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SAL GILL: Hello, and welcome to a new episode of *Electrifying AI* and our final episode of season two. Our mission is to provide a venue for clean energy enthusiasts to gain up-to-date insights on the latest developments taking shape in the electricity sector. Along the way, we'll help demystify the connection between the greatest machine ever built, the electric grid, and the greatest enabler of our time, data analytics.

To help us do that, we've had a series of special guests this season who hold a variety of different roles throughout the electricity industry. For today's finale, we're excited to welcome someone who has a front row seat for the ongoing energy transformation and someone who has a direct hand in navigating tens of thousands of customers through the changing electricity landscape.

Peter Muhoro is the vice president for strategy and technology at Rappahannock Electric Cooperative. REC is a member-owned utility that provides electric service to almost 170,000 connections and portions of 22 Virginia counties. And as for Peter, he has more than 15 years of experience in the energy industry, including roles at the National Rural Electric Cooperative Association and leadership positions at co-ops in Texas and Virginia in the United States. So he's well positioned to give us a unique perspective on what is happening in the industry. Peter, welcome to *Electrifying AI*,

PETER MUHORO: Thank you. I'm looking forward to this, and thank you for the conversation. I think it's really exciting to see where industry has come and where our industry is headed, so I'm looking forward to this conversation.

SAL GILL: Perfect. And I should also point out that, Peter, you're also a board member for SEPA, the Smart Electric Power Alliance, and SEPA CEO, Julia Hamm, was a guest on episode two of the season. So if you haven't checked that guest, please check it out, and find it after we talk with Peter. And because, Peter, you said you want to rack up more views on your episode than Julia did, so we had to drop that in there.

PETER MUHORO: And I hope that everyone who watches votes mine better than Julia's so I can just have fun with her.

SAL GILL: There you go. We'll push for that. So Peter, I always think it's interesting to hear how folks find their way into the electricity industry. How did it happen for you, and why have you focused your career and your insights in the cooperative space?

PETER MUHORO: Oh, great. So the big changing part for me was walking through graduate school and, and I've always been entrepreneurial, but I was in a PhD program in applied physics and realized being in a lab was not my thing. I love lasers. I love experiments and everything else, but I knew it was time to pivot to something more interesting.

So I transitioned my PhD studies into looking at energy and energy issues. And specifically, I was looking at how do you model energy systems when you look at places that are not the traditional electric grid, and so essentially places that are completely off-grid, not connected. When you look at the over billion plus in the world who do not have access to electricity and many more who do not have access to reliable electricity, that really became a focus for me, but I also wanted to add on the layer of how does that impact economic growth.

And so that's really what drove me to looking at the electric system and looking at the electric grid. And by the time I concluded my studies, a lot of what I was riding on was consumer-owned systems. We've done a great job, and especially in the United States in the early 30s, beginning to build out what our electric grid looks like, and that was a big drive to electrify rural America, places that were not electrified. While the urban cities were, it was in the initiation of the Rural Electrification Agency in the 1930s, mid-1930s, and helping electric co-ops by taking consumer members to really drive that force of Electrifying Rural America.

And so I began looking at that as an option for places that are not electrified but not in the traditional sense of generation transmission, distribution and consumption, but maybe from a sense of a prosumer perspective where can both be a generator and a consumer as well and how that, collectively in a smaller scale-- so it's taking what a large grid looks like and looking at it more on a fractal perspective, if we could look at it that way, and helping to drive that from that small scale and making it more consumer-owned.

So that was my introduction to electric cooperatives, and then I began to realize it was a model that is probably the most innovative, most effective. The drivers are not shareholders. So my driving force is provide the best service that I can at the lowest cost, and my consumers are my owners of the electric co-op. And that model, to me, was exciting because it allowed for innovation, it allowed for creativity, and it allowed for flexibility in looking at what an energy system could look like.

And so years later, I pivoted to spending more time in the United States and not globally, as I did before, and spent the last decade or so working with and for electric cooperatives to help us move into the next transition of what our electric grid looks like, still maintaining the foundation of the early days in the 1930s that electric co-ops began to electrify rural America.

And just from a statistics standpoint, some of what might help for the listeners is electric co-ops cover nearly 60% of the land mass in the United States.

SAL GILL: Wow.

PETER
MUHOHO: Especially when you look at the middle of the country, it's primarily served by electric cooperatives, 42 million miles of line that the powers electric cooperatives, that electric cooperatives power throughout the United States. So a huge, huge perspective. I'm sorry. I meant to say 42 million served in 48 states, and I believe it's somewhere in the order of 2.4 million miles that are powered by electrical cooperatives in the US, so a huge area and a lot of innovation and creativity that could happen.

SAL GILL: Absolutely. Yeah. Absolutely. That's a massive, massive span of geography and also opens us up as an industry to really look at the opportunities there as well. So Peter, moving on, among the many challenges of your job is creating a technology strategy that addresses not only REC's needs of today but more importantly the information, distributed generation, clean energy, emerging technologies, and advanced electrification needs of tomorrow. How do you even begin to tackle all of those points?

PETER MUHORO: Well, I usually like to say I rub my head and I can tell the future, but unfortunately that doesn't really [AUDIO OUT]. So really, the couple of steps that you have to think about, and what I always say is you have to maintain the core but plan for the future. Our mission is-- and I'll will talk about Rappahannock specifically. Our mission, when you look at what we do, is providing safe, affordable, reliable, and sustainable energy solutions to our consumers, our member owners, and that drive is what gets us to say-- we still have to maintain the core, and we have to look at how do we ensure that the core does not fall apart because we're still expected to provide that.

But at the same time, we have to evaluate and say, where can we see the industry going? So let use one example. Let's think of distributed generation as a good example. Our perspective where distribution utility, and in fact, if we have-- our job is actually more to think of it as how do we manage the electrons that go through our system and not necessarily worry about where the electrons come from.

So the electrons come from our generation and transmission provider. Great. If they come from behind the meter, great. Our job is to make sure that they can flow and meet the needs at the time when the consumer needs it. So when I look at that, I've got two perspectives where, one, I've just got to make sure I've got a system that's up and running. Two, I've got to find systems that can manage and understand the flow of these electrons. And three, I've got to find a way to use data as an opportunity to manage how it's used wisely.

So that gives you an example of the strategy that I have to apply when I look at different perspectives is to say what has to remain the core to make sure it's still strong, but these are the two areas that are thinking about how do we plan for the future. So that's really kind of the perspective that-- and that's just one example of the many things we could see in our industry that we deal with every day. That's just an example of how we approach developing a strategy for the things that we deploy here.

SAL GILL: And Peter, I'm curious if emerging themes like hydrogen are also on your road map of things to consider looking into the future.

PETER MUHORO: Well, I would say hydrogen is definitely of interest, and I think it has a place in the future. I think I can say we're focusing a lot of our efforts today especially is how do we role out strategically the whole concept of electrification of everything. And I know we've talked about the internet of things as one component of our industry, but now electrification of everything, especially at a time when we continue to transition our electric grid into a more cleaner with a goal of being a clean grid in the future, how do we electrify this.

And specifically, one of our key factors that we're evaluating is electric of transportation and e-mobility from every different sector that we can consider this and the opportunity that exists in that area, but this is where things like hydrogen really come into play because we know one thing for a fact is that, as we think of electrifying everything, a big piece of how we operate is various ways to store energy and if the technologies that begin to make sense.

We're thinking of them as the future because the reality of it is how we use energy today is going to be critical, and how our consumers use energy is going to be very different as we think of what the future looks like. So that's really where we're thinking of these technologies and where they play a role. I'm proud to say we're the first electric co-op in Virginia to go online with a utility scale battery.

This battery can power 1,000 homes for about eight hours at a time, but it has several different use cases, including helping us not to have to build out more on our system. It's allowing us to manage some of our peaks when we need to and things like that. And so that's kind of where we see some of these technologies and where we could go as we look at the future and the technologies in our industry.

SAL GILL: Very cool. So that all sounds very challenging and interesting just as it is. So how has the COVID-19 pandemic changed the game for you in terms of customer behavior, customer expectations, and the technology that is in use?

PETER MUHORO: So first of all, I have to say to everyone, I give you advice, do not change jobs in the middle of a pandemic. I began last July in Rappahannock for just almost exactly-- in a few weeks, it will be one year, and that's been an interesting challenge where we've got 440 strong employees at the co-op and many other contractors, and I haven't seen but maybe 5% of them or so in the time.

So that's a big challenge to begin with, but what we really see is we've seen a shift in terms of more and more residential usage. We're already big on the residential side of it, but what we've begun to really talk about is why reliability is so critical. So the pandemic has really taught us the fact that more and more people will work from home. More schooling will happen from home. So if reliability is not strong, if we don't have the technology to help with that, then we do recognize that there's a big challenge in meeting our consumer needs. And so there are two factors.

One, ensure that reliability is high. But two, can we help our consumers understand how to consume energy in the right way? And so, yes, I know you're working from home, but maybe do laundry late on at night rather than in the middle of the day because it's easy to say, in between meetings, let me just throw a laundry into the washer, or let me do this and this. And so it's on us to really begin to help our consumers.

And I will say this. I think one of the key elements of what our future looks like will be looking at the consumer's behavior and how we can help the consumer understand the role of electricity. It's the same analogy if you look at when-- I'm old enough to remember when I had a pager and then went on to getting a cell phone with 300 minutes and 100 text messages.

And so the behavior was wait until till 9:00 PM. So 8:59' I'm sitting there to make a call, right?

[LAUGHING]

And 9:00 PM, and then I'm on the phone for eight hours. Like, why did I even have to be on the phone? But it drove the behavior. Today I don't even have to think twice about it. In fact, the reality of it is I don't even make as many calls because I've now found other ways to use for communication, and I'd rather just text, and it's quick. It's straight to the point.

So can we look at how we could shift the behavior of consumers to get them to consume at the right time where it's a benefit for them and it's a benefit for us as the utility, and I'll go back to our core of who we are. As an electric cooperative, we're a consumer-owned electric co-op. And so that just gives you an idea of why this, to me, is such a good opportunity to be able to find a way to help the consumers transition into a wiser, more efficient usage of electricity, and the pandemic has just accelerated that piece of it.

SAL GILL: Absolutely. And especially, Peter, as we see more and more of these Teslas and other electric vehicles. I was just in the mall the other day. I saw one from Volvo. So I think it's going to become even more important, as you're saying, to look at how better could we manage not just the expectations of customers but also the load itself, as we're going to see variations and changes in that as well. So Peter, in our last-- go ahead.

PETER
MUHOHO: Let me add one little comment to that. What's interesting is-- so I'm an electric vehicle driver, and I just looked at my total battery usage compared to my total miles. And if I really did the math based on residential rates, having put about 7,200 miles on that, my cost has only been about \$240. There's no way an internal combustion engine will give you 7,000 miles for about 200 or so dollars, right? So when consumers begin to understand that, the shift will happen extremely fast in terms of that, and that's what we have to prepare both on their end as well as on our end for our systems to be able to manage it.

SAL GILL: So may we ask, Peter, what are the electric wheels that you're driving?

PETER
MUHOHO: I drive a Tesla Model 3.

SAL GILL: Cool. Cool. Very cool. Yeah, and spot on. And especially, we may even see it get even more accelerated, given the increase in fuel prices that we're seeing. And I just saw reports the other day that there is even talk of oil hitting \$100 a barrel again, so very, very interesting times. Peter, in our last episode with Ahad Esmaeilian from Avangrid, we talked extensively about digital grids, behind the meter devices, and the internet of things. How does the geography of the area you serve create challenges in executing on these elements of the energy transition?

PETER
MUHOHO: So I will say this. First of all, if you haven't been to Virginia, central Virginia is one of the most beautiful places. The Shenandoah Mountains and just the Blue Ridge Mountains, it's beautiful. We've got a great territory that we serve, but it's also a challenge. We've got very urban areas, and we've got very rural areas. A key thing and a key challenge for us is actual the capability of communications, and that's primarily on the broadband side of it. We're doing some things to help facilitate some of that, but that's a challenge because, at the end of the day, if I want a device that can communicate fast enough to be able to provide the solution I need, I need to have the communications infrastructure. And if that's lacking, that creates a challenge for me to be able to know that I could reach that person who, in some cases, we've got one meter to a mile.

And also, some of these areas are just extremely difficult to build through. I mean, we've got national parks kind of cutting through our territory, and things like that. And so where we see some of these challenges is more and more, and glad to see from the federal side of it to the state level to the county level, a big push for getting rural broadband and those who are under-served and unserved provided with that. Once we can-- the more and more we see that, then there's the other side of it to really help the consumers understand how some of those behind the meter devices will be beneficial.

I'll give a good example. Today, I've got an LG stove that, if I have it open, it not only just starts beeping on me if it's on, it starts beeping, I get a notification on my cell phone. And the other day I walked away, and about an hour later it reminded me that the oven was open, and I was about a 15 minute drive away that it was still on. I had the capability, because it's connected to Wi-Fi, to notify me as a consumer. Now, thankfully, I was actually cooking something. So it wasn't that I left it by itself, but you can see the advantage of being able to have that communications capability that now we can help consumers really understand how to utilize their energy, and that's just one example.

And so as we see more and more options, everything that's connected to the internet, we recognize that access to broadband will be a challenge but also, once we could get there, we could see more and more of these devices rolling out toward our territory.

SAL GILL: All right. And Peter, with all these changes that are taking place, do also see the emergence of new business models perhaps as well for utilities?

PETER MUHORO: Absolutely. I don't think you can do business like you've always done and be sustainable. In fact, one of the things I always say is as much as I love the core of who we are, insanity is doing the same thing over and over again and expecting different results. So if the industry is changing, we also have to evolve. And I can tell you where I see our industry--

The reality of it is, in my opinion, the consumer wants it as simple as possible but also very complicated. That's the challenge that we face today is we've got this complex system. Consumers have access to data. They're able to see a lot of things, so they expect a lot more, but they also want just to come home and turn on their lights.

SAL GILL: Right, right, right.

PETER MUHORO: And so how do you take those two items and marry them? Part of it is-- and I'll be one who continues to say I see a day where maybe the business model is not based on a kilowatt hour anymore, but maybe it's based on a service that you provide just like when I look at my cell phone. I pay one fee.

SAL GILL: Right.

PETER MUHORO: And I never have to think twice about it, and maybe that's what we get, but that will take changing consumer behavior just like we turned around and changed from spending eight hours on the phone after 9:00 PM to, you know what, I'll just text, and I'll just get through this now. Does that lose a little bit about society? Maybe, but I think that I could see a day where our business model is based--

I think you'll maintain both the traditional model, but I think there's another model that provides the energy services and energy solutions side of it, and that's one of the key things that my group is focusing on is what's the future energy solutions that we're going to be offering. What are those future energy services that we're going to be offering? In fact, what happens to that day when the consumer does not care about volumetric perspective, but they want to pay for resiliency.

SAL GILL: Right.

PETER MUHORO: And that's where we as a utility have to really begin thinking about and going there.

SAL GILL: Very interesting insights there and perspectives. So Peter, we love analytics and data here at SAS and also in our podcast, *Electrifying AI*. So how can utilities of all shapes and sizes drive data usage all the way through the utility? What will it take to make that most meaningful for utility? I'd love to get your thoughts on that.

PETER MUHORO: So the first thing that you might hear when you go to a utility, there's a common phrase, the dumb, old utility guys. We've always done it this way, and we're not going to change, right? And so the first step, really, is a cultural change that needs to happen, and it's a cultural change where everyone understands the need and the use of data everywhere else until it comes to the utility, and then they're like, what do you mean?

In our everyday lives, you get on Facebook, and you recognize something that you were thinking about, and you get an ad for it. And before you realize it, you're on Amazon buying something that you probably don't need, right? That's all--

SAL GILL: I just did that last night.

PETER MUHORO: Exactly. That's all data, right? And so we, as a utility, have to accept that there's such a great opportunity in how we can utilize data. And so what we have to do is to begin to make very data-driven decisions to say this is-- I've looked at the last five years. These are the trends that I've seen, and how do I transition to creating a program that does X, Y, and Z?

But the first piece of how we've got to get there is we've got to get the culture change. Secondly, we've got to begin to invest in the systems that can handle the data. Today, if you asked me to take a guess, based on the data that's available, how much we utilize it as a utility, I would say probably not more than 10% because, one, we probably have legacy systems that could not handle the capability of what we could do with the data. And two, we've got, in a way, we don't even know what to do with it.

And so if we can address the culture, invest in the right systems to be able to utilize data, then the next step is actually being able to find that. And where I go with this and what will drive it is, as we see the demand for being a solutions provider versus just a kilowatt hour delivery, that's where I could see this driving more and more to get straight to where we have to utilize data to get us there, but we'll have to address also the part that we do have legacy systems, and interoperability will be a big piece of what we understand.

Now, let me shift the gear a little bit, and I'm not sure if you were going to go here or not. The other challenge that we see with this is the privacy side of it, and I'll go there with it is the cyber security side of it, right? Because it could cripple you from doing anything with data because of the concerns of cyber. So we've got to have a culture that can welcome the use of data but also finding a way to ensure that we're protected. The amount of ransom attacks that we're seeing on any given day, it's alarming, but it also should not be the thing that stops us from being able to do what we need to in terms of data.

SAL GILL: No, those are excellent points.

PETER MUHORO: Let me add one more thing when we talk about culture. What we also have to change a little bit of our thinking when we think of data will be, how do we address the non-traditional way of thinking? And I'll give the example of, as a utility, you have a customer service rep, for example, who traditionally may just answer the phone when a consumer calls.

We have to think a little bit different on those roles and how we change. Data is driving us a little bit differently. So where we have to think differently is how do we take those roles, how do we transition them to provide the right kind of service, and maybe that person also spends time on chat. Maybe that person is also a data analyst and can look and assess and look at different things.

And so there's a part of the culture to really get data to be utilized, but we've got to also begin to think about our jobs a little bit different. Because data is driving everything that we do, our roles, just the typical distribution designer, for example, now has to factor in a data component in their job, and that's a cultural change that we'll have to think about as we move forward to bring a lot more data into our systems.

SAL GILL: Very interesting perspective there as well. Peter, this has been an amazing conversation. Thank you so much for your insights and your time. Here's a reminder for our listeners that they can join the large community that you've created on LinkedIn. Folks can just go to pmuhoro.com, and that will take them straight to your LinkedIn page. Peter is also on Twitter @pmuhoro. So you can also follow him there as well.

So Peter, here's one last curve-ball, and I promise this will be the last one. We're building an *Electrifying AI* playlist on Spotify during the season two, and you get to pick a song. So we'd love to hear what's your selection, and bonus points if it has anything to do with power, energy, electricity somehow.

PETER
MUHORO: Wow. That's a tough one. I got to say I was not expecting that, but I will throw another curve-ball at you where if you go to Instagram and follow what I believe it's @washingtonprobs, there's a great video of an old couple doing the Nelly song *Dilemma*. So I would say--

SAL GILL: Oh, yes.

PETER
MUHORO: And it is great if you can watch that karaoke because they are spot on, not what I expected. So it's the last thing that I saw earlier this morning. And so you asked me a song, you got it. It doesn't have much to do with power, necessarily, but at least someone can have fun if they find that video.

SAL GILL: We'll take that any day. So listeners, what song would you want us to include? Leave your music suggestions in the comments, or tweet them to me @theelectricsal. We might just include your pick on our playlist and send you some cool *Electrifying AI* swag to say thank you. That is all for this season and this episode. We look forward to seeing you again when we'll be back with our season three. Thank you for joining us today, and thank you, Peter, again, for your time as well.

PETER
MUHORO: Thank you for having me. This was fun.

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