

MARTY ROSENBERG
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ARSHAD MANSOOR INTERVIEW

Hi, welcome to GridTalk. Today we're very pleased to have with us with us Arshad Mansoor who's the President and CEO of the Electric Power Research Institute, more commonly known these days as EPRI.

A: Hi, Arshad.

A: Hey, Marty, how are you?

Q: Good. We're delighted, very delighted to have you with us to close out the year for an important conversation of what you've just been up to. You're sitting in London as we chat on your way home from Dubai where you were at COP28. First, paint the scene for us: was there really 70,000 people there and how can 70,000 people accomplish anything?

A: Well, it wasn't 70,000 people at the same time but it was one of the larger COPs that I've been to and clearly Dubai has the infrastructure to support it and what COP accomplishes, you've got the side meetings going on between different country representatives but really the value that we see is the value

that you have almost all the industry segments there. You have key policy makers, stakeholders there and it's the side conversations, the panels, the sharing of information, the sharing of what each country's, each company's doing; that's clearly as much of value as a declaration coming out of COP.

Q: So, how many have you been to?

A: This is my third COPs; Glasgow was the first one. From EPRI, we have been involved in COP on the modeling side. For IPCC [Intergovernmental Panel on Climate Change], we have our modelers work with intergovernmental panel that does the climate change modeling but from an EPRI perspective, we have been going to COP at an executive level from Glasgow since COP26.

Q: So, do you discern a change in the mood, in the tempo and the urgency in the three you've been to?

A: I think I would...if I had to pick one thing from the COP that happened in this, the Dubai COP, I would say that the Dubai COP, one of the key outcomes of the COP and it was in almost all panel sessions and almost all leaders that came was the clear understanding that for this clean energy transition, we need to focus on all the options and the option that was talked a lot was the nuclear, the nuclear power I think that is now almost unanimous agreement on the importance, both

large nuclear central station and small modular reactor nuclear will play so you can call this COP28 as the Nuclear COP28 because I haven't seen this from leaders, from organizations, from industries: Dow Chemical, Exxon Mobile, Shell; oil and gas industry, the importance that nuclear will play.

Q: So, we'll get back to that in a minute but first I want to say that you are my early Christmas gift because if I'd have thought of one person that I'd wanted to talk exiting the COP talks, it would have been you because you sit over an organization with 1,400+ employees and just under \$500,000,000 dedicated to research on the frontier of energy. Given where COP is headed, given where the globe is headed on addressing climate change, do you feel vindicated on the research that you've done that you're pursuing at EPRI? Do you see any gaps that you'd like to address going forward to help meet where the world is going?

A: I think that we always look for what can we do now near-term and long-term. I think our long-term focus is spot-on which is, we've got to double-down on innovation on SMR on long duration energy storage on carbon-capture, but none of these resources really would be available at scale before 2030 and while we are doubling-down on innovation on clean energy technologies, we also have to realize the reality that the climate is changing, extreme weather is no longer that infrequent so we've got to get the

energy system and the grid ready so I would say that from the two big platforms, decarbonization, resiliency, climate-ready, I think we're spot-on. Near-term, there is some opportunities that we need to seize on and do a lot more than what we have done, not just EPRI but really the electricity sector and I would say it's more, right now, it's more of a U.S. focus but I think it will happen in other developed and developing countries. What we are seeing in U.S. is, and this is very recent; for 30 years the electricity demand of industry in U.S. was flat to declining and we're seeing for the first time, a change where we are seeing industrial demand growing. To give you a datapoint on that, last 20 years the electricity demand in the United States went up by 10%, so that's 10% demand growth in 20 years. We are seeing across PJM even in ISOs almost all over the United States, that 10% would happen in four years, so you have a 5X speed upload growth that is beyond the electrification of EVs and heat pumps that we expected. This is primarily because something happened last November that is reshaping our climate and clean energy agenda especially in the U.S., and that something was AI has been democratized. When ChatGPT was released, when you do a Google search; I do a Google search; a billion in the globe does a Google search or a Yahoo search, the backend is generated by AI. The computation need for a search that is done with a backend

that is generated by AI is three to five times more than normal search, so we're seeing an explosion in datacenter growth, not just in areas that we knew data centers happen like Virginia, and then IRA IIJA CHIPS Act; you're putting a trillion dollars to build factories in United States. So, with both of those things together, all of a sudden, we've got to get resources to meet this demand that we have seen in the '80s so you're not going to be building transmission line in three years and we all need how to figure out how to build infrastructure quickly, so what's the research gap? I would say, not research gap. What the industry's focus needs to be in the near-term, three-year, five-year, seven-year? We have to utilize the existing infrastructure as much as we can. The transmission lines shouldn't be only 40% utilized. The distribution lines cannot be 50% utilized. We cannot have only hundred hours in a year contribute to 10% of RP so whether it's virtual power plant to reduce RP. Whether it's line-rating technologies, whether it's advanced conductors, whether it's topology optimization software, we have to double-down to make sure that we have the technologies in the interim that is needed before we start or before we build a new infrastructure, so I would say utilizing existing infrastructure: generation, transmission, distribution, and maximizing that is a gap of deployment that we are focusing on. We are going to be launching

a grid enhancing technologies initiative where we're going to share operating practice of different parts in the world that have tried these technologies but we have to try at scale.

Q: So, let me talk about global collaboration. COP is the largest United Nations international meeting; it's 198 countries. Your yourself at EPRI have extensive international network where you collaborate with 450+ companies and 45+ countries. Tell me about the meetings you had with some of those contacts around the world and give us some anecdotes about things that were said; what you thought were the most valuable conversations you had at COP and what your takeaway is from those conversations.

A: I think several takeaways and the first takeaway I started by saying is I think the debate whether nuclear is going to be a key technology; I think that is now over and, but also, there was a discussion on the industry; the nuclear industry, the stakeholders, the regulators. At EPRI, we will have to stand and deliver and stand and deliver means we need to make sure that existing nuclear plants, we maximize their utilization; go from 40-year to 60-year to 80-year and beyond licensing but also get the small modular reactors on-time, on-budget. That said..

Q: Since you're bringing that up for a second time, recently there've been some hiccups on that front where NuScale was going to unveil a project in Idaho; everybody was waiting for that to

be the first SMR that came online. What in your assessment is the reason for that retreat and frankly also on things like offshore wind where people expected them to ramp up? How do we address these blips when as you pointed out, the need for not only transitioning away from fossil fuels is great but demand is increasing in a way we didn't anticipate?

A: I think it's a clear and think about it, go back 60 years ago, the first coal plant; the first...1940 was the first gas plant and one of the way we were able to de-risk those technologies was, and EPRI played a huge role in the '70s and the '80s with nuclear power plant is, we have to share operational experience of early-stage technology so we can de-risk that. Offshore wind, you are finding out...

Q: By the way, is that happening with SMRs or is that...

A: So, the SMRs is in a different state. Offshore wind is a technology that's ready to be deployed so that's where you share the operational experience. SMRs outside of in ships and Navy and submarines, the first SMR commercially deployed providing power to the grid most likely is going to happen in the 2030 timeframe so you have a number of companies using advanced light-water reactor technologies. Then you've got Gen IV. It is fully expected that you will have hiccup on technologies that you don't even have the first-of-the-kind deployed, so...

Q: So, my question is why is it taking so long for the first-of-the-kind? What's your analysis of what happened with NuScale? What do you extract from that?

A: So, into the common thing on a particular company and their technology, let me step back and look at what it takes to build a nuclear power plant whether there's an SMR or large nuclear power plant. You need a vertically integrated supply chain. You just don't need a design; even if the design is approved by an RC, doesn't mean that you have the supply chain that can build the reactor vessel that has all the way from the start to finish, the ability to build the plant. So, if you look at the public announcement the OPG, Ontario Power Generation in Canada, they've publicly the first SMR could be as early as 2029 and 2029, it's a GE-BWRX. Now, if you look at the nuclear history, GE has built plants; Holtec has built plants; Westinghouse has built plants; Rolls-Royce has built plants so when you look at the technologies and then you have a lot of other amazing technologies where it's more at the design level, and going from design to putting steel on the ground and actually building, that's a step that we have that to take. So, what happened to a particular company I think the big picture is, is Westinghouse moving in? Is GE moving in? Is Rolls-Royce moving in? Is Holtec moving in? And if you look at the landscape now, we see the companies that have the full

vertically integrated, not just supply chain is moving in and I think you will still see one or two hiccups. That's what technology's about. That's why DOE and Advanced Reactor Program is de-risking because if you don't have a hiccup and it's a new technology, first-of-the-kind that is being deployed, that is very common in technology deployment skills so I am not at all disappointed. I feel that is a lesson that we all will learn, but once again, we have to stand and deliver and stand and deliver means you have several SMRs that are...you've got Bankerim, the ex-energy; the TerraPower and 2030 is kind of like the timeframe where you will see where we are coming at, but from now to 2030, it's a huge opportunity and a challenge to meet the demand growth and continue the decarbonization. Maybe one thing we didn't hear at COP which when I shared my insights to our members and to stakeholders, the one thing that we didn't hear at COP was, where are we as a globe, as a nation? Hundred nations committed to a 2030 pledge; 2050 or 2017 MCO is down the road. It will require nuclear; it will require carbon capture and storage. 2030 is 6½ years from now. Actually 2030 is 6 years from now, so hundred countries put a pledge on 2030 but that really wasn't a discussion on three years ago, the pledges that we put two years ago, how well are we progressing to meet those pledges?

Q: So, let's specifically focus on it, the media being the media. The storyline coming out of Dubai is the assembled were going to consider saying fossil fuels no more and they backed away from that. Do you think that was over emphasized and how to you analyze all the debate over what the world is prepared to say, we're moving away from fossil fuels?

A: So, we let politicians and leaders of the country make statements as an aspiration, where we focus in on what can we do now to continue to reduce a nation and do it now at a faster speed so given that, the fact that EVs are ready but we need to deploy the them even faster, the fact that renewables right now is ready but we cannot build transmission infrastructure fast enough to bring more renewable in. The fact that we have technologies like virtual powerplant that are ready but we need to deploy them more. The fact that when U.S. made a pledge at the Glasgow COP26 that we would reduce our economy-wide emission by 50% compared to 2005 level. That was the U.S. pledge. Hundred other countries made similar pledges. At that time to meet that pledge, we did an analysis and we needed to accelerate our decarbonization at 3X speed compared to what we have done from 2005 to 2022, so it's needed at 3X speed. It you look at now with 6 years remaining, the speed has gone to 5X so in order to meet that same pledge, we have to accelerate five times than what we

have done so that means permitting, licensing, renewables, accelerating at 5X speed; no, we're not. Are we seeing EVs deployed at a 5X speed? It has gone up, it has gone up 2X, 3X so what we are focusing on at EPRI is let's make sure we do not lose our focus on the long-term technology innovation that is 2030 and beyond but let's double-down on what we can do today and what we can do today is build transmission, wind and solar; combined cycle natural gas plant to meet this load and to balance wind and solar; virtual power plant demand response and so, we are looking at how can we continue to accelerate in the next 7 years because for all practical purpose, carbon capture and storage, nuclear, long-duration energy storage; all these technologies will not really have any material impact on the emission reduction by 2030 so, it's a long-term focus with EPRI is of the catalysts for innovation but near-term is operational focus. It's licensing, it's permitting, it's utilities coming together to say, you know, we can do dynamic line rating and increase our utilization by 10-20% in certain lines. We can do advance conductors for corridors where we already have right-of-way. We can reduce our demand by 10 or 20% and be able to utilize our existent system more and we have to do this at scale in the next two, three, four, five, six, seven years while technologies that we need for net-zero are coming in.

Q: Are you optimistic we can reach the 2030 goal?

A: I'm always optimistic so if you're not optimistic, you're not a researcher. To do that, it's simple math. We have to accelerate on technologies that we have today by 5X but another thing that came up at COP that was something that we at EPRI that we have been saying is how fast should we go? Well, how fast should we go in the transportation sector? How fast should we go in the industrial sector? Because those two sectors have really not starting moving yet on emissions but how fast should we go on the electric sector because the electric sector is the tip of the spear to help the other two sectors and this is where we are saying...we use a phrase, "it's prudence over pace" because if you're not prudent on how fast we're decarbonizing the electric sector and if it impacts reliability and affordability in a negative way, it will actually impact the transportation sector which is relying on the electricity sector. It will impact the industrial sector that is also relying on the electricity sector and their decarbonization so prudence over pace, accelerating the electricity sector and we need to start getting really focused on transportation. That's the low-hanging fruit that is available now with technology. Industries take time.

Q: So, Arshad, I still would like to get you to get in the weeds with us and tell us what your day at Dubai was like. Who

did you meet with? What dinners did you have? Which conversations stick out in your mind? You were there for what, a week; a week and a half?

A: Almost 9 days and every day you go to, and it's not just me. EPRI was actually represented by Katie Jezera, our Regional Affairs VP; Neil Wilmshurst, our CNO who leads all the clean energy; Neva Espinoza, so we had a team of EPRI executives every day, not just communicating what we are seeing but also absorbing from others are seeing so another thing that...

Q: So, did you keep a journal? Do you take notes of the conversations?

A: Yes, every day we took notes and we actually captured our key insights and I just shared it with our board of directors today; shared it with the stakeholders; love to share with you after this call. And one of the thing that we heard, picked it up actually was from...it's a new term, not necessarily new but it means, it's scaling innovation. You may call it "scaleavation," so scaling innovation means scaling technology deployment by itself is innovation. Innovation is not about just SMRs and CCUS. How do we think differently on permitting and licensing? How do we think differently on supply chain that we need? How do we scale building underground transmission; offshore wind and offtakes, so there was a good discussion on scale of innovation

or "scaleavation" where you're not talking about technologies where the first-of-the-kind will come in 2030. You're talking about technologies transmission line, grid enhancing technologies, virtual power plant that exist today but need to be deployed at scale. The number of good forums on that particular aspect, hydrogen was always there but hydrogen I think I would say, nuclear had a lot more discussion because people are seeing nuclear as the source of hydrogen in addition to renewables. The thing that was enlightening at this COP was everybody believes what the role of renewables would be and now, almost everybody believes what the role of nuclear will be and this COP with oil and gas industry playing a strong role, carbon capture, transmission, and storage. So, the thing that EPRI has been talking about, working on that optionality and not be optional. This is the first time at a COP we felt a preponderance of discussion across many different industries and leaders that is making the same outcome, that optionality cannot be optional.

Q: Can you describe what that means?

A: So, what it means is, yes, we should double-down, triple-down on wind and solar but we should triple-down on offshore wind. But we also should triple-down on our commitment in there was a pledge that was made, there was a number of countries, a number of organizations that signed that pledge to triple-down on

nuclear power by 2050 so, optionality means in some countries, wind and solar is the way to go. In some countries, combination of wind and solar and nuclear is the way to go. In other areas where geological foundation is there, carbon capture and storage is the way to go. So, let's not pick winners and losers. Let's focus on all available technologies but at U.S., it's more a U.S. perspective right now. U.S. is almost feeling like a developing economy in the electricity demand growth that we are seeing; developing economy is already seeing that. They're going two, three, four, five, six percent. If you look at IRPs that are coming out. If you look at PJM, if you look at NE-ISO; to give you another example, southern company Georgia Power just released their IRP and they're expecting electricity demand to double in 2040. That is significantly more than what they predicted even just two years ago, so...

Q: So, before we go down that road though, what would you say has been the main or today is the main problem that needs to be addressed on...you say we need to ramp things up 5X by 2030. Is the economy sending the wrong business signals? Do business models need to be changed? Are regulators still mired in the past? Are new policies needed? What's needed?

A: So, I don't think it's one tool in the toolbox that needs to be; you need a farm and everything needs to happen at a fast pace

so let's talk about a couple of important things that needs to happen. Permitting and licensing to build infrastructure; we've been hearing it, we've been hearing it, we've been hearing it; we just need to get focused to make a change on that. It's a...you know Bob Blue, President, and CEO of Dominion, he mentioned something that still resonates with me that the biggest challenge on this clean energy transition is a challenge of good vs. good and good vs. good means it's good to build transmission lines to bring more renewables. It is also good to do a thorough study of environmental impact of the transmission line and the wind and the solar, but if one good takes 15 years, the good doesn't happen. So, I would say that is frontline and center but you've also got to look at the industry, electricity sector and EPRI works with the industry, we're independent. We've got to help the industry to also think differently and think differently means yes, it is okay to scale up dynamic line rating in the right way. It's okay to scale up demand response so that we are reducing peak demand. And then if you look at from a regulatory perspective, you have investor-owned utilities, you have public power, you cannot do just-in-time grid deployment. Grid is not something you just-in-time you build. You've got to build it ahead in anticipation of EVs are happening, fleet electrification is happening, data centers are happening so there will be a

regulatory thinking that will be needed that we have to build now and when the demand grows a higher use of electricity will reduce the cost pressure on ratepayers and customers so, that's a regulatory mindset of you cannot do just-in-time grid buildout. You've got to build grid when a company comes and says, I need a hundred megawatt to build a battery plant. That type of planning needs to happen in a more coordinated way.

2657

Q: So, Arshad, my final question to you is as you come away from COP and Dubai ~~and sit in London and~~ head back to the States, what insight, what personal motivation, what role for EPRI do you see that you did not see going to COP in Glasgow? What has changed?

A: I think it reinforced what we have been saying for a long time that (A) optionality cannot be optional. The fact that nuclear CCUS wind/solar, there was unanimous almost engagement and agreement on those technologies so that's not a new insight, that is a confirmation of what we have been saying. I think a new insight has been that now when policy and regulatory aligns, at the end, technology still has to deliver and on the nuclear side as we're seeing all the interest and funds and almost a unanimous agreement of building large plants. EDF just announced last year six new large plant buildouts. So now, the industry stakeholders

and RC regulatory, they all need to come together and deliver. What does EPRI do? Well, EPRI plays a huge role like we played in 1970. We have to make sure that their requirements for this new nuclear is not pretty different requirements; it's a requirement that is brought together, all the industries together and we have a clear requirements of what this nuclear needs to do. EPRI needs to make sure that the operational experience on all the way from planning, licensing, design of this first-of-the-kind, second-of-the-kind is shared but the most important thing EPRI needs to do is continue our razor-sharp focus on long-term operation so that the 328 reactors in the world that are 20-years, 30-years, 40-years that they can continue to provide clean electricity up 60, 80 and beyond. That's a huge heavy lift of research that needs to continue to happen. I want to end up by saying is 20 years ago, 80% of the world's energy was fossil fuel. After all the work that we have done on wind and solar and nuclear, today, more than 80% of world's energy uses fossil fuel so the realization that if carbon capture, utilization, and storage doesn't happen and if we cannot scale it up, we will go to net-zero, I think it is wishful thinking so it was very heartening to see especially in the oil and gas industries discussions. They're taking the lead on carbon capture, utilization, and storage. Their lead will benefit the power sector because we would also need carbon capture,

utilization, and storage to get to that last 20%. So, overall, you always come back with optimism but you always make sure that if pledges are made organizations like EPRI, organizations like National Labs, we all need to make sure that we are holding all of us accountable so making new pledges is great but we've got to keep track on the pledges we've made in the past like the Glasgow COP in a hundred countries signing pledges for 2030; where are we on that? So, with that we're looking forward to the new COP and Azerbaijan in 2024 and looking forward to meeting a lot of friends that we have made while we are over there. It is an amazing organization, it's an amazing event where you bring in almost all facets of energy both technology, companies, politicians, leaders, and it is a unique...

Q: And researchers?

A: And researchers. And researchers like EPRI and National Labs.

Q: And Arshad, we're going to hold your feet to the fire and talk to you where you leave Azerbaijan in a year, okay?

A: I would appreciate that, Marty. It's always a pleasure to talk with you and thank you so much for the opportunity.

Q: Thank you and thank you for talking to us on your way home from Dubai. We've been talking to Arshad Mansoor who's the

President and CEO of the Electric Power Research Institute, EPRI.

Thank you, Arshad.

Q: Thanks, Marty. Happy holidays. Bye.

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