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SAM BYRNE INTERVIEW

Hi, welcome to GridTalk. Today we have with us Sam Byrne who's Vice President of Operations of Equinor, a Norwegian firm headquartered their renewable's operations in Stamford, Connecticut where Sam sits.

A: Good morning, Sam. How are you?

A: Hi, Marty. Good to talk to you.

Q: Let's get our feet wet as they say. Offshore wind farms have gotten very big globally in some parts of the world. You and I have chatted about the fact that China seems to have 105 of them; the U.K. 39; Germany 28; Vietnam 26; Denmark 13; and the United States, you can count them on one hand. Talk about the global situation and why it's been so slow to takeoff in the United States.

A: Yeah, sure, Marty. If we just look at wind both onshore and offshore first, I think, there's about a thousand gigawatts globally now and about 10% of that is probably offshore. But that's grown over the last couple of years and the growth rate

for offshore is faster than onshore and I'm sure but from a smaller base, probably around 850 gigawatts onshore and maybe 65 gigawatts offshore only a year and a half ago or so, but there's a number of reasons for one technology or one country to take off faster or more slowly than a different place and it's hard to pinpoint one so those might be support structures which could be in terms of power prices or tax incentives. It could have to do with the existing generation infrastructure and when that might retire, how - what condition they're in. Is there good and sufficient power supply that's going to last 20 years or is there a lot of electricity growth and it needs to be replaced next year, and something needs to replace it? It could have to do with the transmission lines and where it's convenient to put in new electricity and what type of electricity. It has to do with some of the construction costs and the logistics so is the ground good? Is it amenable to the construction of a wind farm onshore or offshore, there's the subsea ground and then of course the wind speeds, so is there good offshore wind resource vs is the wind slower, there's better onshore wind resource and good construction and there's fossil fuel plants that are retiring very, very quickly so that has to do some of their reasons globally. In the U.S. as you've mentioned, there's basically an imperceptible amount of offshore wind at the moment. I think 2016

was when the Block Island Wind Farm, a 30-megawatt windfarm came into operations off of Rhode Island and that's despite the country being a fairly successful wind player. There's only about 150 gigawatts here in the U.S. onshore, so we're starting to see the acceleration now. Some of it has to do with support; some of it has to do with the technology that's come into being; some of it has to do with just the need for electricity and the fact that wind is getting more and more competitive on a levelized cost of electricity and it's not the cheapest, sometimes, it's close to the cheapest.

Q: So, let me just interject for a second..

A: Yeah, go ahead.

Q: I'll refer to what I call the Teddy Kennedy factor when the first proposals for offshore wind were announced, he said that he did not to be sailing his boat off of Hyannis Port and looking at wind turbines. Is that still a lingering issue, the esthetics of these turbines? And then, part B to my question is, what's been happening lately around COVID and then a year ago, we saw the cost of offshore wind went up. How are we getting past that now and do you see a clear path forward?

A: Yeah, and I have to say, those are two different questions, but the aesthetics of wind is obviously a personal sort of impression that people have of the turbines and it's both onshore

and offshore issue, it can be. Offshore, some of the wind farms are obviously much closer to land and be seen quite easily and some are farther away and as we move around the curvature of the earth, they start to disappear around the horizon but the I think the Teddy Kennedy issue as you put it is definitely still a lingering issue and it's a personal one and it's not a scientific issue, right? There's not a scientific explanation for why something might be good or bad for that, so it an issue and it will continue to be one and I would expect so.

Q: Let's talk about the technology.

A: Yeah.

Q: Why it would have made sense for a country like China, which must have enormous energy demand, go so heavily into offshore wind while the United States, where there's a desire to get cleaner, resilient, renewable energy and avoid the need of on-land construction of transmission lines totally bypass or largely bypass the potential of offshore wind? It's been slower to takeoff here.

A: I can give some reasons but by far an expert but not an expert on China, but a piece of it has to do just with industrial policy and so I think there's a lot of electricity generation being built in China, not just offshore wind but all kinds of generation, onshore as well. It's a huge country for the

construction of wind farms. There's a number of Chinese turbine manufacturers that operate mainly in China at least at this point, and their main markets are in China. Some of that has to do with government support for construction and then for the turbine, local turbine manufacturers so I think that there are a number of reasons of why China's sort of a special market has a lot of reasons but I wouldn't want this to speculate on all of them because I'm not a China expert at all.

Q: Okay, so let's get back to the current moment. Tell us a bit about Equinor. My notes say you have about 16; you plan to have about 12 to 16 gigawatts installed by 2030. Talk about that ambition, how important it is, how you hope to achieve it...

A: Um hum.

Q: And how it relates to where we've been a year ago when there was a flurry of articles about supply chain issues and other factors driving up the cost of wind?

A: Yeah, so maybe just quickly on the first question and I'm sure well come back to speak more specifically on the U.S., but Equinor's a global energy player and it plays across the energy sector, both in traditional oil and gas but it's committed to a transition and it's building offshore wind farms. Globally, we have wind farms in the U.K., in Europe, in Norway in particular. We have operations here and then we also have some onshore

operations as well on a global scale. But when we look back at 2023, which I think you asked about before and now just again, it was a tumultuous year in the offshore wind industry in the U.S. and globally. It takes just a lot of time, a lot of money, and a lot of collaboration to build an offshore wind farm, and there were financial and logistical problems last year that hit all at the same time. Supply chain crunches, inflation rate; we saw sort of all of these things taking off at once and hitting a number of players in the sector so the consequence of that was widespread problems here and abroad. Challenged offtake agreements, unsubscribed tenders, project delays, challenged financials; these were major themes that hit different people along with the supply chain in different ways. For developers..

Q: So, if I could focus that, let's talk about your plans in New York State. You're planning to build up to 130 wind turbines, 15 to 30 miles off of Long Island, 2.1 gigawatts and that hit a snag and now it's going forward. Get us up to date briefly on that.

A: Yeah, so a consequence of us from 2023, it was really focusing on accelerating Empire Wind and Empire Wind 1 in particular so that was for Empire Wind, it's a New York project, 15 to 30 miles south of Long Island. It will make landfall in South Brooklyn around the South Brooklyn Marine Terminal and is

another piece of that project to revitalize that terminal as a construction and operations hub. It will use a 15-megawatt turbine which is a big machine, it's about 145 meters tall or so...

Q: Compare it to the Empire State Building or an airplane?

A: Roughly say a Washington Monument I guess; think about that.

Q: Okay, so you're going to be putting a 130-foot Washington Monuments offshore that will be rotating?

A: Exactly and that rotation creates a swept area that's roughly say, eight or nine football fields if you were to show them together so it's really a mega project off the coast of New York. Each of those locations will settle, create an area of eight or so football fields, powers a home for about 1.5 days. It will power about a million homes once completed in totality so it's a really substantial project.

Q: And you recently concluded an agreement with New York State for the price of this power being higher than New York State originally envisioned but commiserate with the business pressures you faced to make this project a reality.

A: Yeah, so one of the things that New York did last year was announce a sort of a rapid action process for their offshore wind industry and they wanted to get short of shovel-ready accelerated projects in that were financially viable so it was a competitive

process that Equinor took part in and fortunately won, and we'll be building Empire 1 soon as a consequence of that.

Q: So, the South Brooklyn Marine Terminal, it's a piece of land that faces almost directly across from the Statue of Liberty, right across from Manhattan?

A: Yes, it's just...you can see the Statue of Liberty really from the South Brooklyn Marine Terminal, it's just off of it.

Q: And this is an industrial area that is in need of development. You're going to be constructing components made elsewhere in the world? They are into turbines, loading them on barges, taking them under the Verrazano Bridge and out to sea. I'll mention this just because it's been in the news lately with the concern about Baltimore. Folks that haven't been in Brooklyn don't know there are no pillars in the middle of the straits under the Verrazano. Do you think it should be easy transporting these out, and at the same time, it will be a spectacle seeing these things, will it not?

A: Yeah, well building a wind farm is always complex, it's always challenges and it's always sort of a massive engineering undertaking. So, just in terms of the South Brooklyn Marine Terminal, it's about 73 acres and it will be comprised of a substation, the operations facility, and the staging area, and the staging area is where these components will come from places

in the U.S., as well as abroad and then they'll be taken in on barges and shipped out to be assembled at the wind farm itself, at the project site, and of course, a lot of engineering has gone into both on how we get them in and how we get them out to sea and so the bridge is definitely a piece of that consideration work. We're confident that it will be done smoothly and then a lot of assembly will be happening out at the Empire Wind Farm site rather than on land to make that possible.

Q: The components you'll be assembling, will they become primarily from Vestas in Denmark? Where will they be made, and how many countries will be involved in sending you the components?

A: It's a number of countries; I don't want to give you the wrong answer but it's quite a few and some of it will be American companies who manufacture. We've got Vestas is the turbine manufacturer and some of their manufacturing of course, is done in Europe. And then we've got some domestically, too, for example, the vessel we're using, the server's operations vessel, the VVSAV is manufactured down in Louisiana with Edison Chouest at their shipyard there so it's a bit of a mix but yet it all comes together at this South Brooklyn Marine Terminal.

Q: So, my understanding is it will be 1,000 jobs building that terminal?

A: Yeah.

Q: Has it started and when will it be completed, and when do you start getting the first turbine out off of Brooklyn in Long Island?

A: Currently it's prepped so it's preconstruction work, pile driving has happened and some mediation work, but ground breaking will happen eminently, sometime this Spring at South Brooklyn Marine Terminal.

Q: Just talk about the construction work, the difficulty of recruiting workers, and then talk about the permanent workforce you envision there supporting this infrastructure?

A: Yes, so there's a number of different types of jobs that we see from a wind farm and construction, so we start out with the construction sector basically and there, we've got your foreman, your construction managers, your project managers, your engineers, your HSE advisor so there's a lot of construction work that goes into it.

Q: What is HSE?

A: Health, safety, and environment so it's a full spectrum type of jobs; carpenters, electricians, scaffolding holders, welding; I mean, it's sort of everything that goes into building a building. We'll be building a building, we'll be building a substation, and we'll be building a port, essentially. And those

skills are also necessary for the construction of the wind farm offshore and then we go into the permanent operations which will last for say 35 years again, we need maintenance technicians, marine and vessel crews to get out there, planning teams, medics, more HSE, more engineers. We'll have the warehouse and logistics at South Brooklyn Marine Terminal. We'll have a control room which requires control room operators to monitor what interacts with the grid to know when we need to curtail. There'll be the facility maintenance and then there's the off-site roles like financing control, power trading, IT systems, so there's a lot of roles that come along with the wind farm and then there's hopefully, the local coffee shops, restaurants, and businesses that grow up around the South Brooklyn Marine Terminal to support it.

Q: So, when you estimate 1,000 construction jobs, is that building the marine terminal itself? Does it include erecting the wind turbines?

A: That's across the construction phase so for the terminal as well as the wind farm.

Q: Now, do you have workers in Brooklyn that know how to maintain wind turbines and how do you go about finding them and training them?

A: So, the wind turbine technician business or sector is one of the, well I think but I'm a little biased I guess, but it's one of the most interesting sectors in the U.S. It's the fastest or one of the fastest growing jobs in the U.S., according to the Bureau of Labor. Most of that happens onshore in the Midwest and Texas and California and sort of in that wind belt especially down the central part of the U.S., but we'll need them in Brooklyn. We'll need a workforce that goes out on the vessel. It will mostly be rotational work; two weeks out, two weeks back type of lifestyle and we'll be building up that workforce over the next couple of years and then through the life of the wind farms and hopefully, growing it as the industry grows in the U.S.

Q: Is this going to be a major eyes or spectacle really earlier? Is this going to be a major impact on the city of New York; it's culture, it's engagement in renewables? Is it going to be highly visible and what kind of responses are you getting from folks at the mayor and Senator Schumer, or do they think this is a major prize that's going to take New York City into the next century?

A: I think there's a big view that this is a going to be; I wouldn't say a spectacle but a very good thing for New York both for the community as well as for clean electricity and we've seen that through good support and engagement with local stakeholders,

whether they be in the government, whether they be in community-level and that's what we're trying to be focused on and while the wind farm will be 15 to 30 miles out, we'll have a lot of people sitting in South Brooklyn who are going to need to be good neighbors and good community members there. We're building a Learning Center where we hope to engage with the community and schools and work with them and answer questions. Then we have sort of an investment fund to work with local businesses, especially those related to the offshore wind business. And we'll even be doing some tours through the facility during construction the first couple of years to try to sort of engage with the community but it is something I think that could...that is engaging; we are engaging and getting very good sort of collaboration from many stakeholders in the government and elsewhere and one of key ones of those is the New York Economic Development Corporation, NYCAEDC which is obviously a key, key relationship for us.

Q: So, Empire Wind is going to be 2.1 gigawatts. New York State has declared that it wants nine gigawatts of offshore wind by 2030; that's just six years off. Do you see a lot of new players joining you offshore New York State? And are there any signs that they're going to reach that goal? How important will nine gigawatts of offshore wind be to New York State?

A: Well, I think there's a number of players in the industry. I mean, we've seen Eversource and Orsted. We've seen Avangrid, they're the Copenhagen infrastructure partner. There's a lot of developers who are, I think, working towards the Mid-Atlantic/New York/New England area in developing wind farms off of that area, and so I think that there's good engagement with the state of New York and other places to try to make these goals a reality. There's obviously ambitious targets set both at state levels and not just New York but many state levels have ambitious targets that I think we, on the developer side and the investor side and the supplier side, and the government all need to work towards hitting together but ultimately, it's to create a sustainable, reliable power grid which I think is critical for the country.

Q: Is this ambition of New York State going to have a major impact on its grid, and talk a little bit about the physics? Offshore wind I understand is probably more reliable than onshore wind in terms of predictability and timeframe. Talk a little bit about that.

A: Yeah so, the resource itself, the wind resource is; it blows more strongly and more consistently offshore and it better matches electric consumption patterns than a lot of other renewable sources and so in the afternoon and in the evening so from just sort of an electric fundamentals of the physics side of

it, it's quite good. But of course, it's offshore and we need to get it onshore and connected so it requires the subsea cables to reach the land and make landfall and then it needs to plug into the grid. And all of that's a major project that will need transmission developers, and will need the governments, and will need the generation developers all to collaborate on of it so I think that there will be changes to the grid. I can't say which one specifically but for sure, the wind farm is only as good, is only worth anything plugged into the electric grid somewhere.

Q: So, are you not developing the cable infrastructure to take it from the turbine to the marine terminal, or are you?

A: We take it from the turbine and we take it to the substation at the South Brooklyn Marine Terminal where that's the point where it interconnects with the grid so we are developing that piece as well.

Q: Alright. You've talked about the East Coast. Let's segue to a discussion of technology and the West Coast. You're also involved with the ALICE Wind that's developing offshore wind that's not as firmly fixed to the seabed. Talk about that technology, floating technology, and the promise of that.

A: Yeah, so as we get into deeper depths of water and there's often good deepwater sites with good wind resource, we move towards floating wind and here at Equinor is one of the few

companies that has floating wind experience. We've got a floating wind farm in the U.K., and we've got a floating wind farm in Norway already, Hywind Tampen there. But this is sort of a next generation technology that'll allow us to tap into good wind resources in convenient locations near the coastal urban hubs but with sea depths that are more challenging or at least more technically challenging than the fixed foundations that we have today so it does represent a next phase I think of the technology where some people have dipped their toes in like Equinor, and the West Coast is potentially a big region for that as are some places in South Korea for example.

Q: Is it comparable costs of more fixed offshore turbines or is it more expensive?

A: It depends a little bit and sorry to give kind of a legal answer but legal in the plans or political answer but it depends, but it will depend a lot on where it is and what type of foundation we would have been using and what the seabed would have like and how far away that fixed foundation would have been so the cost of as we were discussing before, of getting the energy back to shore. So, it's definitely a different type of technical challenge but of course, it needs to develop to a point of where it's also a feasible electricity source for the ratepayer at the end of the day.

Q: How fast is the turbine technology itself changing? You talk about these units off of Long Island being 15 megawatts. I remember not too long ago; folks were bragging about offshore wind units off of Germany that were five megawatts. They thought there would never be anything bigger. Are we peaked out, or could we go past 15 megawatts, and what would a much more powerful turbine look like?

A: Yeah, if you drive through the Palm Springs area, you can kind of get a history lesson of wind turbines. You can see the old lattice tower, sort of small kilowatt machines; their much bigger ones and soon we'll be getting 15 megawatts into the water off of New York, but I think right now, the equipment manufacturers, the turbine manufacturers have been pretty vocal that the pace of development for wind turbines is unsustainable in terms of CAPEX, in terms of quality and in terms of making small improvements so we're seeing kind of a pause or at least a slowdown in the pace of development. That being said, I'm sure..

Q: When you say pace of development, you mean making units with larger and larger outputs?

A: Exactly.

Q: Okay.

A: Well, bigger. I guess bigger is what I meant actually.

Q: Okay.

A: So, hopefully we can see more output from the same size and also then, scaling that up. But I'm sure that we will continue to see bigger turbines with greater output in the future. That comes with a lot of challengers, right? The whole industry actually needs to keep pace with it. Sometimes we think just bigger is better but it needs to be transported somehow and when you start thinking about how large the technology is and can be, the transportation, the foundation, these things all need to grow at the same time as the turbines so it's not just the equipment manufacturing technology, but it's the whole industry along with it.

Q: My last question, Sam, is to ask you to personally reflect on this industry and your involvement in it. You've been with Equinor for a scant six months, but before that, you were with Vestas, the Danish company for eight years; first in Denmark then in the Asia-Pacific region. Vestas, of course, is one of the largest developers/manufacturers of turbines in the world. What's your sense of this industry now? Is it still the cowboy pioneer era? Is it a much more mature industry or you see it segueing into a much more mature industry? What do the rest of us that don't pay attention need to know about wind power and what's coming?

A: I think it's much, much more mature. If we look just at the levelized cost of electricity, wind is often the best source of new generation we could build so just from the sort of maturity of the technology to the financial sense it can be, it's often the most attractive generation that we can add to the grid. It's also getting to the point where we're sort of seeing more professional companies moving in. It's not just as you said, a cowboy industry. I think the regulators are involved. I think trade groups are speaking as one voice. I think it's becoming more and more of a mature established industry than it was before for sure.

Q: Just on the Macklin Scale, solar as it relates to wind, is one growing faster? Are they growing in tandem? What can we expect on a renewable front?

A: I think the connection was a little blurry for me for a second there, Marty but I think you were asking about solar versus wind but it depends a little bit I think on where you are; they're both growing very, very quickly and certainly some resource conditions are better for solar than for wind so solar will be a more attractive source than wind, but both I think are good generation sources within the power industry.

Q: Thank you, Sam.

A: Thanks, Marty.

We've been talking with Sam Byrne, Vice President of Operations of Equinor in Stamford, Connecticut.

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END OF TAPE