MARTY ROSENBERG
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MARK GABRIEL INTERVIEW

Q: Hi, and welcome to Grid Talk. We're pleased today to have Mark Gabriel with us. Mark is the Administrator and the CEO of the Western Area Power Administration, which is one of four power marketing agencies in the country. Hi, Mark; how are you?

A: I'm doing terrific, thanks.

Q: Good. So, just to lay the groundwork, you have about 17,000 miles of transmission extending over 15 states and knitting together 57 hydro power plants the last time I counted. Is that about right?

A: That is correct.

Q: Ok. Assets of about $4 billion, sales of about $1 billion, and you touch the lives of at least 40 million Americans. So, my first question to you is, how do we need to reconfigure the transmission grid as we try to march towards a carbon-free world?

A: Well, that's something we try to deal with every single day, Marty. You know, I jokingly say our footprint is like going from Paris to Moscow and Athens to Oslo, with all the politics in between. The changes that we're seeing right now with particularly losing the inertial resources, also known as coal and nuclear plants and some gas, is really changing the system

dynamics and operations. When you add into that a variety of technologies that are being included on the edge of the grid, and whether that's solar on the rooftop of a home, utility-scale solar or storage, it really is changing some of the operating characteristics of the grid. So, for example, when we do lose one of the fewer and fewer coal plants on the grid, the ability of our system to pick-up that change has really required an acceleration of our thinking. It has required us candidly to add several people over the last few years. We've added real-time engineers who every 15 minutes have to look at and reconfigure what's happening on the grid. So, as we look out to a carbon-free system, what we have to understand is that there are operating parameters that will be changing. And, as somebody's who's responsible for a very large part of the Western footprint, our biggest challenge today is getting real-time information in real-time, coupled with the fact that, unlike, let's say, the East Coast or the Southeast (which is a lot of power-plant density); when we lose a power plant in the middle of Wyoming or Colorado, it takes a lot to fill that hole. For example, the transmission system is used to being a fairly well-occupied most of the day and all of a sudden, a big piece of that drops out because of the generation resource. So, over time, it' going to require an investment in technology, it's

going to require more intelligence, and it's going to require a different understanding of how the grid operates.

Q: So, let's talk about that from a high level and then from a ground level. On a high level there's been discussion lately that as vast as your system is, the merits of possibly linking the East and West grids possibly with ERCOT with possible more transmission links. Do you think that would address some of the problems that you just eluded to?

A: Well, I think this is a multifaceted answer. I do think expanding the connections which exist between the Eastern and Western grid, and remember there are six AC/DC ties between the East grid and the West grid. There's four back-to-back ties in WAPA's service territory and I think right now that's the quickest and best way we can this carbon-free future happen. Well, over my several decades in this industry there's been lots of talk of a transmission super highway. I think that's less likely at least in the next 10 years because of the time that it takes to build those types of large-scale transmissions.

Q: So, Mark, just to see if I understand you, you say you have four major links from WAPA to the Eastern grid.

A: That's correct.

Q: Do you look at increasing that and by what number?

A: Well, again I don't think we need to increase the number of the connections. I think what we need to do as an industry is invest in the upgrading those connections. Today, for example, in Sidney, Nebraska, which is one of the connections that WAPA happens to have; it's the Virginia Smith Center. Right now, it's roughly 200 megawatts in one direction and 150 megawatts in the other, right, because the grids are asynchronous. What I would envision and I think is a wise move in really in the short-to-midterm is upgrading those, that particular AC/DC tie, and let's say, make it five or 600 megawatts in each direction. Because if you think about the real challenge we have Marty, is making sure there's enough diversity in the carbon-free resource. It does not do that much good if we've got excess solar in Arizona and what we're doing is moving it to Nevada or California. I think it would do a tremendous amount of good, given the time differences, if we could move Arizona or California solar all the way through into, let's say, SPP footprint. So making the right investments and then expanding the conductor capacity so to speak, some of those connections. Now, would I like to see a transmission super highway connecting into the WAPA system going all the way across our footprint? Absolutely. But, I'm also a realist trying to figure out how do we make sure that we keep the lights on, not just for WAPA's 40 million Americans, but

also for the million Americans in the West, as well as providing benefits to those folks across to our Eastern interconnections.

Q: So, you bring up an important point because as we sit here, and I just checked before we started recording this podcast, PG&E has an excess of 13,000 customers that are without power. Southern Cal Edison has close to 2,500 and California's going through the first rolling blackout they've experienced in 19 years. How can this problem best be addressed and what's your assessment of causes that can be most immediately and readily addressed?

A: Well, I'm glad you split the question into two. On the first one, having lived both through the Northeast-Midwest blackout in '03 when I was at the Electric Power Research Institute and certainly in '01 and 2000 when I was in California. One of the things that I believe we've misunderstood is that markets are just financial overlays on physical systems, right. So, last September, September 29th actually, the California Independent System Operator told all of us that they anticipated being roughly 2,300 megawatts short by this summer; a number that will grow between now and 2024 upwards of six or 7,000 megawatts. So, I think anybody who believes that this was a surprise failed to both listen to the warnings and to recognize the history of what is going on. And I look at it by

the simple fact that again, markets are financial overlays on physical operating systems. When you eliminate capacity as opposed to energy, the system is very unstable. We've all seen the duck curve in California. I jokingly call it the giraffe curve because the neck is getting taller and steeper so you've got a situation where we're closing plants. We do not have capacity to pick up those times when (a) it's hot; the wind's not blowing; it may be cloudy, right. It isn't to say that there's any fault here from my perspective about people to blame the renewables, people to blame the market. I think we've got an interesting coincidence of challenge. That is, the system needs capacity, fundamental inertial load. Which, if I can make a pitch for hydropower is why we have to maintain and essentially expand hydropower resources. At the very same time that we've gotten more intermittent resources on the system we see this over the years. It is not magic. It is physics. As I like to say, physics trumps policy every day. So, what do we need to do, which is really I think the questions we all have to be asking; I think we've got to do is how do we value capacity in a way that it incents folks to maintain some spinning reserves so that we don't run into this problem again. Battery storage over time will certainly help this. But I really think it ties, Marty, back to your original question: what do we need to do in a

carbon-free system? From my perspective, we got to have more intelligence to take advantage of the various components that are being added to the grid and I go back to my experience on the great Northeast and Midwest blackout in ’03. In our research we found that there were 400 megawatts of standby generation sitting in Manhattan which could have been used to bootstrap the system back up again. The problem was, first and foremost, there was no way that the utilities or the New York ISO at that point, could actually get and dispatch those to bootstrap the system. So, we’ve got to think about how do we operate in an environment where there’s less capacity and at the same time protect what capacity that remains.

Q: Now, California aiming to increase their percentage of renewables to 60% by 2030, is that going to exacerbate this problem?

A: Well, I don’t think it’s the addition, Marty, of more renewables necessarily but we’ve got to figure out the right balances. As you add renewables, we have this weird market dynamic and the market dynamic is renewables are being rewarded financially and other assets, other resources, are being penalized. So, that if somebody has a gas plant, a back up-plant; heck, even some hydropower, they’re not compensated for

that. So, as that number of renewables goes up, we're operating closer and closer and closer to the edge. Like California, the 49,000-megawatt system, give or take a few hundred megawatts, and I can tell you from a WAPA perspective, we worked really hard over last weekend to get them whatever megawatts we could. In some cases, we were turning pump-loads off to get them 20 megawatts so, it shows how we're operating closer and closer to the limits. That's forced by the financial model and markets. At the very same time, we're adding more and more of the very thing that is pushing us to those limits. I think we got to get a balance of those things.

Q: So, you dropped a little aside in there that I'd like to tease out a little further. You said the need to expand hydro resources. That, of course, would be consistent with moving towards a carbon-free generation system. As you look at your 57 units, how much more growth can you see; how much power can you ring out of those and possibly new facilities?

A: Well, if I could wave a magic wand, you know, we could probably add somewhere between 8 and 10% more to the existing units. If you think about our 57, they range in size from Hoover Dam at 2,100 megawatts and Glen Canyon Dam at 1,400 megawatts; all the way on a very small unit. I really think the answer is to take a look at the other 80,000 some-odd thousand dams that

exist in the United States and figure out how do we take advantage of it. But number that always sticks with me is only three percent of dams in the United States have a hydropower capability. If we simply took a small percentage of the remaining 97%, right; there's roughly 90,000 dams in the U.S., and put power capabilities on it, I think that's part of the broader solution. And I know dams may not be popular with some folks but when I think about the alternatives, I'm glad today that WAPA's got its 10,000 megawatts of nameplate capacity out of hydropower. It gives us both capacity, energy, and helps grid reliance and grid resilience.

Q: So, you mentioned the possible use of CAES Could you to talk a little bit about your efforts to possibility couple battery energy storage with hydro?

A: Well, one theory, and I must admit, it's really a theory at this point is we've got to work with our partners at the Bureau of Reclamation to see if it would make sense to put large-scale batteries at some of our dams. As opposed as to what we're doing today, which is putting batteries in locations where we've got to rely on other resources to charge them. Because one of both the benefits and challenges of hydropower is, we've got to let water through the dam, right. We have to generate at times when there's no market for it, and/or because of environmental

regulations, we have to have a certain amount of flow. We've also had transmission lines coming out of the dams so from my perspective, adding large-scale battery storage at some of these dams, which, if you think about it, tend to be located fairly remotely, would give us the opportunity to charge those batteries when we have to run the dams and there may be no market for the power. And I think there's a great technology match between large-scale storage and hydropower because I know for sure, we're going to be running the dams; we have to. That's just part of river-flows and environmental regulations that we live with. But at the same time, we've got the capability of them charging the batteries and running them through the transmission lines, which already exist.

Q: Talk a little bit about what you've done in artificial intelligence in machine-learning on the spectrum of one just being started, ten being, well, very advanced. How would you rate WAPA and the utility sector in the Western Region?

A: Sure. Well, I always like to point out that we have all lived with this industry for a hundred years by adding intelligence to the system. You know, the first Smart Meter was brought in in 1906 by Sam Insull, the Wright Demand Meter, so I also want to point out that sometimes people think about it as the dumb grid, and it's not. We're continually adding sensors,

capabilities, and understanding. I think we finally have an opportunity with some of the advanced artificial intelligence that we're seeing to get the machine-learning and the algorithms and models with this massive amount of computing power to help manage in this constantly changing environment. And I think it's important to recognize that what I talked about in the beginning with real-time engineers and all of our folks in the control room; at some point we're going to reach beyond the capability of human beings to do all of these calculations. Think about it in the sense of a community with 10,000 solar rooftops and 2,000 batteries and a community solar fields and a feed from WAPA. How do we take all of those things together and really squeeze out efficiencies and I really believe that the work that's being done; we're working with the Department of Energy. You recall, in 2019 they announced $20 million dollars in funding for R&D in AI and machine-learning. The Office of Electricity where the PMAs are directly bolted onto; have $7 million dollars for eight projects exploring the use of big data; AI and machine-learning; to improve grid operations and management. And I think one of the important things that's going on right now is the North American Electric---Energy Resilience Model, which is a tremendous product for all of us to have a really broad understanding; we call it NAERM, of really what's happening in

real-time in the grid. If you think about the inter-dependencies whether it's weather, whether it's natural gas, whether it's hydropower, I believe that the "secret sauce" will be in the merging of all of that information. And it has to happen behind the scenes with very strong computing power to help inform the decisions we make on physical grid operations. And I think that's to me, one of the most exciting pieces we have. It's going to be critical to have a carbon-free system.

Q: So, are we at the early days? Are we midway through or how far along are we?

A: Well, in certain things, we're midway and a lot of things, we're in the early stages. When I think about having grid visibility and understanding what's going on, really going on real-time in the system, I feel pretty good; we're probably just below the midpoint. In terms of what I really envision which is this broad scope of really understanding everything to the edge of the grid, I still think we're just at the very beginning there. But we're learning more and more every single day. How, for example, do we couple weather, right? One of the things everybody could predict: this summer. As I said, CAISO told us on September 29th they were going to be 2,300 megawatts short. The prediction that it would be hot in the summer is kind of a no brainer, right? It's kind of like saying increasing darkness

towards evening. But what we didn't know was the time and the timing and then to link that back through so that we're not all scrambling across the reliability coordinators, across the balancing areas. We ended up, as we do phenomenally in this country, we ended up scrambling in getting the job done for the most part. But wouldn't it have been great to have more predictive modeling so that we could have known earlier on that hey, cut the pump-loads in California, right, in the Central Valley Project. Cut the pump-loads at Friday morning of last week as opposed to Friday afternoon, right, by the time we were heading towards this peak. Wouldn't it have been phenomenal to take the weather data that we already have and match that to the load data and match that to the cloud cover so we could have had real pinpoint accuracy on when the cloud cover was going to impact solar and/or when the temperature was going to get to such a point that the wind wasn't going to blow, right? Those are all data points we actually have but it's putting that together in the right mix to get an output that we can then act on as an industry.

Q: As we talk, the country's suffering through a pandemic and an economic downturn that is a direct consequence of that. The last time we had a major downturn around 2007-2008, so government saw investment in electric infrastructure as a way of

helping to stimulate the economy; one of the ways, and I believe you got a borrowing authority of over $3 billion dollars. Do you think as we move now in coming years to recover economically from Covid, it would make sense to again invest in the grid and what would you be able to accomplish? What would your priority be?

A: Again, great question. You know, the Transmission Infrastructure Program came out of the American Recovery and Reinvestment Act and it's a $3.25 billion dollar loan authority revolving fund, so to speak, which still exists. We have done two projects. One was the Montana-Alberta Tie-Line, which was built and sold, and the other one that currently exists is what's known as Electrical District Five to Palo Verde Market which is down in Arizona. It is a phenomenal opportunity for low-cost, near zero interest given where the Fed is for the money. Ironically enough, we've got seven or eight projects sort of waiting in the wings. In fact, several that I signed the Records of Decision to move forward as far back as 2015. Here is the challenge. The challenge is really the issue that until we have Off-Take Agreements, by we---I mean the industry---somebody to guarantee to take the power; it is difficult to get these lines built. I've argued that yes, it's a challenge to get the permits. Yes, it's a bit of hassle and time to deal with all the

land rights. Yes, there's issues out there. You know, you've got to have good credit in borrowing money. Those aren't what are gating these projects. What are gating the projects is nobody is willing to step forward and say, I'm willing to sign a Power Contract for the next 30 years thereby guaranteeing the repayment of transmission-side of the equation. I mean there are literally dozens of transmission projects waiting in the wings. If you think about it, it is the challenge of the uncertainty that we live in in the industry. So, to answer your question directly, do I think it would be a great way to be sure to help the economy get back on its track? Absolutely. Do we have a need, especially as we move to carbon-free systems to build more transmissions to bring distant resources, such as wind into critical markets; 100%. But until we solve this last leg, until we figure out who's going to pay for it and how they're going to pay for it, transmission is stymied. We've got 1,700 miles in current projects that are literally waiting for someone to stand up and say, I'm going to commit to the off-take of those lines.

Q: To tie everything we've been talking about together with a neat bow, we've talked about Covid and economic impact. We've talked about the major outages now roiling California with rolling blackouts. And we've talked about the need of evolving the transmission grid to deal with ever-increasing renewables.

Do you think the solution to bring those three things together; is this a timely opportunity to address the gating issue that you talked about and hit the ball out of the park?

A: I do believe so. I do believe we have a unique opportunity to get these investments moving which helps rebuild the economy. Gets us towards a carbon-free future. Creates jobs, as well as takes care of the uncertainty. If you think about society today and I do thank the men and women---

Q: Mark, let me just interject when you said take are of uncertainty, you're talking about forestall the kind of problems we're seeing in California today?

A: Correct.

Q: Ok, go ahead.

A: Correct. Again, I want thank the men and women of this industry who've done a heck of a job. Can you imagine this pandemic without electricity, right? So, I think we have to keep that in mind at all times. We have a phenomenally reliable system and that's why when it frays at the edges, we have such challenge. I do believe there's an opportunity for the right investments, the right construction, and the ability to work towards what we all see societally, which is a carbon-free or reduced-carbon future if we can get this right. The pieces are

there. I just don't believe yet we've come up with a "secret sauce" to bring them all and tie them all together.

Q: Thank you, Mark.

A: Thank you. Thanks for listening to Grid Talk and thanks to Mark Gabriel, the Administrator and the CEO of the Western Area Power Administration for talking about the challenge of bringing in the transmission system into a carbon-free world. You can send us feedback or questions for future podcasts 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 this series or subscribe, visit SmartGrid.gov.

END OF TAPE