Chris Root

COO of Vermont Electric Power Company

Interview with **Chris Root**

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vermont electric power company
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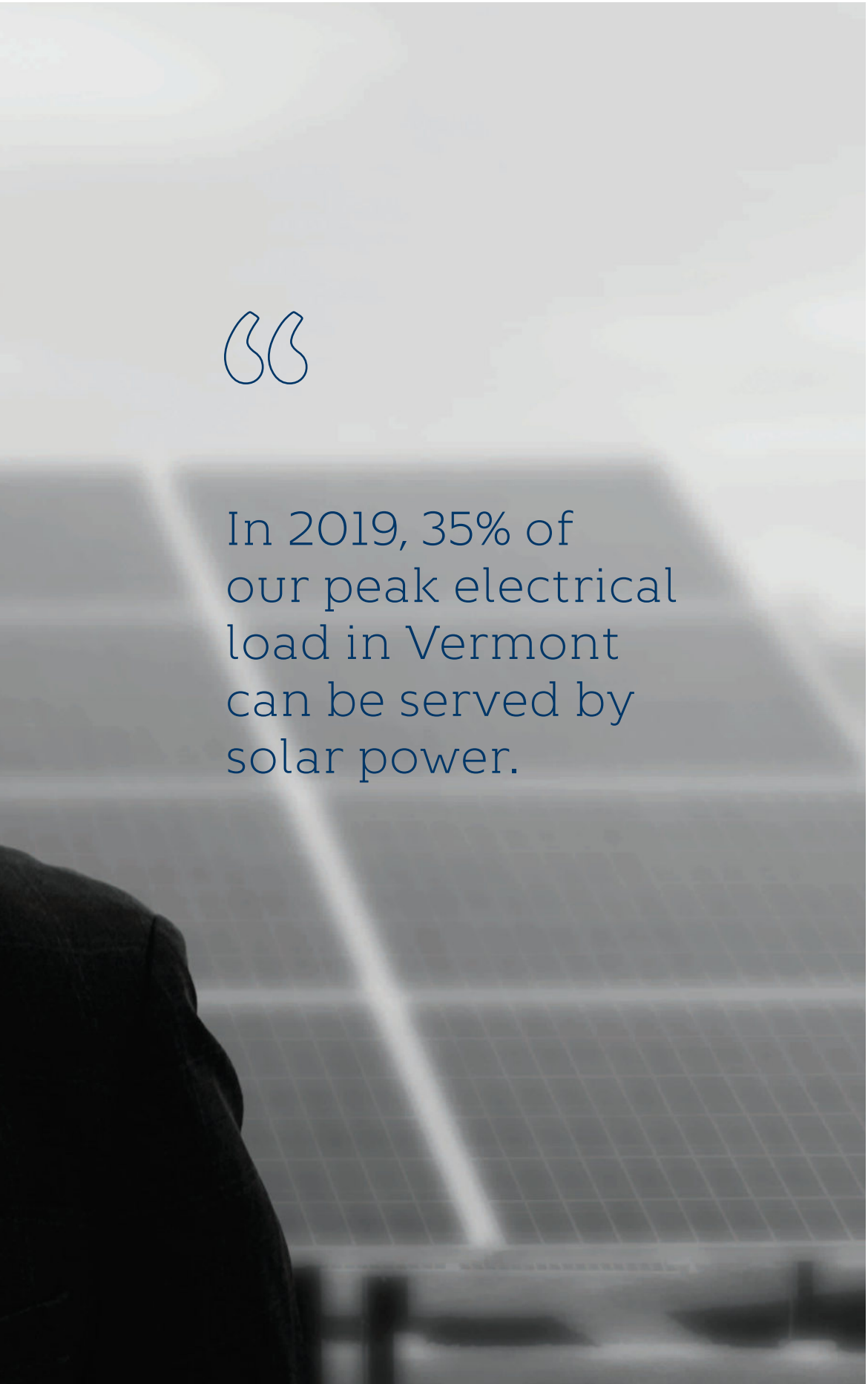

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Alan Ross, our Editor in Chief recently spoke with Chris Root, COO of Vermont Electric Power Company, on the changes that Distributed Energy Resources and battery technology is having on the New England grid, or at least the part that Vermont Electric provides. What happens when you depend on wind and solar, but the wind doesn't blow and the sun doesn't shine? Find out what Chris Root does.

Transformer Technology: Can you tell us more about Vermont Electric Power Company and some of the things that you see regarding changes in technology and what you do from the grid standpoint? And by technology, I mean solar and wind and the Distributed Energy Resources (DER) you have going on.

Chris Root: In Vermont we are very environmentally conscious and have aggressive state goals about climate change and controlling carbon. In 2019, we have 35% of our peak electrical load in the state which can be served by solar today, which is a very high number.

TT Do you use much wind power?

CR Yes, about 18% of our power is wind. We have five different wind farms, much smaller from the type of wind farms you would find in California. They are smaller in nature, but they are effective. It's interesting that they are very seasonal - In the summertime, we don't have a lot of wind. Our windy time is in the fall, winter and in the spring. When we don't have a lot of wind, it is really the perfect time for our solar which is in the summertime.

TT Our grid was built on a step-down system, from generation to distribution, but Distributed Energy Resources is changing that to a step-everywhere system. How is that affecting your grid?

CR The vast majority of our solar is connected at the distribution level. There is only one solar plant that is actually connected to transmission; everything else is at a lower voltage. There are a couple of things associated with that. The impact on the distribution system is when the sun is shining, obviously, which changes the voltage profile on the circuit, so the distribution companies have been trying to make sure that they get their voltage regulation correct. The other thing is that we have several substations between distribution and transmission which means that the power flows from the distribution system into the transmission system daily when the sun is out. That is a classic step-up caused by DER as you mentioned.

When these stations were put in, nobody originally envisioned them to need to handle that change, so we have had to change some technologies to make sure that the system works when the power is going either way, supplying into the transmission system to be sent to another location. Additionally, one of the interesting things is that we are different from the Southwest which does not have a lot of clouds. We do get clouds and we have partly cloudy days quite often. One of the interesting things we have noticed is that when a cloud comes over, a large solar plant of 20 megawatts, which is a plant that would use about 100 acres, a big geographical space - does not go to zero, but it goes to maybe 10.

Then when the cloud passes, it jumps right back up to 20. So, what you have is a generation pattern that is completely weather dependent, but you can't just let that be the case. You have to handle those unique changes. It's intermittent generation on days when it's cloudy, which raises challenges to make up that power. How do you do that? You have to do that with another type of generation.

TT As a result of that balancing act, have you had to rethink your transformer fleet in terms of what you purchase, when you purchase it, etc.? Has that changed anything?

CR It hasn't yet, but at some point in time, I could see a couple of things: Your transformer ratings are very much dependent on the load cycle, or how much current for how much time. So, now that these flows are radically different, you have to run your ratings again to make sure that there is enough cooling time for these transformers.

It hasn't been a problem so far, but it's a different way of thinking. One thing we have had to do is modify the times when we need to trip off the solar because of an operating condition. We've had to put in place a lot of protection schemes that go between the transmission and substation and reach into

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The generation patterns of wind and solar are completely weather dependent. This intermittent generation requires balancing between the two types of generation to make up the power.

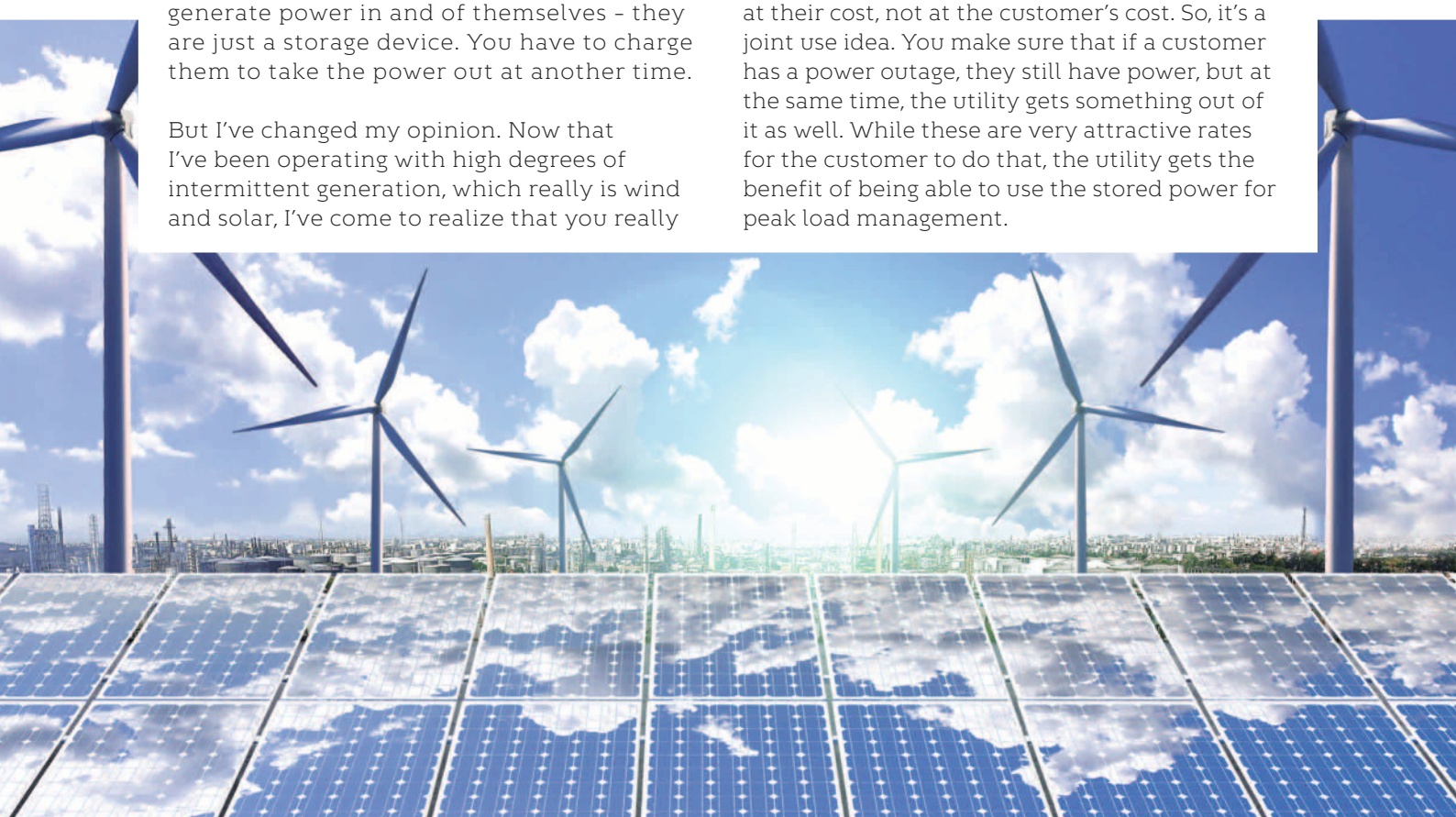
the distribution system. We need to shut off plants if there is a problem to avoid creating a safety issue of islanding.

TT I want to ask you about battery technology. If you are dealing with a lot of intermittent generation, you need to have good battery technology. Where are we and where are we going with that?

CR I've come a long way in my thinking of batteries. A couple years ago I would say "Boy, it's pretty expensive technology, how can we justify it?" We have to remind ourselves that batteries don't generate power in and of themselves - they are just a storage device. You have to charge them to take the power out at another time.

But I've changed my opinion. Now that I've been operating with high degrees of intermittent generation, which really is wind and solar, I've come to realize that you really need to fill those valleys in. But how? I think storage is your best solution to be able to do that. It operates very quickly so you can use it exactly when needed. Therefore, in Vermont we have two utility scale storage devices that are owned by customers and they use that for peak load management.

He also have 2,000 Tesla® power walls installed in customers' houses and those are rented from the utility to use as an interruptible power supply, but also if there is an electrical outage at the house. At the same time, the utility can control these power walls for peak load management, or for other purposes, and then it fills them back up at their cost, not at the customer's cost. So, it's a joint use idea. You make sure that if a customer has a power outage, they still have power, but at the same time, the utility gets something out of it as well. While these are very attractive rates for the customer to do that, the utility gets the benefit of being able to use the stored power for peak load management.



TT How did you choose the locations for all these power walls?

CR Some are sold with solar, but the vast majority of them are being sold to people who may have a second home and worry about it - what if the lights go out, will the heating system be off, will their well work, can they get water? Those are the types of reasons for purchasing a power wall. Vermont is a rural state. People are pretty excited about being able to use technology and it's been well received.

TT Wow, that's excellent. I know Elon Musk thinks he's going to change the world with his Tesla power walls, but to a certain extent, he is already changing Vermont. We're all waiting for that next great leap in

CR I think right now everyone is in love with lithium-ion batteries, just because they're available. But that doesn't necessarily mean that they are the best technology for use on the power system. It has a charged and discharged fixed number of cycles and there are all kinds of other issues. I think a lot of the utility people are waiting for the "flow battery" breakthrough. Flow batteries use two types of liquids that make reactions, so the energy can be stored chemically in these liquids and then run back into generating power.

The good thing about it is that it's completely expandable, so you can use bigger tanks and more membranes to generate the electricity which is creating and storing power.

When operating with high degrees of intermittent generation, battery storage can be your best solution.

That is very attractive to utilities. And also, the fact that there isn't a fixed number of stops to starts before you have to change them out is extremely attractive to utilities as this ensures longer time frames. Lithium-ion batteries go for around three or four hours, but with flow batteries, the potential is to go for eight to nine hours, which would have big benefits for the utility.

It looks more and more like pumped storage - like a hydropower storage plant that we've been using since the 1960s.

TT Is it the cost that's keeping us from getting there, because I don't think it is technology anymore?

CR There are still several demonstrations going on with flow batteries to get the exact chemistry right. One of the utilities' feedback was to make sure the fluid is not hazardous to the environment. Ideally, we should come up with a couple of chemicals to use that are biodegradable and are not going to create all kinds of problems. If we can do that and try to get some membranes exactly right so that they have a long-lasting lifetime, I think it's more tweaking right now, but I do think we are on the brink of those going commercial in a big way.

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TT Chris, thank you for joining us for this interview.