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HANNE STORM EDLEFSEN INTERVIEW

Hi and welcome to GridTalk. Today we're heading all the way to Copenhagen, Denmark to chat with Hanne Storm Edlefsen, who is the vice president of Energy Islands to talk about a new project that has huge implications for Denmark and conceivably for the entire world.

Q: Hi, Hanne. Thank you for joining with us.

A: Thank you for inviting me.

Q: So, to cut to the chase, Denmark has been a world leader and early innovator on wind power energy. Talk about where this Energy Island idea came. The company you're with or the entity you're with is called Energinet which as I understand it is a public enterprise owned by the Danish Ministry of Climate Energy and Utilities. Talk about a little bit about Energinet and what you're up to.

A: Okay, sounds great. Well, first of all as you mentioned Energinet is state-owned so we have a board but on the other hand we are owned by the Danish citizens via their payment of taxes to

the energy system. We are a transmission system operator for both gas and electricity which means that we have also a long experience in sector coupling and hence, we've been working also on the whole combination of electricity and gas for some years now.

Q: So, you're going to be creating two energy islands: one in the North Sea; one in The Baltic, and the one in the North Sea is going to gather energy from wind turbines and ship it to Denmark, UK, Germany. And the one in The Baltic is going to also supply Denmark, Germany, Poland, and Sweden. Why are you going to these island hubs? What's driving you to do this?

A: Well, the whole vision about the energy island as a concept is the core idea of getting the green transition up in scale and also up in speed. As it is now, we are seeing that these radial wind parks where you have only one connection to one country from a wind park that is being set up around the world but not very fast and rarely to more than one country. And the core idea here is to put up way more wind far out at sea in areas where you don't usually go to get the wind and then create an artificial (?) environment. That way, you can have shorter lines from the wind farms to the island with a hub as we also sometimes call it the collet and then you can have longer cabling to other countries and use those cablings for both import and export. So

basically, this nearshore environment create an offshore net or offshore grid that is being used by several countries and you also have comparable to the business as usual, wind farms less buildout of grid onshore, so it's a way of getting up in speed and a way of getting up also in size.

Q: So that our listeners understand Denmark's commitment to wind energy has been both early and sweeping, it provides half of consumption right now and the goal is to increase it by 80% by 2024. I had the pleasure of spending a week in Denmark in 2008-2007 and at that time you had ambitions to have 6,000 megawatts or 6 gigawatts of wind and that was considered a huge reach. Now my understanding is these two islands will add 6 gigawatts more of wind generation to your grid, enough to serve 6 million households. The population of Denmark is about 6 million so are you going to be a major electricity exporter once this project is done?

A: Yes, that is the expectation from the government's view and also supported by most of Parliament in Denmark. We also have an obligation in Denmark to share our renewable resources and that is mainly in wind in Denmark, so for us, this is also an opportunity for the next chapter as you may say of the whole wind industry. As you mentioned, we started with wind farms quite early on land and we have moved out offshore and nearshore and

this is just an add-on. It's just a new chapter of the fairytales of Denmark's of the wind venture so this will be also for Danish use but last but not least, for the countries that we will be connecting to.

Q: So, let's head to sea for a second and talk about these two islands. You have an ambitious timetable to have them both done by 2030; like 7 years from now. One...

A: Yeah, for the Bornholm.

A: Yeah, tell us, one is a man-made island; one will be on an existing island. Could you sketch that out for us please?

A: Yeah, if we take the small one and I say this with a smile on my face for the listeners because it's three gigawatts which is not really small but that is on an existing island and it's supposed to be ready in '30. The expectation is that this will cover around 3,000,000 households which is way more than there is on Bornholm or on sea land in Denmark where we're connected to, but this is because we are also planning to have a cable to Germany where they are very keen on getting more renewable energy. So, in the first phase, we will buildout two gigawatts of cabling to Germany and 1.2 gigawatts of cabling to Denmark and then of course, the citizens on the small island will be able to also dig into the green energy of the Bornholm Energy Island.

Q: How do you build an island? How will you do that?

A: Well out in the North Sea, we're going to build an artificial island so that's a whole other project. This is supposed to be finished in 2033 as the plans are now. It will be in the beginning three or four gigawatts of offshore wind which is to be decided by Parliament within the next couple of months but the ambition is actually that later there will be added even more gigawatts so the artificial island in the North Sea will end on 10 gigawatts which is so much electricity. Some of it might be sent to Denmark or Germany or Belgium; we don't know that yet but it will by all means in the first phase have two gigawatts to Belgium of cabling and either 1.2 or two gigawatts to Denmark of cabling depending on how much offshore wind we put up.

Q: So, just to in a macro sense, Denmark was heavily influenced by the development of North Sea oil. Do you see this as a way of totally transitioning from that era to a new era?

A: Definitely and there are a lot of the same things happening as there was when we changed also in other countries like Norway, etc., the whole areas around in the North Sea from the fishing industry to the oil and gas sector and now it's going to change again to the wind sector, so it's basically the same things that are happening; that people are changing jobs. The industry is changing focus and the areas around both in the harboring, the

harbor's close and also of course, the environment at the seabed and is going to change now.

Q: So, this podcast is very interested in emerging technology and when people talk about wind power, the very next thing to come up is energy storage. And the other question we have is transmission lines. What new technologies are you going to need to develop to store this amount of energy on these islands? Will you store them on the islands, or will you ship them off? And what kind of new transmission technology will you be developing to make this happen?

A: I'll start with the latter because that comes first, so at first, we anticipate that in the North Sea will all be electrical which means that the three or four gigawatts of offshore wind will be used for electricity on shore. But still, because of amounts of shore wind, three or four gigawatts is a lot. There is a need for standardization and the whole cycle of the market of offshore wind. As it is now, wind farms, transmission systems, cabling, etc., don't all talk together in the same language, so we need them to fit like legal bricks to fit them together which means we have to standardize a lot of these things. And then, with regards to HVDC cabling specifically, there are some things that we would like to be better at and where we would like the market to also develop some of the communications systems so that

we can have DC gear on the island even though it's up to a hundred kilometers away from shore, so the HVDC equipment will also be new and we will have DC equipment on the island that will be used maybe for the first time in the world or the second time in the world but at least for some of the first times, so...

Q: So, will you be researching the capabilities for these new technologies in Denmark at first? One of the places that I visited was the Risø National Laboratory. Do they have an involvement in developing new technology for this project?

A: Yep.

Q: And to what extent will you be reaching out to the United States and other countries to do some of the research?

A: Well, we have invited both the universities and also some of the biggest players in the industry like Siemens, ABP, etc., and some of the biggest wind farm developers like Ørsted, Vestas, etc., and there is a huge project now also combining other TSOs from other countries called InterOpera that we just got some funding from the European Union; quite a lot actually to deep dive into this and study this more. We might not be ready with solutions for the first island on Bornholm but we can test some of it there. And the good thing is that in the Baltic Sea the whole situation of the environment there is less unstable as in the North Sea where we have a lot of wind and big waves, etc.

It's a bit more stable in the Baltic Sea and there's also an infrastructure because it's an existing island so it's easier to take people there and sort of talk about the showcase and learn about the showcase there.

Q: So, the United States is behind Denmark but it's actively trying to catch up. The Biden Administration has set a goal of 30 gigawatts or 30,000 megawatts of offshore wind by 2030, which is really starting from scratch. We also had a concept that you may have heard of, about two decades ago where Google Energy and Marubeni wanted to build something called the Atlantic Wind Connection; there was going to be a hub off the East Coast. It makes a lot of sense to create these kinds of centers for wind power because you get away from the land-based criticism of transmission. Have you collaborated with the U.S. Department of Energy or its National Renewable Energy Lab to see if there's a partnership here where the U.S. could learn from this? Have they expressed any interest in learning what you're up to and possibly helping?

A: We have a corporation within GPST it's called where we cooperate with some of both the TSOs and TSOs from America to look into this. I can't recall who exactly is with us there but I have some colleagues who can come back to that if you want to hear more about it. That's, of course, not so useful for the

podcast right now but at least we have somebody working there especially on the HVDC parts together and also about the standardization. And then...

Q: And you must be aware you are on the leading edge of bringing wind from offshore and to that end, how much are you excited by and challenged by the fact that you are the first ones dipping your toe in the water with this kind of approach?

A: Very much excited but I also feel sort of the strain of the sort of responsibility I'm actually succeeding with this because also there's a lot of eyes on us. There are also other countries working with the whole energy island concept. Belgium is working on it now and we have for some years, and interconnect network with our colleagues from Germany and The Netherlands so because the whole thing is that it's not enough for one Energy Island in the North Sea or one in the Baltic Sea; we need others to join as well so the whole part of international collaboration is just really key but it's also key to be among the first for our country so that our industry can benefit from that and we can sort of build on the experiences elsewhere.

Q: So, you have a nice map in one of your decs of where Energinet is active and only about one percent of your activity is in North America. Do you see North America as a possible area that you'd like to take some of this expertise and expand to?

Q: Well, as we are now, we only have a very small part of us who can actually go out and sort of sell ideas, etc., so it will basically be on corporation level but of course we can share our ideas, etc. We have an open-source consortium where we work with the Energy Island concept called North Sea Wind Power Hub. There, we have shared all studies, etc., so that everyone can dip into them and hopefully, this will also give some shared practices as long as we go on with the project. But basically, you can do the energy island concept everywhere where you have wind resources far from shore. It doesn't matter how deep or how windy there is, then you will just address the way you build your island or your wind farms to that. So, if you want to collect the wind far out from shore, this is a concept where you can do it cheaper and more stable.

Q: So, the platform, the new island you're going to be creating in the North Sea; will you be exactly replicating what you did for platforms for what you did for the oil industry, or are you going to take a new approach?

A: Actually, we don't know exactly yet but there will be a caisson structure island ? and then maybe, also some platforms, but they will look...

Q: By caisson, you mean like concrete sunk into the sea that doesn't go to the seabed itself?

A: Yes; well, it's fastened to the seabed but not like an island where you have a lot of under-the-water surface which is sort of fills up with sand because that was very costly and also takes a lot of time, so the caisson structure is more like a Lego brick that you land on the seabed and it's also possible to build it out, but the thing is that it's not in Energinet which is going to build the actual island. It will be a public/private ownership so we will see who will bid on building the island. Maybe they will do some more out there. There's a possibility of also doing Power to X, which I also know you've covered here in your podcasts and this gives for the second phase of the Energy Island. Also, the opportunity that you could actually have a hydrogen tube instead of the offshore wind, the electrical gear only there so that you could have Power to X on the island.

Q: That was actually the next topic I wanted to talk about where you're going to take surplus green power to produce hydrogen through electrolysis I would assume?

A: Yes.

Q: And create climate-neutral fuels for maybe aviation, ships, and heavy industry?

A: Yes.

Q: Is this just a small part of your project or a major part? Is there a lot of effort going into this as well?

A: As it is now, the first phase of the Energy Island in the North Sea is foreseen to be mainly pure electricity, but the next phase is. We will expect to see both on it and maybe even on the island in the North Sea, production of hydrogen from the green electricity or the green power.

A: So, do you envision that you will take surplus wind power when the demand is low on the continent and in Denmark and generate hydrogen at that point for use almost as energy storage; you're diverting excess power to another use?

A: Well, we have market players who say that they will only do it when the power is quite cheap, when there's surplus, but we also have market players who say that they can see a business case and using it all year round and that they will need the electricity all year round to produce the hydrogen. But we're still lacking to see the big factories of hydrogen; the Power to X, it's been on lots of everybody's tongue for the last couple of years but we are still lacking to see it actually out there working so I think that we will see a factory of this character in a good size at first onshore where you can control the environment a bit more and then in later phases maybe out in the North Sea, but it's definitely going to be a key in the whole green transmission because we need something green to fuel the jet planes and the heavy ships, etc., in the end.

Q: Do you think that's really going to be sooner than a lot of people suspect?

A: Well, yeah, every sign is on that and I think especially here in Europe with the energy crisis due to the Ukraine War and the high gas prices this has shown that we need to do more faster so hopefully it will push also some of these things in a good way.

Q: So, I remember from when I was last in Denmark and touring your wind sector, know something about Denmark that there's extreme environmental sensitivity and know there are a lot of studies being done on offshore the wind and its impact on migrating birds and whales and fish. Have you studied or will you study the environmental impact of this two-island project and what have you learned so far?

A: Well, this is a very key and very important thing of our whole project is that the reason why we put up all this wind is because we want to be able to take care of the planet so there's no point in doing that and on the same way doing it in a way where it doesn't take care of nature and the environment so since May last year, we've had ships out surveying the environment on the seabed, taking samples, checking everything, counting the animals, etc. It has been done on both of the projects and Energinet is in charge of this work both for the areas for the

wind farms but also of course for our own cabling. And with regards to the North Sea to the artificial island especially the artificial island is something new and something that we don't have very much experience about so as a whole country so we will look a lot into this and how it's supposed to be built and still be safe for environment and nature, so it's a key thing.

Q: So, it's interesting that it might be a challenge and of concern but it might be an opportunity to do some landmark research on thinking of the corals and how there are efforts on how to restore the corals. Do you think that there's a way, especially this man-made islands can not only be a detriment to the environment but possibly enhance the environment and fish and bird migrations? Is there opportunities to make this a plus?

A: Well, in some ways. What we see especially in the North Sea is that this has been quite hard; the whole fishing industry has been quite hard on the North Sea, especially the trolling where you troll over the seabed. This is not possible to troll when you lay out cablings from the wind farms and the cabling to other countries.

Q: Because it's dragging of a net along the sea bottom?

A: Yes, exactly, and everybody who knows just a bit about fish also knows that the whole trolling is not a good idea for the nature there so this project will mean a stop in those areas for

the trolling if it's not already forbidden. And then when you have the fundamentals of the wind farms, we also see a lot of shells, etc., sort of growing there and notarizing there which means more fish so what the fisherman will see and what the nature will see is that there will be an increase in some fish because they can live there easier and because the trolling will be stopped, so it might be better on that way, but of course, how you balance and how you actually sort of put up this is also depending on what glasses you have on but we're definitely looking into also the upsides.

Q: Good, so the last question I'd like to ask you, Hanne, is a personal question given your background. I see from your LinkedIn profile that you studied political science at the University of Copenhagen. To what extent do you see a project like this being politically transformative? Do you see new kinds of alliances and ties between countries when they start pursuing these grand technological challenges like you're engaged in?

A: Well, it definitely takes some braveness from the politicians to start these projects where a lot of the technology is still new or untested when they are taking the decisions. That is one thing. It's also sometimes difficult for politicians to take these decisions that take 7-10 years to build because maybe they have a shorter way of looking at the perspectives because

usually, they're elected for four years and they need show some results within the first coming years so when I present them for things that will take 7, 8, 9, 10 years, this is, of course, another perspective. But at the other hand, where we have together from both the political level and from the bottom/up from the TSO side, is on the international cooperation. On that part, we have really helped each other because we've made a reach-out to the countries that we want to connect to, both from political side and from a unit side, which means that the Minister has made some political agreements with his counterparts in other countries and on the other hand, we've been out there for many years and making agreements with our neighboring TSOs. And this has happened way faster than usually where it's a longer process and we start from bottom/down and then we go over long way so we have made some good agreements on much shorter time than usually, so I think I see that the political system is definitely working with us on this but of course also that the whole thing about the long-term perspective is sometimes difficult to sort of grasp within a political, more short-term world.

Q: Thank you for your insight, Hanne, and thank you for talking about changes in the industry from the European side.

A: Thank you for having me.

We've been talking with Hanne Storm Edlefsen, who's the vice president for Energy Islands, a major initiative of the Danish transmission industry and the enterprise called Energinet. And thanks for listing to GridTalk. For feedback or questions, please contact us at GridTalk@NREL.gov and we encourage you to give the podcast a rating or review on your favorite podcast platform. For more information about the series or to subscribe visit SmartGrid.gov.

END OF TAPE