the most competitive on blades. Next slide, please. Okay, this map shows the 41 US manufacturers currently making or capable of manufacturing towers, blades, foundations, and permanent magnet generators.

The US has limited coastal manufacturers, except the large fabrication sites and you can see those would be the blue dots and those sites currently serve the oil and gas industry and also coastal bridge and other shore site construction projects, and most manufacturers are located best to serve the land-based wind industry as it stands today, but again we see a lot of opportunity as the offshore wind industry and the larger parts will require that these parts be produced close to water.

Okay, the next slide, the US manufacturing scorecard was also developed based upon 280 US manufacturers current or capable of making these wind parts. Let's see, a green, yellow, red rating system was used. Green signifies that we can manufacture that today. Yellow requires some capital investment, and then red, a major capital investment is required. The chart is also broken down into three megawatt and five megawatt for the land based.

And then also for the offshore wind turbine components, and the component categories are towers, blades, generators, cash tubs and support bases, forged rings and (unintelligible), composite housings, fabricated support bases, tier

boxes and you've also got the offshore key balance of plant that would be the jacket foundation, (unintelligible) foundations and also sub-C cabling.

Those that are red, those if you take a look at the chart are in the castings and forgings and offshore foundations, the balance of plan, and larger five megawatt towers and blades are also shown as red, so a capital investment will be required to make this a solid business. Next slide, please. Okay, our friends in Germany have an excellent model for the US to follow. The German offshore industry started in 2000 and this is how the industry has progressed 11 years after as of 2011.

And this is hard data from Germany with 5.9 billion Euros in value added for 2011 and it's projected to be 20 billion by the year 2021. And this industry will approach approximately 1/3 of the German automotive industry, so it's not a—it's not going to be a small industry in Germany. And I guess I also wanted to point out that the manufacturing high section is 61% of all the total value added in corresponding jobs that go with that value added there.

And that is followed then by project planning and development at 15%, grid connection 10%, transport and assembly 8%, operations and maintenance 4%, and finance insurance, 1%, so this chart really says go USA manufacturing to add American jobs with this new industry. Next slide, okay, okay, what does—I think this study is why this study was important for US manufacturers that the slide that you had there.

Tessa Dardani: Yes, okay. Yes, that's right.

Patrick Fullenkamp: Okay, so you know, what this says is you know, the green turbines are permitted offshore installations, and you get representation of the orange turbines are the plan site. You can see the map and info on the permitted and

planned sites at our website, www.glwn.org, and the expansion of our online wind supply chain to include the sites, components, and search features is a part of this DOE project.

I think that the main point here is that wind is here to stay. Turbines are getting bigger, specifically for the offshore and the size of parts and logistics can be in our favor, and we are at the point now where we definitely need to think about investments. Okay, and the next slide would be the major observations. That'll be the last slide.

Okay, the general observations are—is that the US has a good foundation with more to improve with capital investment. The investment can be used to be most competitive in series production and utilizing the lessons learned from automotive, a 30 to 50% process savings potential was observed during the plan visits, and next, the old wives' saying of if you don't make it, you can't innovate it, applies to the US casting and forging business for the larger wind turbine components.

So if you don't make castings and forgings, you lose the value added supply chain of the machining, the machine tools and codings, and these backbone components make up 23% of the cost of the wind turbine, and next the US has a major market opening up in offshore wind. The global competition sees it as theirs, although winning this business is in the cards for US companies that invest wisely.

Okay, and the full report is on the DOE website and it's also on the GLWN website. Last slide, next slide, is thank you and I look forward to your questions at the end. Back to you, Patrick.

Patrick Gilman: Great, thank you so much, Patrick. Last but not least we have Suzanne Tegen who's going to talk about offshore wind jobs and economic development impact scenarios that she's been running for us. Suzanne manages the wind and water deployment section at the national renewable energy labs.

She's a policy analyst by training and researches when deployment issues such as radar wildlife grid integration, work force development, and public engagement. She'll be talking today about work that she does estimating in economic impacts from offshore wind using (unintelligible) jobs and economic development impacts model. Suzanne, take it away.

Suzanne Tegen: Great, thank you, both Patricks, and the last slides that you saw were a great lead-in to talking about jobs and supply chain modeling, which is what this is about. This presentation is on a JEDI model, and some of you have heard about the jobs and economic development impact model, but the JEDI model that we have for multiple technologies at ML, and they are—you can download them for free from our website, which I'll show you in a little bit, here.

The jobs and manufacturing topics are always of course in great interest to state decision makers and other decision makers, and you all know that, so that's kind of the important thing here. Let's see. I'm just trying to—there we go. I'm just trying to advance this slide. Okay, there we go. So NRL's published the offshore wind JEDI model for six bottom projects this past year, and so far this includes most all offshore winds, but of course not the floating or platform ones that you just heard about—Patrick talked about.

But there are four kind of demo projects out there right now. There will be a few more I think in 2016, at least two, and then we'll probably see more in the future, but this model that I'm going to talk about is just for the fixed bottom

projects, and as usual for our JEDI models, we gather data from project operators and also we work closely with Navigant and other researchers and local experts and then performed analyses.

So these slides that I'm going to show and I probably won't show all of them because I think we want to leave some time for questions, but they will talk about the JEDI model itself and then also the four regional analyses that we did. If I can get my slide to advance—there we go. Here are the four regions that we analyze. We looked at the southeast, and we looked at the Great Lakes, the Mid-Atlantic and the Gulf of Mexico.

And we realize there are many other regions in the US and we'd love to do analyses in other regions as well, but we focus on the kind of larger, shallower offshore wind locations because of fixed bottom and we are currently working on a model for floating technology, so we're hoping to do more locations in the future. So we didn't work on these alone. We worked on these with partners and I think I'm just going to keep talking. My slides hopefully will catch up with me. There we go.

We worked with Professor John Miles and (James Emmett) and (Michelle Kramer) from James Madison University on both the southeast and the Atlantic portions, and then we worked with Professor David Loomis who is also working with the Great Lakes Wind Network at the time and also NY State University is where he teaches.

So the Gulf Coast leads folks to numerous regional experts and performed the analysis in house and around, and let's see here. So for the offshore wind JEDI model, again I'll kind of go through the model and then I'll get to our results. So our defaults are based on real world projects where we're actually talking

to the owners and the engineers. Then they're also based on another model called in-plan, which is an input/output model.

And that's kind of the JEDI backbone. I'm going to kind of whiz through these things because I want to get to our regional results, but if you all have questions I'm happy to talk about you know, all of the questions, maybe offline if we don't have time today, and then there's the website there. You can click on that and we've got lots of information on the website.

So for our default and kind of our substance of the main part of the model which it can change when you get onto a JEDI model, so further default we have cost information from Navigant. We've got some of the defaults based on a representative project in the Atlantic. We used a jacket substructure in 25 meters and it's 100 nautical miles from port, and we're now working to make the model more accommodating to other parameters and we'll have other details in there.

And of course you can modify the default costs that are I there if you have enough information, so right now we're kind of constrained by that jacket kind of structure until they get some more information. I think I'm going to just skip over some of this except to say, and those of you familiar with the JEDI models have heard this before, but if you're new to the JEDI models, our results show gross economic impact, not net, which just means when we say our project has a full-time worker, we don't know whether that worker came from the oil and gas industry or from unemployment.

We don't know where they came from, so we just know that you know, this person's job is supported by the project that we're talking about. We can't say it's creating a job, that this project is creating a job, because we don't know if that's maybe just a job transfer, or what that is, so we use the word supported,

that our project supports this job, and I think I won't go through all of the rest of those.

But I will say that JEDI's results are presented in full plan equivalents, and that's the number of people working full-time, so if you have two people working half-time, that's considered one full-time equivalent, and so JEDI presents to you, you kind of put a few things in the model, you put in the size of your project, the location of your project, and then if you can the installed cost or you can use the default for that and then what it fits out—the results are the job, the earnings, and so that is income as well as benefits that you got from your employer.

And it comes—they come in—the results come in three different output categories, and so I'll talk about those now, and slide—there we go. For our visual learners we'll have some pictures here, so the first one is project development and onsite labor and this is all of the labor that's onsite so that what you would really picture happening, the people who are steering the vessels, the derrick operators, the truck drivers, the management, people who are out there doing the work, but not the equipment.

So our first category is just the labor onsite. Our second category is the local revenue, the turbines, the supply chain impact, and this is the largest category, so all of the equipment and supply chain as well as the people you might not think of like our accountants, our bankers, and any property taxes and that kind of thing come in the large middle category. The third category is induced impacts and so that's money from revenue it's spending from the first two categories, so somebody who comes to work on the construction of the offshore wind project would stay in a hotel.

And revenue that that hotel gets is then included. It's a very important and real part of the economic impact from a project, so this is one that's sometimes left out or people don't like to consider it, but it's actually a really important one, the induced impact. So I'll go on to our regional case studies and concentrate on kind of our assumptions and those are based as I said before on interviews with regional contacts.

And in each case when I introduce one of these, I'll talk about our inputs that are unique to that region compared to kind of the national offshore wind JEDI model or default. In the southeast we see that the wages are about the same as the JEDI default. There are several large ports that are well-suited to become offshore winds manufacturing hubs, and also there's even though there's no deployment there, there's still a lot of manufacturing in that area.

So in each of the regions we performed analysis on three different scenarios. We did—we looked at high deployment, kind of a medium deployment, and then a lower deployment and I'll show you that for each region. So for the southeast we had some in depth knowledge that—and some good contacts there that led us to do a bit more of a complex analysis, and again I can come back to this if people are interested.

But the folks at James Madison University had really good contact and they were able to do kind of a few side scenarios instead of three and get more out of that. So here is the first scenario that we'll talk about in the southeast. We've got the high, medium, and low. These are cost scenarios. Then we looked at local content, and we also looked at the deployment numbers. I'm not going to show everything here.

But you can see on the bottom there the local content would range from 28% local in 2020 to 75% local in 2030, so a big jump, and then you can see the

lower ones, 20 to 29% so I tried to be really realistic about what could happen there from talking to the people at the ports and talking to the local supply chain there, and I'm trying to show the results. Here they are, so these are the estimated full time equivalent jobs supported.

And I'm not going to stay on each one of these for too long, but just kind of just show you not surprisingly the low cost, high deployment and high regional content scenario shows the biggest impact here, but it is quite a significant one, so that's 60,000 full time equivalent jobs. And we'll move onto the Great Lakes. Here there are a lot of differences of course. This is freshwater. There are fewer port options than in the other regions.

The wind sites in the Great Lakes are usually farther from the shore, and then there are issues with the locks, because if we're getting equipment from overseas, that equipment going through the locks, there could be barriers there, logistical challenges, and then one great thing about the Lakes of course is that they don't experience tides, so that's a plus, but overall the development in the Great Lakes is a bit more expensive than the Atlantic despite some of these things.

Like there's no—you know, it's freshwater instead of salt water and there aren't any tides. And so some of our assumptions we have that low, medium, and high scenarios here, again you can see the deployment in 2020 and 2030, and then the local content is below again where we looked at a low scenario and then a high, which gets up to 57%, so lower than what we thought might happen in the southeast, but still a really significant portion there.

And here is what the job trajectory looks like. Again, that high deployment scenario with 57% local content by 2030. I know I'm going through these really fast, and just to remind everybody these webinars are available online at

the podcast afterwards, but I know people are going to have questions, so I wanted to make sure we get to those.

So we'll move on to the Gulf of Mexico regional findings, and of course there is the oil and gas existing industry there and that would help a lot with work force because we've already got that skilled labor. There's higher potential in the thirty meter depth and so they've got more kind of more possibilities there, but there is also hurricane exposure and we're not really sure—there are some studies right now on hurricanes and offshore winds, but we don't have the results in from those, so that's kind of an unknown right now.

So I'll show you the scenarios. Again, we have the low, medium, and high deployment scenarios, and then you can see the local content here that goes up to 80% because we've already got that existing gas industry for some of it is already in the region. And here I show that estimated full-time equivalent jobs supported and again you see there that high scenario with the 80% local content is not surprisingly you know, what (unintelligible) into the higher realm there.

We'll go then to the Mid-Atlantic regional findings where we just like in the southeast are similar to the defaults in JEDI. We didn't have to change those much, and of course we've got the large ports that are well-suited to offshore winds, but of course they'd have to be, you know, upgraded and modified, but still and we talked about this a little bit. The states are already offering some incentives. I have a slide here that is the same map that (Secretary Chu) was holding in Patrick Gilman's intro slides.

So that's a map from the bureau of ocean energy management of the current winds energy leasing areas off the Atlantic coast, at least I think I have that slide. So anyway if you look there, you can see the mid-Atlantic kind of on

the bottom half of that map. And we talked about I think then we also heard about policy in Massachusetts and New Jersey. So moving on to the fair development scenarios, we've got the low, medium, and high again for 2020 and then 2030, and then the local content.

The seas get up to 80% as well, and then of course for the low (unintelligible) stay around 40. So here's the next slide showing the high scenario, the medium scenario, and the low scenario, and then to kind of sum it up I think for all of these scenarios the jobs are well compensated. The onsite earnings are around 130 to $140,000 a year, that higher one being in the Great Lakes region. Supply chain earnings, approximately $60,000 a year and induced at around $50,000 a year.

And then to let you know just to give kind of a brief summary of the JEDI results and compared to other results and jobs and economic impact studies, you can see here, so this is from our regions up top and the four that we did here, and you can look at the construction period full-time equivalents for megawatts and then other studies that have done similar kind of jobs estimates...

Patrick Gilman: Suzanne, I think we're going to need you to wrap up here.

Suzanne Tegen: Okay. You can see that those—that JEDI's right within that range. The first two are earlier studies, and so they had a lot lower costs, but in the—but ones on the bottom there that are more recent, you've got really similar costs. So thanks for listening. There is a report out on this. (David Keyser), K-E-Y-S-E-R, is the author on that, if you have questions. I'm happy to take them. And I'll just end there.

Patrick Gilman: Thank you so much, and thanks all for holding with us, for being patient. Sorry we're going a little bit over the hour. If folks are okay staying with us a couple more minutes, I think we'll try to go through 4:05 eastern and ask a couple of questions. So I'll just start right off. We have a question I think for Patrick. Questioner asks, how many manufacturers of offshore wind energy electric power systems do we have in the US and who are the largest?

Patrick Fullenkamp: The—you've got—from—as I showed on the one chart, there was 41 manufacturers that would have that capability. Nobody today makes any components for the offshore wind industry, since there's no industry here and nobody exports parts over to Europe and Asia at this point in time. It looks like the leading wind turbine OEMs would be the Siemens with the Cape Wind project, also with the Block Island project. And then you know, they both also are involved in the demonstration projects.

Patrick Gilman: Great. Thank you, Patrick. Suzanne, can you give a sense of the timeline of when the floating offshore wind JEDI model might be available?

Suzanne Tegen: Yes, we're hoping to have this out in 2015 so probably mid-2015 we're guessing, and if you are an expert yourself in floating offshore winds and know a lot about it I'd be happy to enlist you as a reviewer or somebody to talk to about it, so don't hesitate to get in touch with me.

Patrick Gilman: Great. We have a couple of other questions. First is what's your projection for wind electricity generation in the next ten years? I'm afraid that's not something that DOE typically engages in. I think there a number of forecasts out there I would encourage you to Google. Yes, and I think that that's about all we have time for. So thank you so much, everyone, for joining today. I really appreciate your time and attention.

These—this webinar will be posted on the WINDExchange website just as soon as we can get transcripts made up and everything, and thanks again to Bruce, Patrick, and Suzanne for their presentations today and we look forward to seeing you on the next WINDExchange webinar. Thanks very much.

Coordinator: That does conclude today's presentation. Thank you all for joining. You may now disconnect.

END