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**BILL MAGNESS INTERVIEW**

Q: Hi and welcome to Grid Talk. We're here today with Bill Magness, the President and CEO of ERCOT, which governs Texas and oversees its electrical reliability and operation of their grid and a whole bunch of stuff that we're going to get into today. He's been with ERCOT for ten years; first, as its General Counsel and then in 2016, became its CEO and President. Good morning, Bill. How are you?

A: I'm well, thank you, Marty. Glad to be here.

Q: Well, I really want to start with what I think is a headline story that probably has gone under-appreciated and that's the importance of wind power in Texas. You're coming up on a milestone the end of this year where you will have 30,000 megawatts of wind capacity installed. And I did some quick back-of-the-envelope checking to give people an idea; we hear these numbers; we kind of gloss over them and don't appreciate the significance. Denmark fashions itself as leader in wind power. If you fly into Copenhagen Airport, you'll see all these neat wind turbines spinning out in the harbor. If you drive across the countryside, you'll see multiple generations of wind turbines that are deployed that are going back decades. Well,

Denmark has one-quarter of the population of the Texas and as the end of this month, its total installed wind capacity, it will stand at 5,500 megawatts. Texas will have five times that amount and Bill, I'm not sure if you've done the math yet comparing Texas with China--I just did that this morning. China, of course, is huge with 60 times the population of Texas, with over one point---close to 1.4 billion people. It leads the world in wind deployment with 221,000 megawatts of capacity. But while Texas has one-sixtieth of the wind deployed in China, which, by the way, the Chinese total is one-third of the total world capacity. Texas has one-seventh; will have one-seventh of the installed wind capacity of China. One-sixtieth of the population and one-seventh of the wind. How do you integrate all of that wind power and maybe you could tell us the story of how we got there?

A: Sure, Marty. It's a big part of the story of ERCOT over the last really decade and more. And, on the how-we-got-there part, I think you know that the essential thing is, and this is true with solar as well, you have to have the wind and Texas has enormous wind resources. Practically, first began to build them out in West Texas in the Texas Panhandle and anybody who grew up in the Panhandle and in those area knows it's windy just about all the time. So, with the new technologies for wind generation,

those were ideal sites from a physical perspective. In addition, as technology improved, we were able to take advantage of a lot of wind on the Texas coast so there are more and more projects that have been built on the coast, and the wind there has very different characteristics from the wind in the West; it sort of blows at different times, so that's been something we needed to learn about. And really, having that natural resource base sort of that next essential piece of the growth of wind in Texas, was building transmission out to those areas. Most of those areas where there's the most wind, particularly in the panhandle of West Texas, were not high population areas, so the Texas legislature committed to a very large buildout of transmission to take advantage of that resource base and bring it into the population centers. So, that Competitive Renewable Energy Zones project which got going---gosh, I guess the legislation was around ten years ago. Those projects were completed in the 2013-2014 timeframe, really unlocked the wind capacity that was available in those areas to bring it in and generate it into power. In addition, the obviously, the Federal Production Tax Credit has had a lot to do with the deployment and development of wind all over the U.S.; that's been a big factor in the projects here. And then in addition, our market---our energy-only market---enables resources that have least cost to run most

of the time in an economically efficient way and I think that's been a benefit to the deployment of those new resources as well. That's kind of the history.

A: So, let's focus on the market for a second. The Texas market deregulated in 1999 under then-Governor Bush where he deregulated the power markets. So, you quickly went from 160 megawatts of wind in 2000; marched up and magnify that close to 200-fold to get to 30,000 megawatts. How instrumental is the market been in that in your opinion?

Q: I think our market is instrumental in most everything that happens in ERCOT. It is a market that has low barriers to entry. I think the legislature when it restructured the electric markets, wanted competition; wanted new entry; and this is true in retail, this is true in generation. And so, the ability to both get in and built and get going was very important and I think this commitment to building out extending the transmission system to these places where the resources are was also pretty critical. I think that in a lot of places that have similar wind or solar resources that don't have as much of a commitment to getting a transmission built out to them, I think you see less development than you've seen in ERCOT. And plus, I think the market and the way it was restructured had a whole lot to do with what we end up seeing.

A: So, let's focus for a second on---or more than a second, actually; it's kind of fascinating---on reliability. You have a peak demand. You had a peak demand a year ago at close to 75,000 megawatts. This installed base of wind, which of course, is an intermittent resource, is going to be a sizeable hunk of that total of 30,000 versus 75,000. You've been operating at fairly low margins over the last two summers. How do you manage to have a more intermittent resource base and work on slimmer margins and keep the whole thing moving forward in a healthy fashion?

A: Well, the first thing I'd say is understanding the resource and how it operates and when it operates has been critical. And, you know you can sort of put that under the heading of wind forecasting. In the old days, you basically had to forecast load, right? You needed to know when the load was going to show up that you had to serve so you looked at the economics; you looked at the weather, and you put together your models and figured out what load was going to look like. On a traditional system, you don't forecast generation. To put it very bluntly, you turn it on and you turn it off and manage outages. And so, we had to get educated about when and where the wind blows and make our best forecast for when those resources would be there. And those resources were at different times, in different parts of the state. For example, we calculate an estimated load

carrying capacity for wind resources so that when we, for example, do a summer peak load forecast, we're counting what we can realistically expect from those resources, not what their nameplate capacity is. And that's been done by a process of observation and study and modeling through the years that we've been managing a lot of wind on the system. So, each day that goes by, we're learning more and more and accumulating that data in our models about how the wind's going to blow. So, when we forecast on a say on a peak summer day, we have very different expectations for the wind resources in different parts of the state. For example, the West Texas wind---we would estimate somewhere---and I don't have the exact numbers at hand, but somewhere in the neighborhood of 15% of nameplate is what I'm going to expect at peak of those resources. On the other side of the state, the coastal wind over peak on the hottest summer day, I'm expecting over 50% of the nameplate of those resources. And of course, that all has to be mixed in with what is the weather on that particular day. So, it's a process of trying to understand the resources in a more granular way and make your plans based on that reality. As solar grows---utility-scale solar continues to grow at ERCOT, we're doing the same thing; we've been doing solar forecasting because cloud cover, the way the sun shines in different parts of Texas, things like that,

just as we learned with the wind, we're going to be learning the details of the dynamics of solar. So, that forecasting part and getting a much greater depth of understanding of the resource that you have has been critical. In addition, we needed to write our market rules, our grid code in such a way that we require certain things from these resources, like frequency response, like voltage ride-through, that sort of sets the groundwork for what those resources need to bring to the grid to help us manage reliability. We've changed our ancillary services suite, to enable us to have better products available or for things like fast ramps, up or down, which is a feature of wind and really intermittent resource when you can see a lot on the system and all of a sudden, very little on the system depending on again, like cloud cover with solar. We have conducted a lot more risk assessments than we did in the past. For example, in our control room, we established what we call a reliability risk desk, which is a person who's dedicated to running studies forward, looking at different scenarios that may occur; often focused on the dynamics of the wind and the solar on the system and what we can expect during any given hour or day. And then in addition, I think the way our real time market works, the five-minute intervals on which we send out dispatch instructions. That speed helps us provide some certainty in knowing where we are and

managing it on a very close real time basis. So, all that said, it's affected most every part of our planning and our operations to try to manage these different sorts of resources because they do behave really differently on the system.

Q: One of the assumptions is that with greater reliance on intermittent renewables, more energy storage is needed. But if I read the data correctly, you only had about 125 megawatts of battery storage in ERCOT at the beginning of this year. Is that correct? Are you planning more energy storage and how do you get by without it?

A: Well, there's a lot more in the queue. We're expecting--- let's see, we're currently tracking, when we look at our generation interconnection request, we're tracking over 19,000 megawatts of battery projects. Now, those may be early stages; those may not get built; but you're seeing a lot of interest in batteries in the ERCOT market. And that may be paired up with solar farms for example. That might be on the distribution side where we're seeing an increasing amount of distributed energy resources and distribution generation resources, so there's a lot of interest and it's an area where we're spending a lot of time with our stakeholders to develop the market rules. Again, to kind of go through this process like we did with wind and solar, getting the market rules right, understanding the

operational characteristics and figuring out how we're going to manage this new resource on the system. So, we see that growing in the near future.

Q: Let's bring solar into the conversation. You're headed from 3,000 to 5,000 megawatts of solar by the end of this year. You're also planning to continue growth of wind resources projecting it to grow to close to 40,000 megawatts in 2023. That's close to a 30% rise from where you're at now. Do you see solar gaining at about the rate? Do you think it will grow to be much more significant in the mix? How do you see both of them playing in the ERCOT market in the next decade?

A: Well, I'm going to pause for just a second on a terminology matter. When you say we're planning on it, ERCOT doesn't plan in a sense of like an integrated resource plan. When we report the generation that we're expecting, that's a reflection of what the generation developers are telling us they're bringing to the table.

Q: So, I stand corrected.

A: So, we're managing; well, I think it just makes the difference from the perspective of having an integrated resource plan is a very different dynamic for operating the grid than seeing what the market brings and managing that. Now, based on what developers are telling us, and what the market's telling

them apparently, we're seeing a lot more solar. Again, when we look at that generation interconnection request, there's like 80,000 megawatts of solar that is at least a twinkle in someone's eye, whether they'll get built or not so, yes, there's a whole lot of interest in utility-scale solar. And it's not just in far-west Texas where a lot of the large solar developments have occurred so far, it's starting to be in different parts of Texas. So, we're really starting to see that propagate in a lot of different parts of the state. And I think, like wind, there seems to be just continuing decreases in costs in the technologies that supports utility-scale solar, and I think that in a market like ours, I think that certainly drives the continued interest because if it's going to be the least-cost provider, it's going to run at ERCOT and that's why---a big reason why I think we continue to see increasing interest in it.

Q: So, you operate quite a sizeable grid; 46,500 miles of transmission. To give a picture of that, that's sixteen trips between San Francisco and New York. It's quite a lot. What are your plans for changing that and evolving the technology? What kind of capital investment do you need to make, given the expectations that you just outlined of solar and wind growing in the coming years?

A: Well, there continues to be a significant transmission investment ongoing in ERCOT. Kind of put it in perspective, that Competitive Renewable Energy Zones, a program that I mentioned earlier, I think one of the largest buildouts of transmission we've probably ever seen at least in the U.S., certainly in the time period in which it was completed---an amazing project---that the overall cost of that was in the neighborhood of \$7 billion dollars. And, in 2020, we energized over a billion dollars' worth of new transmission projects. In 2020, our board endorses---if a transmission project is large enough, it needs an endorsement from the ERCOT Board. We've endorsed over \$900 million dollars of new transmission projects. And if you add up all of the transmission; that's engineering, that's licensing; construction sort of in process, it's over \$7 billion dollars. So, we're continuing to build additions to the transmission system that rival the really large buildout we had in the mid-2010s with CREZ and that's driven not just by limited resources. I mean, it was driven primarily by load growth. Load growth in West Texas where oil and gas development has taken off in a big way over the last few years. Load growth in the Houston and the industrial area surrounding Houston on the east side of Texas where you see petrochemical renaissance and other industrial development. And then just the overall continued

growth, particularly on the industrial and commercial side of the State of Texas. So, that's driven a whole lot of this continued investment in transmission. And so, we continue to see that and transmission is not the only solution. It's not the only thing we have to manage and continue to grow the grid. Obviously we need the resources coming in and providing power but with the continued load growth we're seeing, you're seeing investments in all of those areas.

Q: So, this surface territory that you serve represents quite an island in the middle of the North American grid. It's been independent. Do you see that remaining the case or are there going to be challenges and changes that will affect ERCOT's independence should there be should you be integrated more with the North American grid?

A: No one who's in charge of what I do is in favor of losing our independence. I think the market participants in ERCOT, the state government in Texas has very favorably viewed what we accomplished with the independence of ERCOT and we continue to meet the needs of a growing state. So, I don't see any impetus from Texas to change that arrangement.

Q: Or, to put it in a different context, having a large market with a lot of generation resources and independence kind of makes a lot of sense, doesn't it?

A: It has so far, yes, I think it has and I think---well and you look at things like the Competitive Renewable Energy Zones project. That was something the Texas legislature looked at as a policy matter and approved. That kind of thing could not or would not have been done if there had not been policy directions from our legislature and then implemented by our Public Utility Commission to make it happen. So, I think there's a maybe a unity of purpose with our legislature and our Public Utility Commission about how we ought to be operating this market and I think it allows us to move somewhat nimbly and quickly once we get that direction and there's the desire by a lot of people here to support that growth that continues to make our economy thrive.

Q: You've been interfacing with the regulatory system that manages electricity in this country for a variety of capacities. You've been in the office of consumer protection in Texas in the late '90s. As an attorney, you've appeared before sixteen state commissions---utility commissions. Give me a background of given the hands-on experience you've had at ERCOT, what kind of lessons can the rest of the country extrapolate in terms of what's possible given where technology's headed; given where public appetite for renewables is increasing. What kind of

lessons do you think folks outside Texas can learn and what do regulators need to learn?

A: Well, I'll say a couple of things and not to say that people haven't learned them because I think these things go on in other markets and in other regions of the country but couple of things, I'd say have been really important. One is the stakeholder process that we have and making sure there's a seat at the table for everybody who has a stake in what's going on. In the ERCOT market, we have a board that's made up of independent board members but also includes representatives of transmission companies, generation companies, power marketers, consumers, co-ops, municipal utilities. Pretty much everybody who has a stake is represented and that drives better decisions and the relationship between those stakeholder processes and the review by our public utility commission kind of puts us all in the same boat where we can keep heading in the same direction, but I think that if you don't have the participation by the consumer and the producer-side of the business, you can hit snags. The second thing is being clear about what it is you want out of your electric system and I think this is where some of my counterparts in other parts of the country have challenges is, you know, in the ERCOT market, the market was restructured and our objective is to provide reliable, least cost power to the

citizens of Texas and 75% of the state in a competitive retail market. That's been the central driving force behind what we do. And we've made adjustments to our market rules in order to achieve that as we've gone through and learned that as we've achieved new things. It's challenging when if I had that objective but I also had an objective to develop certain kinds of generation or I had an objective to achieve other policy objectives. If those begin to conflict, you're going to have a problem. And obviously those problems get worked in policy forums---Congress, legislature, ERCOT, elsewhere, but again, that sort of unity of purpose and a clear understanding of what it is we're doing here and what it's for, is pretty critical from the policy perspective. And I think that's something I've been very benefited by in my time at ERCOT is we've had that community of purpose with legislature, the commission, ERCOT, the stakeholders, so even though there's lots of disagreements and lots of pushes and pulls, we're mainly pushing in the same direction.

Q: So, so, let's take that mindset and frame of thinking of things to one topic we visited earlier that you've achieved fairly low reserve margins in 2018 and 2019 and still managed your summer peak. If the policies and the technologies and the management skills that achieved that could be extrapolated

around the country, wouldn't that represent potentially enormous savings for companies and customers?

A: Well, the way our market is structured and I'm not saying our markets for everybody. The way our market's structured; when you come into the summer, the peak season in ERCOT, you have very, very strong economic incentives to make sure your generation units are running. You have strong economic incentives to make sure that transmission lines are functioning because the consequences of being caught out on a bad day can be very severe. So, having a market structure that can have very bracing outcomes but also very profitable outcomes for those who are there and providing services for those times when you have scarcity pricing and prices go quite high, that can be a really good day. So, the incentives are economic but they're very strong and they're pointing in the direction of the reliable service. And, they're pointing in the direction of making sure your equipment's running and doing what it's being asked by the overall system. So, I think it does encourage behavior, business activities' investments that support reliability, even though they're market incentives so again, different people have different objectives and different needs but it's something that as we have gone through ups and downs in our reserve margins and we've seen fluctuations over the twenty-some years now that

we've been doing the restructured market, they go up, they go down. And it's based on business cycles of investment and retirement. In 2017 when plants retired, we knew that the summer of 2018 would be tight. 2018 and 2019 were tight and there were good economic returns and we've seen a lot of desire to invest in the market, and we're going to see higher reserve margins going into the summer of 2021. There's no promise they'll stay there. They'll probably go up and down, but that's why all those things I mentioned earlier about how we manage intermittency, how we manage renewables, all those tools that we have to have in place to manage the changing and dynamic system, that's why we have to do those things because we're not in a steady state. That's now how this market works.

Q: Well, it's been a fascinating conversation. Do you have any concluding thoughts you'd like to leave with us, Bill?

A: I'm not sure that I do. I appreciate your interest. It is something I think we're very proud of that we've seen the kind of success in the ERCOT market that we have and going through a year like 2020 when there's been so much dislocation and difficulty, seeing that the structures we have in place, whether it's in our stakeholder process or the day-to-day work of linemen and grid operators and everybody who's got to get the job done, it's been very gratifying to see that sort of public

spirit that work has maintained and flourished throughout all this. So, from that perspective, as rough as 2020's been, it's been a good year to see we still have that spirit in this business and that we've been able to pull together and make it work for everybody. It's all could have been quite a bit worse if there had not been reliable electricity.

Q: Thanks, Bill.

A: Thank you.

Q: And thank you and thanks for listening to Grid Talk. Thanks to our guest, Bill Magness, the President and CEO of ERCOT in Texas for sharing his insights about changes in his market and the industry at large. Please send us feedback or questions to [GridTalk@NREL.gov](mailto:GridTalk@NREL.gov). And we encourage you to give the podcast a rating or review on your favorite podcast platform. For more information about this series or to subscribe, please visit SmartGrid.gov.

END OF TAPE