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STEVE POWELL INTERVIEW

Hi, and welcome to GridTalk. Today we're very pleased to have with us Steve Powell who's the President and CEO of Southern California Edison, one of the preeminent and largest utilities in the United States and in the world.

Q: Hi, Steve. Thanks for joining us.

A: Thanks for having me, Marty. Appreciate it.

Q: Well. We have a huge amount of ground to cover on the changes that are coming to your territory and to the American public across the country. Because of your size, I think the scope is really mindboggling to contemplate, and you have about 15 million customers. Talk about the geographic-fixed swath they cover in the state of California.

A: Yeah, Southern California Edison like you mentioned, we provide electric service to 15 million residents across our territory. We go from the Pacific Ocean all the way over to Arizona and Nevada, up to central California and down to San Diego so it's about 50,000 square miles and we cover beaches, desert, and forests. We've got all different types of topologies

that we work across and so our system has to be able to adapt and be designed differently for different parts of that system, but it's a big territory and we're seeing lots of different growth across lots of different parts of it.

Q: So what got me very interested in talking to you is seeing the state that you expect demand to grow over the next decade. And it that wasn't enough, preparing for this interview, I've seen some pretty dramatic videos that you've developed. I guess in your location of Southern California, I should not be surprised at your ability to use video technology to tell your story, but close to 80% may be a doubling of demand by 2045; that's crazy. Other than the early days of your utility a century ago, have you ever experienced growth like that?

A: So, not on a sustained basis at that volume. Really, in the last probably 50 years have we seen that level of load growth and so, like I mentioned, by 2045 we expect to see 80+% load growth where we haven't really seen any load growth over the last two decades so it's a very different shift in how we have to think about designing the grid, getting enough resources, and supporting our customers through this.

Q: So, I've been around for longer than I care to admit covering this industry and I remember for decades, there was talk of load growth, no growth. You developed a staff of

engineers and experts and regulatory policy people that have dealt with that environment. What kind of pivot do you need in your company to address this kind of challenge?

A: Yeah, so when I think about the amount of load growth and it's going to begin to ramp up over the next few years really, it starts with thinking through, understanding load growth so economists and forecasters that are helping estimate how much load growth there's going to be there, where it's going to show up, and then we have to feed that into how we plan the grid and so, our engineers that are mainly used to dealing with relatively small changes on the grid and small amounts of load growth are really focused on making sure that the infrastructure stays reliable are now having to think very differently about how we plan for customer load growth, and load growth is showing up really quickly and so customers are...if they want to install electric vehicle chargers, they want new warehouses, they want; there's new homes being built; that's a shifting dynamic and so our teams have to think, it's not just the designs standards that we've used in the past, we have to think about instead of building just 12 and 16kV circuits, maybe we need to build 33kV circuits. So really, the engineers are beginning to think about how do we design it differently in new areas and how do we support load growth in areas that are already built out?

Q: So, this challenge in itself would be daunting but you face a lot of mandates being in California and in the United States at a time of heightened awareness of climate change. I've read that you need to add something like 80,000 MW of renewables to your mix and 30,000 MW of storage in comparison. I think you've added 5,000 megawatts of storage in a fairly recent period so this is quite a significant ramp-up. Just talk about how you're going to do that; where're you're going to get all those renewables, and is the storage technology ready for primetime?

A: Yeah, so in California, we have the benefit of having pretty good access to renewable energy and so we've been adding a lot of solar and a lot of wind, in particular, and we expect to see a lot more solar and wind development to support the load growth that's needed. If you take it to 2045, I talk about that load growth to meet it, we think it's actually 80, maybe 120 gigawatts of new renewables to meet that demand. It's probably north of 30 gigawatts of energy storage so we expect to see a lot of solar and wind. It has to be backed up by energy storage and the energy storage technology available today, four-hour lithium-ion batteries, that is great for capacity that goes onto the system. California has added more than 10 gigawatts of energy storage just in the last five years. We've got more than three online just at SCE and we've got five more coming over in

the next few years so those batteries are out there, they're on the system and they work. When you look 10 years out, you may need some other technologies. You may need long-duration energy storage, batteries that store energy for 12 hours for multiple days. You also going to need to think about beyond just the renewables, at some point you're need some sort of, we call it firm clean energy so that can be anything from new nuclear down the road. It could be geothermal, it could be carbon capture and sequestration, so we know we're going to need some new technologies in 10 or 15 years out but solar and wind plus batteries can do a lot for the system over the next decade.

Q: So, research by utilities has not been a strong suit over the decades, R&D compared to some other industries but you're talking about new technologies over the horizon. How are you integrating your work and your engineering work with the research over the horizon, R&D coming from NREL, from startups like Don Sadoway at MIT who's been involved with and do you see game-changing storage technology that may make this lift a lot easier?

A: So, Edison like many of our peers, we work together in particularl with EPRI, the Electric Power Research Institute, where we fund programs and we look at research across the industry because doing it just as an individual utility is a

little subscale and so when we look at major changes like nuclear, carbon capture, we're working together with our peers across the industry through EPRI and EPRI is a great gateway into NREL and the other National Labs that we also partner with on projects. On energy storage, there's a lot of different potential technologies that are out there from a long duration perspective. They all have a ways to go in terms of being viable at scale and being able to hit the right price point so customer affordability is top of mind for us at all times. But as we've seen with lithium-ion batteries or as we've seen with solar technology in the past, when a technology really begins to make traction and to make its way down through the development curve and gets to volume, you can see rapid drops in the cost, even things like hydrogen could be, as storage, could be a gamechanger down the road. Don't want to place bets on any individual technology because there is a wide swath of them and a few of them may be needed for different needs on the system but we're hopeful that in the deployments that will happen over the next five years supported by some of the federal funding that's available, we'll see some little breakthrough technologies that can help with energy storage on the system in the long run.

Q: So, if you need to be adding, and by the way, it's not primarily you but it's companies that you work with to develop the generation; you don't generate it all yourself, do you?

A: That's right.

Q: If you and your partners needing to be generating an 80 to 120,000 megawatts of renewable generation, and north of 30,000 megawatts of storage, the footprint you described is not bound in the desert; there's a lot of people living in that territory. What's the challenge of putting 20,000 miles of transmission in and to link it all together?

A: Yeah, so you hit the nail on the head. You can get the resources built but you have to get the energy to the customers and a lot of time, that wind, that solar is not that close to our load centers and where the customers are so building new transmission's going to be a key part of what needs to happen down the road. You look at the California Independent System Operators' 20-year outlook and they're talking about fifty-plus billion dollars of new transmission that needs to get built. In our numbers, we say we're going to need to build transmission miles at four times the pace that we've seen historically so that's a lot of challenge. Siting and permitting are the biggest challenges that needs support nationally and at the state level. We need clarity around who's making decisions, we need clocks

and timelines for when decisions get made, we need resourcing so we can push it through faster; it can take 10 to 12 or even longer or more years to build a new transmission line. That's too long when we're talking about trying to get this total energy transition to happen over the next 20 years, so we're focused on getting the policy changes to support that transmission load growth. We're also focused on getting the most out of the existing transmission system. We know we're going to need new transmission lines but there's technologies available that can really help get more out of the system that's there today.

Q: So, talk about that. You're doing some reconductoring and what does that get you, and then I'll want to ask another question about changes you've put into your transmission and distribution grid.

A: Sure, so advanced transmission technologies and grid enhancing technologies are two classes of these I'd say transmission technologies that help you get more out of the system. There's advanced conductors so you can go and reductor a line and the new line or conductor that you put up, it doesn't get the same impacts as the old conductor in terms of heat and creating sag so you can actually get more energy through those lines. Depending on the line, you might get

25 to 80%; some would say double but probably the engineering limitations will put you at more 80% as you re-conductor a line so that can be a real help because you don't have to go site a whole new line, you can just replace the conductors so instead of taking 10 to 12 years, maybe it only takes you only three to five years to get a re-conductoring job done. We've installed more than 504...re-conducted more than 540 miles already with some of these advanced conductors and we expect to do more. There's a recent grant application that we partnered with PG&E and the state on; some of the state agencies, where we were awarded \$600,000,000 to help deploy additional advanced conductors through the re-conductoring as well as other technologies like dynamic line rating that help you get more out of the existing system as well by instead of just having a single rating for a line that looks at what's the minimum that I'll always be able to provide, you can adjust the ratings online so you can get more out of them at certain times of the day and throughout the seasons.

Q: So again, getting back to your territory, it's been afflicted with unprecedented fires and problems with wildfires over the last decade for sure and I know you've been very practical with other California utilities trying to deploy new technology to detect fires early and mitigate the damage when

they're detected. Talk a little bit about that and bring us up to date on this fire season, then I'd like to ask you to segue into a conversation of how that work has prepared you for what you need to be doing building out the grid in the next decade.

- A: You got it so the fires that we've dealt with in California over the last now seven, eight years have been a huge impact to our customers. Public safety is top of mind for us always so we've had to rapidly think differently about how we reinforce our system so that we can avoid ignitions that are started from utility equipment, so we've; our primary program has been about hardening the grid so how do we go out and we've been installing covered conductor we call it or insulated wires in our high fire risk areas. We have about 10,000 overhead line miles of distribution wires in our high fire risk areas. At this point we have replaced about 6,000 of those with what we call covered conductor and so instead of having bare wire, it's insulated so if a branch comes and hits it or a squirrel's going across it or the lines slap together, you don't have impacts and so it's a very effective technology to reduce wildfires or risk. Where in targeted places, we're undergrounding a few hundred miles is ultimately our goal but we ultimately want to harden those distribution

wires in high fire risk areas cause that's where the ignition tends to happen for us on those distribution lines. In addition to the hardening, advanced vegetation management, getting bigger clearances around lines, we've totally revamped our inspection programs where go our and we have people that looking at it from the ground but we're also using drones to take images of the system. We're inspecting more than half of the structures in high fire risk areas every single year. In addition, we have a lot of situational awareness. We've added more than 1,500 weather stations. We've got more than 150 HD cameras out there so we can see as fires are happening, there's AI technology that's always monitoring the images coming off cameras to identify fires quickly but that, those cameras, they are weather stations are particularly important because they allow us to see when the weather's changing on our system so that we can do things like a public safety power shutoffs in very targeted ways to help protect customers so collectively this side of technology has allowed us to reduce our risk of a catastrophic fire started by our equipment by 85 to probably over 90% now We reduced the risk of losses by catastrophic wildfires by 85% to more than 90% compared to pre-2018 levels.

just since 2018 so it's been a huge effort for the last five years so that we can really reduce wildfire risk and keep our community safe.

Q: As you've risen to this challenge are you learning things or deploying technology that will help you with what we've been discussing earlier, adding a massive amount of renewables, building a lot of new transmission, and getting storage deployed?

A: I think there's lessons in any of these programs and it's interesting cause actually some of these programs that we've deployed on the wildfire were built on grid modernization and things that we had started before and so when we knew distributed resources would be growing on the system, we started a grid modernization program around 2015 and that was really getting more switches, automatic switches on the system, more intelligence onto our systems so that we could manage reliability and help integrate things like EVs and rooftop solar. That technology actually became a foundational thing for our Public Safety Power Shutoff programs because it gave us the visibility and allowed us to target our PSPS programs so every time we rollout a new set of programs, we're standing up to a new challenge, we're building on the technologies there in the past, so I think about the wildfires and what we've had to

deploy there, a lot of how we deploy at the siting and the licensing, getting resources, that will apply to how we have to buildout new circuits on the grid to meet the demand and growth that's coming for sure.

Q: So, we've talked about what you have to do on your side of the system, let's talk about the demand side. This is coming, of course, from a massive adoption of electric transportation. Your own reports saying Southern California which, in many ways is the symbol of massive car transportation is going to go through a sea-change getting to upwards of 90% of EVs in the foreseeable future. I also think you're going to have electrification of heating and building infrastructure. Talk a little bit about demand and what your customers' lives will look like in 2045 as you double the amount of electricity available. How will their lives look different?

A: Yeah, so as you mentioned, a lot of this is driven by policies that are supporting a decarbonized future, right, getting to a carbon-neutral by 2045. To do that, really the only way to get there is to have clean electricity serving a lot more of society's needs. You mentioned transportation so 90+% of vehicles will need to be electrified; 95% of space heating and water heating in homes and buildings will need to be electrified, so what customers are going to see is they rely a

lot more on electricity and a lot less on fossil fuels; a lot less gasoline, a lot less natural gas so I think about the daily lives. Today, about 20% of the energy that customers use is electricity. By the time you get to 2045, I would expect 50 to 60% of it to be electricity-based so customers are going to be two to three times more dependent on electricity than they are today. That means our level of service has to be better, reliability's going to have to be better, so that just reinforces the work that we have to do on the grid. But along the way customers are going to have to adopt these technologies. They're going to have to be simple, they're going to have to be cost-effective eventually, and they're going to have to work well and so, that dependency will grow. The part that we like to point to as well because people way, wow, that's going to cost a lot to transform the electric system and so what happens to customers' bills? By 2045 the customer shouldn't be thinking about their electricity bill. They really only need to be thinking what's my cost of energy in total. We expect by 2045 when you add the together the combined electricity, gasoline, and natural gas so their total energy spend, the customer energy cost will actually go down by up to 40% so while the electric bill will go up, the amount of electrons going through the system, we'll get more out of that system so rates should remain

manageable on the electric side but customers will spend a lot less on gasoline and natural gas and so overall, this should be actually an affordable transition for customers as well. We just have to make our way there in a smart way.

Q: Is that well-known? Is that a story that you think is appreciated?

A: So, I think it's a story that we talk about a lot. I think that customers that adopt electric vehicles today begin to learn that story but when your gasoline bill and your electric bill are separate bills, and you don't always look at them together, getting a picture of what my total energy costs looks like, most customers don't see that or understand that, and that's a change in mindset that we're going to have to work through.

Q: Talk about your company, your company is Southern California Edison will be a traditional electric utility and a utility in multiple senses, but you'll also be the Exxon and Mobil of Southern California. How does that change your approach to business? How will that change your company?

A: So, I think getting there, I don't think our core or our foundation changes, right? I think because I think about what needs to happen, our job is to provide electricity, to do it reliably with resiliency and to make sure that we're ready for customer load growth and so that's something that's going to

sustain really over the next 20 years. We're going to continue to find ways to help customers find more affordable ways for their electricity so customer programs will be really important. We're going to continue to look for ways to support adoption of electric technologies, things like our Charge Ready program that help get EV chargers out there, but the approach to business has to focus on I'd say anything keener, tighter focus on the reliability of the system, focus on affordability, those core things that we deliver for customers and we have to be listening to our customers because through this transition, they're all going to be experiencing and having different needs along the way and we're going to have to adapt to that to ensure that our grid is able to meet all of their needs. We're also dealing with all of the external factors like accelerating climate-drive weather events.

Q: So, as you grow bigger and as you're mandate expands and gets more complex, isn't it incumbent on your company to get more visionary and let me just give one small example. If 90% of the cars going down the Santa Monica Freeway are powered by electricity, does it make sense if each one of them plugs in at home every night or do we look at embedding infrastructure recharging those cars as they're on the freeway? And what role

does your company have in developing that technology and nurturing it?

A: So, the first part that I really think about is how do we make the most out of the resources that are out there and thinking of those vehicles now as resources, and so if they all plug in at night and that's the way that customer behavior is going to be, then we need to figure out can we manage that charging? We don't necessarily need them all charging at the same time if they're all plugged in, we can move them around at different times of the night to use battery storage and other technologies to absorb it when there's too much energy and then frankly, leverage those cars when they happen to be plugged in during the peak when the sun is coming down that people are using more energy at home so we've got to be able to have managed charging and frankly, what we call bidirectional charging, being able to pull electrons out of the vehicles at times. We've got to set the right tariffs and programs so that it makes sense for customers to shape their behavior but that's a huge technology change and to facilitate and orchestrate all those vehicles on the system. Now you mentioned, maybe there will be technologies that will have, instead of wired charging, but you can have people charging while they're driving down the road. Those are the ones where we, as an individual company,

aren't going to do the R&D on that but that's where we go to groups like EPRI and the National Labs to see are there and frankly internationally, to see if there are technologies down the road that can be adopted. I think we have to think very differently about partnerships, right? We're used to working more with our industry but partnerships with the automakers will be critical as we think about the best ways to leverage those vehicles because we both tried the technology, we both tried customer adoption and customer behaviors as well and so partnering differently with industries that we didn't have to work with before as closely is going to be critical.

A: I would imagine the oil companies would be looking for some of these partnerships if they're going to lose the lion's share of the fossil fuel sales to cars. Wouldn't they want to put their considerable resources and talents into developing that kind of infrastructure for charging cars on the fly?

A: That may well be the direction they decide to go and I'm thinking that a lot of the oil majors are getting into things like electric vehicle charging businesses so that they can understand and see if there's opportunities and so, our goal is really to figure out how do we get the most out of the EVs and the technology that will be there in a way that supports the grid and makes it reliable and affordable so, I think that the

partnership, I'll call it ecosystem, the types of companies that we'll need to partner with will evolve quite a bit.

Q: So, I'm not as clear right now sitting here talking to you about the relative size of the electric utility business and the oil business but as you know, there are multiple oil companies, not a lot of them and that most major investor-owned utilities enjoy monopolies. Do you see that kind of landscape changing and having maybe multiple energy companies; some combinations of the bill being energy and not electricity or any one single factor but multiple energy sources? Do you see that regulatory landscape changing and do we need to have investor-owned utility monopolies in our urban centers?

A: So, I think to drive the transition of infrastructure and technology on just on the electric system alone you need a strong, healthy utility to help drive that to bring the capital in to make the investments in the infrastructure that will advance the energy transition and I imagine it will continue to be regulated. That regulation may shift over time in terms of what they focus on and how they focus. You do have many electric utilities that also have the natural gas component in their business. We're electric only but many of others have both and that allows them to make some of the tradeoffs and balance that transition, looking to see what where they can begin to shut

down or decommission parts of their gas system and replace it with electrification in those areas so those are the sorts of things that we may need to partner with our gas counterparts on. How the major oil companies that have a very different footprint engage in this is still to be seen so I think there's opportunities for innovation on the regulatory side. Right now, our focus is really on; we've got 20 years essentially to rebuild and double down the size of our electric infrastructure because we know that that is the core thing that's going to be needed with decarbonization and the customer needs and so, that's really our focus is making sure the policies are aligned with the execution that we need to help to load on as well as help get customers the technology that they need.

Q: This is really a tremendous outline I think of the nature of times we face and the challenges you're facing and you're marshaling the resources to address it. Is there any one point you'd like to leave us on what people don't appreciate about what's coming that they need to pay more attention to?

A: I think people are beginning; people, the media, the broadly society is beginning to understand the scale of infrastructure that needs to happen. I think that they are; there's concerns about the affordability of it. I think our analysis has shown that yes, a lot of infrastructure is going to

be needed. It's going to be renewable resources and storage. It's going to be updates to our transmission system, it's a lot more distribution. The work can be done but we have to go now. We can't be still planning and still sorting it out. We have to begin to accelerate the infrastructure deployment so that we're ready for customer needs and customer demands and that's the part that we just have to begin to start moving faster, changing policies that are in the way and really putting the dollars and the focus on how do we scale now and build quickly. That's really the primary part that I think people are still coming to grips with like we're running out of time if our goals are net-neutral by 2045.

Q: Thank you Steve.

A: Thank you very much, Marty. Appreciate it.

We've been talking to Steve Powell who's the President and CEO of Southern California Edison.

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