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A DEEP DIVE INTO THE GRID

Bhaskar Ray, VP of Interconnection & Development Engineering at Qcells USA and Silas Mähner of Clean Techies Podcast discuss the major challenges facing the grid currently and some of the potential solutions going forward.

Intro: Hey everyone. And welcome back to another episode of Clean Techies podcast. This is episode 43, and I am really, really excited to bring this episode to you. This is a conversation with Bhaskar Ray, the VP of Interconnection and development engineering, Qcells USA.

And today we are discussing kind of everything and anything about the power grid. So, Bhaskar just a quick introduction to him. He has over 30 years of experience in the power delivery space. He started his career working in utilities. He worked for Xcel Energy, Pacific gas and electric, Southern California Edison, and then eventually moved into renewables, working with the infamous SunEdison. Eventually then moved into consulting and then back to renewables IPP where he is now at Hanwha Qcells. And of course, Hanwha Qcells, just shout out to them.

They're developing and owning renewables projects, renewable generation projects across North America. And so, Bhaskar is highly involved in the thought leadership and just kind of helping solve grid issues with various different ISOs. I know he is highly involved with FERC and NERC in general. So really, really knowledgeable person on how the grid works. Has seen kind of the transition from conventional generation to renewables with the intermittency issues.

So, we had a really good conversation. We kind of start with a history of the grid and how it played out. Some of the big regulation changes and then shifted into what we have now, and then talked about some of the possible solutions for solving the future. So, I'm really, really excited to be able to bring this to you, because I know Bhaskar, I've known him for a while and I just think this is a really, really informative conversation, especially for a lot of people who are not familiar with the space.

This is something I've become a bit familiar with because I've recruited a lot in it. But I think a lot of people could really stand to benefit understanding kind of the basics of how the grid works and some of the issues we face, because there is a lot of innovation that needs to happen in the future here. So really excited for this conversation. Before we do get into the show as always, I want to make a special, thanks to our sponsors Next Wave Partners for sponsoring this podcast.

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Silas Mähner: Welcome to the show Bhaskar, how are you doing?

Bhaskar Ray: Thank you. I'm doing very well Silas, always a pleasure talking to you.

Silas Mähner: Yeah, absolutely. It always is a pleasure. I very much enjoy working with you and everything you guys are doing at Q Cell. So, I guess let's start out, for everybody who does not know you, could you maybe just give us kind of a quick introduction to yourself and what you're doing now?

Bhaskar Ray: Sure, absolutely. I'm happy to do so. And first of all, thank you very much for the opportunity to talk with you and your audience. So, appreciate the opportunity and I am Bhaskar Ray vice president of Interconnection and Development engineering here at Hanwha Qcells USA. I came over to Qcells a little over a year ago from another renewable energy company named BayWa. I have been in this space now for about 31 years. So, it's been a while since I've been in the power industry.

I have a master's in electrical engineering, and I started my career in the very early nineties in Xcel, energy in Minneapolis. And I spent the entire decade there working as a transmission planning engineer. And then after I got tired of this, I came to California back in 2000 to start a new millennium and joined Pacific gas and electric company up in San Francisco and did more transmission planning as a senior consulting engineer. I did lots of transmission upgrades in the greater Bay area.

And then in Southern California SunEdison expressed an interest to bring in a subject matter expert in the transmission space. So, I came down to Los Angeles and joined Edison in their power procurement department. And so, I was in Edison's power procurement department for a few years, helping on evaluating transmission issues for energy procurement projects. And then I went to the transmission side of the house in SCE back in 2009 and started doing interconnection work for renewables on a full-time basis.

That's really when I think I got drawn into the renewable space and I saw the tremendous opportunity when President Obama launched the American reinvestment and recovery act. I did a great deal of work with the California governor Arnold Schwarzenegger's energy advisors. And then I came into the renewable space back in 2011 to work for a large German company named Solar Millennium, where we had perhaps the largest solar project in California called blight solar project.

And that's really when I came to the renewable development space, unfortunately that company didn't survive. Their business strategy didn't help them to be successful. So, they fell apart. And then I went to another company called Su Edison, who everybody knows. And I was there as their head of interconnection for over three years. I did a great deal of work in California, as well as in other spaces, SunEdison had a large portfolio of solar projects. And so, after SunEdison sort of fell apart as well, I went to the consulting space in Burns and McDonnell and helped with renewable work as well with many developers and such.

And then last two years, I've been with renewable companies and in Hanwha Qcells, my work has been twofold. The first is to build a strong pipeline of projects. When I came over just about a year ago, we didn't really have a pipeline. So, we went from, a zero-megawatt pipeline to over 13 plus gigawatt pipeline in less than 9 months. And then I also started building a team so that we can handle this 30 gigawatt to the expertise, thanks to you and your team for supporting me with bringing in talent. And talent acquisition became also a primary focus.

So, in this space I've been very actively pursuing solar plus storage projects, as well as standalone storage projects in a variety of markets. I'll just mention some of the big markets that we've entered and successfully been maturing projects. They include New York Eyes. So, they include Archi. They include Pacific Corp, they include Colorado. They include ISO New England. They include some of the Circle regions. And obviously, you know we're now exploring additional regions like Kala ISO, Midwest ISO Pacific northwest and some other regions as well, individually, which are not ISO jurisdiction.

And PJM obviously is very much in the list for ours, to enter for Greenfield. And then on a parallel track, the company has also been looking at buying portfolios, Hanwha Qcells is $188 billion company. The growth is potentially significant. We've been building our team all across. So that's been kind of the focus in terms of what we're trying to accomplish. So, this year the goal has been to focus on maturing this,13 plus gigawatts and on a simultaneous parallel track also find out how the strategy should be to further bolster the pipeline

Silas Mähner: Yeah, it’s obviously an exciting time. I think with the investment they're able to do quite a lot with Hanwha. I became, maybe because you've kind of worked in, I mean I'm not sure if this is completely unique, but it seems quite unique to me that you've worked in all of the major areas of consulting in the developers and in the utilities. Maybe the one exception having not worked at an ISO, could you maybe explain a bit about the history of regulated and deregulated markets? I'd be keen to understand kind of the evolution of how it has all come to be.

Bhaskar Ray: Sure. Well, in the nineties, when I worked in Xcel Energy, it used to be called North States power company, it was not Xcel Energy. It was a very highly regulated market, vertically integrated industry where utility coverage generation, transmission distribution, and it's essentially determined what they need to build to serve their customer load. They had it all. But then in the nineties along came FERC with their 888 and 889 rules where they deregulated, where energy marketing was separated from transmission.

And that's how things got started when California ISO was formed, essentially deciding, made rules that no longer I utilities will have monopoly on serving their customer load. A generation market should be divested as a result of that, a lot of utilities like PG&E and Edison sold their power plants to third parties. And hence the entire North American energy trading became a different animal altogether in terms of establishing energy markets.

And the utilities were told to avoid monopoly sale. Majority of their generation assets so that other parties can play ball. But along with that came the whole challenge of how to incorporate other generation into the market and reliably serve the customers because in the past utilities were fully responsible. They had monopoly market, they build generation closer to load and serve them. Now you have no control on where generation is being located and hence you have to bring that generation closer to the load. So that's really when the whole concept of figuring out how to avoid grid congestion started because resources could be located geographically remote, and you need to have proper transmission to serve the load.

And that is what we're dealing with 25 years later, catching up in understanding how transmission should be built. I'll give you a simplified example. Let's take an example of Los Angeles. Los Angeles has a huge amount of load for serving LA Base and over 18,000 megawatts, let's say, but most of the generation is not based in the Ele Metro area because it is impossible to have the large power plants built in the Ele Metro. They are served from remote regions like Northern LA Base or Eastern cluster in the desert, for example in the I 10 corridors in the Palm Springs and farther Eastern all the way into the California areas and border.

So, then the question becomes, how do you bring generation to serve these 18,000 megawatts of load? And then as generations started to slowly retire because they're aging assets, they need to go for retirements, environmental issues and assets along came renewables to replace and intermittent resources. It's not very easy to replace existing traditional resources like coal units, hydro units or gas units with renewable because there are grid issues, which are highly complex, where grid stability, grid reliability has to be maintained.

You can't say that I would replace 1000 megawatts of coal plant or gas plant with 1000 megawatts of renewables. It's not a one-to-one ratio. Megawatt wise the calculation means show you so, but it is not an apples-to-apples replacement. So that's really what the complications came in on how to do this. So that really is the biggest challenge in my mind for utilities and ISOs to figure out how can you accomplish adding renewables in the grid, but don't degrade the reliability.

Silas Mähner: So just to clarify, you can't replace it apples to apple because of the intermittency?

Bhaskar Ray: That is correct. The intermittency of the resources requires you to have supplemental facilities in conjunction with it. Let's take a simple example. Due to unforeseen circumstances Edison was forced to shut down their nuclear power plant between LA and San Diego and San Onofre, which is basically between Orange County and San Diego region. When all that nuclear power plant was shut down, Edison scrambled to figure out how to maintain [16:08 inaudible] reliability. It wasn't that easy to say, oh, I lost 2,000, 3,000 megawatts of generation in songs, which is the acronym of San Onofre nuclear plant.

And I will just replace that with 3000 megawatts of solar resources in I10 corridor. It required much more than that, they had to bring back a lot of retire at old units in the coastal area for voltage board on the grid because they had to operate those units as synchronous power plants to provide [16:43 inaudible] support on the grid. Because even though the active power may be replaced from somewhere else, intermittent resources sometimes do not produce sufficient reactive powers. So reactive power became a big issue.

And that's where the biggest challenge lies, is to come up with reactive power that in the past were coming from real generators or real inertia-based machines. So that is to me, one of the biggest issues that I source are currently facing.

Silas Mähner: I want to back up a little bit. Do you have insight as to why did the regulation happen? Why did the FERC regulation happen, that kind of split this thing up and just broke up the monopoly? And is that the case in every market or are there some markets that still maintain the old model?

Bhaskar Ray: Excellent question. I think majority of the markets have now been deregulated where you rarely see situation that utilities have full monopoly, under the current deregulated market, especially for regions that are RTOs. We have so many big reliability regions, like PJM, New York Eye. So, Archi, California ISO, and also New England. All these regions, it is a fully deregulated market. The main idea was FERC felt that after feedback from several players that utilities are fully controlling the market on the generation side and not allowing other IPPs to enter the market and build potentially generation.

And there is no competition. You may remember that the cell phone industry deregulated. Communication was completed deregulated. We can go and buy cell phone from multiple companies in this particular case, electricity being a commodity end-use customers had no choices. You are forced to buy electricity wholesale, retail from utilities only. Prices are still very high. So, the idea was the energy markets will become cheaper if consumers have a potential to buy energy from developer X, Y, Z, who's all playing ball in the market as opposed to only utilities. So that was the main reason. The main reason of deregulation was to bring cost down for electricity.

Silas Mähner: So, when that's done, so I feel like there's maybe a flip side to the coin. When that's done, obviously you can reduce the energy price overall, but perhaps what we're seeing now with the complicated issues with building generation, and we can talk about this a little bit in a second. The time it takes to interconnect, aren't the prices going back up because of how costly it is to build or is it still significantly lower? Because I don't have anything. I've never purchased electricity before this market.

Bhaskar Ray: I think the prices are still better because of the economy, because you now have an energy market where people can bid in, with all sorts of energy cost. And it's showing that if we had not deregulated energy cost would have been very high, and monopoly always kills competition. There is no competition in the electric wholesale market. So yes, in certain regions cost could be going high, but there are potential solutions for such, if you didn't open the market, I don't think that utilities would have been driven or motivated in terms of clean energy.

They would've continued not to bring in clean energy because there were no incentives for it. And the RPS mandates only helped accomplish it. In certain regions, yes, it is true transmission has to be built, but I don't think that, had we not put utilities on the spot and taken away some of those resources, it would have been possible to avoid that because eventually utilities have also run out of ideas on how to build generation. Generation eventually had to be built far away from load.

Because there's only so much generation you can build closer to LA Base in North San Francisco. San Francisco is a classic example. There's no generation right now in the city of San Francisco. The city of San Francisco has 1000 megawatts of load, which hangs on relatively weak transmission. And there is a high voltage DC transmission line under the Seabed that brings in power from the other side of the bay to serve the customer load. So, generation had to go away. Utilities would not have been able to build a new generation in the city of San Francisco because of strict environmental standards. So, power prices in San Francisco would not have come down if there is not enough deregulation.

Silas Mähner: Okay. Got it. That makes sense. I think it's obviously just understanding the tradeoffs and there's a bit more complication when it happens, but obviously the benefits seem to be positive. Could you perhaps talk about what is the? Well, obviously we'll focus on utility scale interconnection here. What does the process look like currently and maybe how has that changed just over the past five or six years? I don't know if you want to give a specific ISO example or maybe across the board, kind of what does the process look like cost and time wise, roughly speaking and how does that look like for a developer like Qcells?

Bhaskar Ray: I think one of the big things that happened is for 1000 rule. For 1000 rule took away utilities ROFR. ROFR stands for right a first refusal. So, utilities were put farther on the spot and their right of refusal was taken away saying there will be a competitive solicitation process now on transmission. So, if an ISO, for example. Let's just take California ISO as an example. If California ISO determined that it is economic to build a new transmission, for obvious reasons that we talked about. You are not really telling the utilities that they're the only player who can build their transmission because a third party can come in and build it cheaper, faster, and help the renewables access that transmission and serve the load.

In other words, if California determines that there is, let's say a new transmission that has to be built between ISO and Arizona to bring in generation. And let's say that path could become a bidirectional path where renewables can leave California exist, renewable can leave California and go to Arizona and as such, as opposed to curtailing so be it. And let's say a third party's building a transmission between California region into Arizona, to connect the nuclear power plant at Arizona SRP system.

So that process farther opened up in terms of the renewable developers to utilize their opportunity and say that third party merchant transmission is going to be able to allow bringing in remotely located resources. A classic example would be if we were to build, let's say a transmission line, set aside, permitting challenges for a second, from Wyoming to Arizona California. All that cheap wind resources in Wyoming can have a huge market access to California. And if there is not enough need for all these solar resources in California, vice versa, it can flow out of the state and serve load in the so-called WCC region.

So, I believe in the last five, six years after FERC 1000 ruling came out. FERC opened up the path further for renewables, saying one of the big impediments right now is cross country transmission. Cross country transmission must be built. So, the resources are not stranded resources in the state and being curtailed. You're building billions of dollars of infrastructure with solar wind resources. And they're getting curtailed because there's not enough transmission, that's an oxymoron. What if we build these transmissions? So, I think the biggest hurdle right now is to overcome permitting challenges and build more transmission so that these renewables can travel long and serve [25:29 inaudible] load.

Silas Mähner: I wanted to talk about that a bit. So, I think this has been. I've noticed this coming up a few times in other people's podcasts that I listened to talking about kind of this permitting process and oftentimes this environmental regulation, that really has good intention, ideally at the beginning to preserve certain wetlands or whatever it might be for endangered species, et cetera. Obviously, I think people would typically have put renewables folks and environmentally friendly folks in the same camp.

But it's almost like there's kind of a competition now because it's really hindering, especially we see the issues with Ukraine and energy dependent. It's really, really hindering the process to build the transmission load. I think that large cross country, that large transmission line that inventors are working on. I think it's called the wheat belt or something. That's taking obviously well over a decade.

So, could you maybe talk about your perspective on how could we hypothetically get more transmission built quickly? The same way that back in the day we built the highway system, we just did it because it was a matter of national security and all these other areas. How can this be done again? Because as America, we don't really build things, at least not very quickly anymore.

Bhaskar Ray: Correct. And a very good example of that would be California. It takes forever, sometimes 84 months to be precise or more, that 7 years plus to build simple transmission because the rules and the standards for environmental agencies are so stringent that it becomes a highly bureaucratic process. And folks that are permitting new transmission doesn't have a clear understanding on why it's important to permit them.

They have some valid reasons and legitimate concerns, but I think that FERC has to step in and say, look, you can't take that long to permit a project. There is this process called CPCN certificate of public convenience and necessity. Sometimes CPCN process could become a major problem. I'll give you an example. When I was in PG&E I tried to build a 33 mile long from Palo Alto into San Francisco to serve the customer load because we were shutting down generation in the city.

It took us over 6 years just to permit a 30-mile-long transmission line. And a major challenge hit us when they basically said, I'm not going to allow you to build this transmission line overhead. You're going to have to put this underground because you're going through some sensitive areas. We ended up skyrocketing the project cost, a simple transmission line that would've cost us $100 million, ended up costing $233 million. A lot of that transmission had to be put underground because these communities between Palo Alto and the city of San Francisco came in and said, well, this line is going through my territory.

What do I get out of it? It sounds like the city of San Francisco benefits out of it. But in that process, you are causing environmental concerns to me. I have all sort of bay water and it's going to impact my habitat, blah, blah, blah. There is all sorts of stuff, environmental issues, fish and wildlife could be affected. I don't want this power line to go through my community. So, they look at this power line permitting process through a different lens than you would to serve the load.

So, I think to overcome that issue, the biggest thing you have to do is FERC needs to step in and say, thou shall build this line and you have two years to build this. It is a mandate. So, with the right political support from the right agencies, these transmissions could get built a lot faster, especially if you put premium on it. And if the agencies are ordered to do so, but right now, there is no process to tell these agencies that you shouldn't take and drag your feet for 84 months to allow build.

Silas Mähner: I mean, it's super difficult. I mean, think about, especially, I think after COVID now we have this, especially from California, the mass [29:57 inaudible] of people going to Texas for example. I'm not totally sure how this will continue to shape in the future, but you can't 8 years later rely on the same exact load going to be there. By that time, you don't know if there's going to be a transmission. So, it needs to be much more flexible and quicker, right?

Bhaskar Ray: That's right. That's exactly right. And Orcan is facing the same situation as you said. All of a sudden you see all these problems in Orcan. And the next thing you know, is there is a blackout in the wintertime. What caused that blackout because Orcan transmission didn't get built in a timely manner. There was deregulation in Orcan market, enough resources were not put in, in what we call operating reserves, planning reserves. And these generation was not brought in, in a timely manner.

And basically, at the end of the day, the load had to be straight up dumped, which happens in third world countries. Third world countries, you have this thing called load shedding. When demand exceeds supply, you just shut it off. The switch is flipped because there's not enough research. And that's really what happens. So that is the risk you run into is if you don't have enough grid outlet, resources are stranded. They're shut off they're curtailed, and the customer cannot be served.

Silas Mähner: Yeah. I think about this from the perspective of, if we want true reliability on the grid everywhere, and we just don't want to have to worry about it, regardless of what happens with the demographics within the United States is obviously a massive country, to handle this. Wouldn't it be best hypothetically for the population, not necessarily the developers to just have massive amounts of transmission going over the place, in addition to having more assets than you need?

And then maybe putting Bitcoin mining, computers or something. Something to take the load when you need it. But essentially having way more than you need. That way you can turn the switches on and shift it around.

Bhaskar Ray: That's right. You have to be careful in both ways that you don't want to have stranded transmission assets where you've now over built transmission and transmission is very poorly loaded, meaning the load ability of those transmission lines. The line is basically floating in the grid because you've just built too much. But right now, the biggest problem in PJM for example, is lack of new transmission. PJM is shutting down their queue for two years because they are inundated with renewables in the grid. And they don't know what to.

Since October of 2020, I've been participating in their interconnection process improvements, stakeholder process to figure out how to get BGMs transmission process cleaned up for making the interconnection process not become a bottleneck for renewables getting acts to the grid and starting October of those year PJM is going to shut down the applications acceptance for new renewables and figure out in two years how to clean that grid up.

So, it cuts you both ways where one end, you have to figure out how to strategically build transmission, but at the same time strike a healthy medium to say, okay let's just not blindly build transmission all over the place. Let's try to figure out how to maximize what we've got right now, utilization of the existing assets for example, for a recent rule, the dynamic line ratings, for example, is a very important thing where you need to bring out juice from the existing grid by another 15, 20%, if you can do this.

So that is another way to determine that majority of the grid problems are caused by transmission lines that are loaded, let's say 10, 15% on top of their ability to carry power. If you can extract another 10 or 15%, a lot of the problems go away. So how can you do that? There are ways to maximize that. So, I would say, you know, the focus is now shifting to figure out what we've got today. Can we work with that and essentially extract another 10, 15% of juice from the grid?

Silas Mähner: Would you say, I guess from what you're saying, to me, it seems like there's essentially a coordination issue.

Bhaskar Ray: Correct.

Silas Mähner: Tied with, it takes too long to do things. So would you say that those are the two kinds of main things, if you could have some type of body that was able to coordinate, which again, obviously it's pretty much impossible to do there's too many things. I don't even think a computer could run all those calculations. But if somebody hypothetically could manage the entire thing and coordinate maybe with other bodies, including like demographics shifting and people moving, et cetera, and being able to build things quickly, would those be the two major fixes that could hypothetically solve this on a mass scale?

Bhaskar Ray: It would, because right now your biggest challenge is, let's say you want to build a big transmission line to remove renewables in both directions from Wyoming to California. And that line goes through three other states. Those three other states in the intermediate path essentially becomes a choker and a bottleneck by saying, I don't want to pass permitting for this line, because I don't benefit out of it.

What is your benefit on this? Years ago, when Southern California tried to build a power line from Palm Springs area into Arizona, Phoenix region, Arizona commission looked at it and said, it sounds to me all the benefits are primarily going to California, so I don't want to participate. And they reject it [35:54 inaudible] to Palo Verde line. Construction with a permitting saying, no, I don't want you to build it because Edison, all the benefits go to you.

You get access to reselling renewables into other markets. And you also now have access to cheaper resources from a nuclear plant that resides in Arizona. There's nothing informing. So had you had a federal entity overseeing the whole process and said, no, this really needs to be done. Let's say [36:22 inaudible] stepped in and mediated that line would've been built 15 years ago. So, answering your original question, you need FERC to take a more prominent role and help this so-called interstate transmission lines get built by saying we're working on a common goal. You shouldn't restrict and have this vision where you say, oh, the line is just going through from point A to point B.

I am not a recipient of any of these line benefits. So hence I should be refusing to permit this line through my state. And the project is dead. I'll kill this project. So, had you had a federal entity looking over that, you would probably be able to build more transmission?

Silas Mähner: Yeah, I feel like that gets a little bit sticky because then, essentially, they have to favor somebody, right? At some point somebody's going to get a benefit. Somebody's going to get the short end but the difficult obviously as a country.

Bhaskar Ray: It's a type of war now between federal government and state government. You get into that highly political situation where the state is now wrestling with federal.

Silas Mähner: And then every company is going to recruit tons of lobbyists essentially, to try to get their things. It's a tough one. This is a very tough topic. I guess obviously though, it comes down to, the need, maybe this is another, like, this maybe obviously for a different podcast, but this idea of America being entirely one country.

It's basically too large to manage at least efficiently. Maybe this could go to the question. Do you think, I mean, it's difficult, especially with the United States, for example, where there are massive resources located in certain areas that other areas don't have. Wisconsin does not have a lot of sun. Out west has a lot of wind etcetera, but they don't have as much load there. So, do you think in this case that the obvious answer is to find ways to try to work together? Or is it better to have, the smaller the grid, the better. The more micro type of grid, obviously not quite a microgrid, but smaller grids that are just reliant on themselves. And they have less to worry about?

Bhaskar Ray: The answer is yes to all of it. And microgrids are enhanced becoming so popular. Radiancy is an issue. However, the biggest problem right now you have is lack of energy storage. Batteries are needed because you have this in famous duck curve for example. Colorado is a classic example. I was in a conference recently where the Colorado regulators utilities like Xcel talked about the fact that they have all these winds and solar. And because of the diversity of the nature, they have this thing called sand dune problem where wind resources are coming in, when wind is blowing in the night time and solar resources obvious they're coming in their daytime and they don't have enough energy resource to solve or absorb these resources and store them and dispatch them at a time when you need the most. So, they're forced to curtail it.

So, I would say it is a very case by case basis where you do that evaluation of this markets saying, okay, I have wind, I have solar, but I don't have enough batteries because the prices have been at a point where large-scale batteries were not built to integrate these resources successfully to the grid. As a result, I am curtailing generation that I could have saved and essentially smooth out the so-called duct curve.

And so, I would say energy storage has a huge role to play in this market where you're just not storing enough resources. And like you said, you are always going to have higher amounts of solar resources in markets like Texas, California, Arizona, where the weather is different than going into New England market, Wisconsin market, Minnesota market. The radiance is different. So I think you have to get really coordinated in those states and figure out how can I solve this problem by putting more energy storage so that when I'm generating that resource is being stored somehow for serving load when people are going home at 6:00 PM in the evening and flipping their lights, their conditioner, that solar resource that I capture during the day is not being wasted.

Silas Mähner: Yeah. I mean, I think this could go to a broader discussion too. I mean, there's obviously, I've heard a lot of people in here talking about energy storage and I think there's one company that specifically comes to mind. I think it's called Hydro store, if I'm not mistaken. That has more of a mechanical type of energy storage, where they just lift up a weight essentially, and then charge it. That's a very inexpensive way to build energy storage in those situations where you don't require massive amounts of minerals, et cetera for these batteries, which is oftentimes a complaint.

We're depleting resources. That's another topic, but what about the future of electric? I would assume, I'm making a big assumption here. Out west there's a lot more agriculture, and what if this machinery ran off of electricity instead of fuel? Could that help somewhat, maybe not a whole lot, then it helps somewhat flatten the demand or flatten the peaks?

Bhaskar Ray: The answer is absolutely. And that's being looked at as we speak to figure out how can the ag lands benefit from using electricity and as such so that you have a more coordinated effort in terms of the electrical resources, serving those ag land requirements. And that their reliance on other resources is diminished. So again, it becomes a coordination issue, who is responsible to do that coordination?

Silas Mähner: I also feel what about the possibility? I don't know, maybe this is being done. I've heard a bit about this in Texas, but what about having flexible demand, basically I'm just thinking of like Bitcoin mining specifically where you can maybe just haul a trailer around to an area that really needs to suck up some demand, while there's a transmission line being finished or whatnot, is this something that's being done or are there other things being done similar to that?

Bhaskar Ray: Bitcoin mining is being looked at very seriously in several regions and as such to figure out how variable load resources could suck up the generation. So, there is some significant effort here right now under way, especially in Orcan, like you said, look at Bitcoin mining. So, the answer is, yes, people are looking into this region wise. Some folks obviously are more motivated on doing something like Bitcoin mining as opposed to others. But yeah, we are recently seeing an influx of those in the market.

Silas Mähner: I would assume. I don't know if this is the case, data centers could also be something like that too, but they have to be under constant powers?

Bhaskar Ray: That's correct. Data centers are popping up all over the place. We are being regularly asked to look into that. That's correct.

Silas Mähner: I guess maybe kind of getting towards the end here. What do you think, I guess generally speaking the future based off of, if you feel like you're very plugged into what's happening on these different levels, what do you think the future of this kind of interconnection and grid process will look like? Maybe the upgrades, how are things going to shift out in your rough estimation as new technologies pop up and we try to electrify essentially everything?

Bhaskar Ray: I think it's a twofold approach in my mind. I think the two major things we need to accomplish in North America is how to make life easier for building transmission faster, cheaper, in terms of making sure that it doesn't take 96 month or 84 months to build transmission. What are some of the things you need to do to regulate the permitting process so that people who are highly motivated to build transmission other than utilities, has the ability to enter the market through competitive solicit process.

Next to that for example has enter that market right and playing ball in that region. So, you have to promote that motivation and build back better plan, was supposed to pave the way for some of those activities. And then the second thing is new technology. What could be done for example, grid forming inverters. These inverters are capable of providing great benefits for reliability improvement, stability improvement.

How can you deploy grid forming inverters for example? I'm just using an example or what we call power electronic fax devices, the flexibility transmission systems that could help you maintain some of the reliability problems in conjunction with renewables if you build a large [45:05 stat] com, for example. The stat com will help you, maintaining your reliability right next to a big farm. If you put in a big 500 megawatt solar, plus energy storage farm, how can you build that? So, I think those are the things that you will see being focused on in the X three to five years to ease up the bottleneck in the grid.

Silas Mähner: There was one question I had along those lines. I kind of lost the train. I thought you were going to keep going on the thread I was trying to listen. I guess what do you think is going to be the effect of EV charging on the grid or actually. Sorry, I remember my question.

It was, what do you think the effect of offshore wind is going to have and is that going to be a really big benefit or is that going to cause a lot more strain? I know there's a lot of talk of floating offshore wind probably in the next five or six years or something like that on the west coast. I'm kinda curious to hear your thoughts on that.

Bhaskar Ray: Yeah. I've been exposed to offshore wind quite a bit during my consulting life and offshore wind could be pros and cons in a sense that it could cut you both ways because there is specific node where only the bureau of ocean management will give your ability to inject offshore wind. And then the point becomes, okay, so you put in this large amounts of offshore wind into these points, how do you integrate that? You need large amount of ESS or energy storages resources to integrate that offshore wind.

Offshore wind is not essentially all the time good news. California is looking into that offshore wind, PG&E down tis shutting down their [46:51 inaudible] power plant in San [46:53 inaudible] in central post area. Offshore wind is being looked at right now as a replace, potentially for that. People have lined up in the [47:01 inaudible] queue three years ago to put offshore wind.

You inject all that offshore wind into the grid. You really need infrastructure, transmission, storage to collect that offshore wind. Otherwise that offshore wind could cause potential grid congestion. It could become a cheap resource in terms of replacement power for the nuclear plant, because you're concentrating it. You might be able to use the suddenly unused transmission capacity that you got. If you are retiring a 3000 megawatts of nuclear plant, all that power line that was primarily there to deliver the nuclear power plant output to the customer load are now floating.

And essentially because the unit is gone. So how can you do that? So, the offshore wind essentially is that replacement, but it is again, an intermittent resource. So again, you have this challenge of integrating, it's a grid integration issue. Intermittent resource has to be integrated. And then on top of that, if you have solved resources in that vicinity where wind is being pumped into, now you have a diversity problem.

Silas Mähner: I think this is kind of a debate in the renewable's communities, why wasn't there a push for nuclear and why did we go away from it so badly given that we can trust technology, our battleships, aircraft carriers run off of them. Do you have any thoughts on how that might play into the future or if it would come back?

Bhaskar Ray: Yeah, there has been a lot of discussion about this. Nuclear is one of the cleanest power plans. However, the big nuclear threat, let's not go very farther just to see what happened to the Chernobyl plant recently. It is now under Russian. Nuclear power plant while provides very cheap, very reliable, clean power to the grid because of its nature is a high threat, in a sense that you also have to deal with the fact that nuclear waste has to be formed.

This became a big issue because federal government was going to build a nuclear waste plant in the Yucca mountains area in state of Nevada in their desert, but it never materialized. So nuclear waste storage is a big issue. And because of the nuclear power plant security threats, nobody wants to bite the bullet and do it. And because of some of the accidents that's happened, for example, in Japan, that accident happened.

So, there is a tremendous amount of political opposition in building new nuclear power plans. For example, there is a nuclear proposal in state of Utah, for example, to build this. Would it get build, the Bill gets foundation is behind it? It's in the queue of Pacific world. Question, is that going to get built? Time will tell, but because of the inherent nature of what it is, my guess would be, you are not going to see much of nuclear, even though nuclear is a very reliable, clean power.

When I used to work in Xcel Energy, I'll give you an example. We ran out of storage space by Mississippi river for a big plant called Perri Island. Perri Island was about to get shut down. It was running out of resources. Minnesota public utilities commission came back to Xcel Energy and said, okay I will give you this thing called dry cast storage, where you can store these nuclear waste rods in this dry cast storage that you can build. But as a result of that, I'm also going to mandate you to build 400 megawatts of wind resources in Southwest Minnesota.

If you build hundred megawatts, I'll give you three dry cast storage. If you build 200, I'll give you five. Incremental they were forced to put clean energy. So nuclear plant is a tough animal. Edison shut down already their songs plan, PG&E is shutting it down. Why are we not building new nuclear plants? The answer is obvious. Because of the reliability issues, as well as the high threats that comes with it, they're prime targets for attack and as such.

So, my guess is while the technology is robust and America has been very successful as older nuclear plants shut down, you're probably not going to see much more new nuclear plants being built. Rather people would continue to build solar, wind and storage to do their replacement.

Silas Mähner: Yeah, I think it's a tough one. I think if we can build it correctly, I think it'll work out right. Especially, I think Bill Gates has also a company that's working on concentrated solar energy to manufacture steel, I believe. So as all those manufacturing really shifts to trying to do things differently with electricity, I think that will help with the intermittency issues. I was curious maybe; I don't know if you have many thoughts on this.

We talked about security just a little bit ago. What about cybersecurity and how the grid operates? Like is that something that's a big concern currently? Because I think it was what last year sometime there was some issues with some of the software that a lot of solar renewables companies use. I was just kind of curious to hear your thoughts on that space. If you have [52:31 inaudible].

Bhaskar Ray: It is a huge concern because of cybersecurity threats, the hackers and as such utilities and ISOs has become increasingly concerned about having this infrastructure information, not being falling into the wrong hands, for lack of a better word and doing it. I'll give you an example. Stringent requirements are in place right now, even if you want to get for legitimate reasons, power flow base cases, as simple as that, you have to go through a CEI clearance process. CEI stands for critical energy information system data where you have to pass first background check before you can get access to a power flow base case.

Because if it falls in hands of, I'm just going to use name Russian hackers, it could potentially be catastrophic because they can shut the grid down by jacking into the sensitive information. So, it is a huge issue right now for everybody to make sure that sensitive grid infrastructure data doesn't fall into wrong hands and hands. You're going to continue to see more and more stringency on narcs compliance for cybersecurity.

Silas Mähner: Yeah. Interesting. I think that's an interesting one. I had interviewed before I ended up in renewables. I interviewed for an opportunity and cyber security. It was interesting, but I didn't see myself in its long term. Now I think that is a fascinating one and a dangerous one, obviously important to take care of. Maybe to wrap things up, I'd be keen to hear from an education perspective.

I think you and I both during the recruiting process, have noticed that there's a very tough time to find these engineers, but to see like there's going to continue to be, a need to have more of these engineers who can handle these things. So, what are you seeing, is Qcells or other companies doing partnerships at universities to help kind of spur this interest in the space? Are people educating, people when they come in from a graduate level. What is exactly being done to make sure that there's a good pipeline of talent in the space?

Bhaskar Ray: Absolutely. I think that's a very good point. And in fact, funny, you mentioned about going to the universities. We're definitely exploring into going into career fairs, for example. Educating the universities about our needs so that students have opportunities to come into internship opportunities, to renewable companies so that they can learn what are some of the blue chips and essentially recruit fresh talent from straight out of college as well as engineers, obviously the future for engineers in the power industry is bright.

I see a massive need for talented engineers to join this because in order to cope with all the issues that you and I just discussed in the last 15 minutes or, so you are going to need a lot more engineers to handle this. A good example is you saw how much engineering resources I have hired during the last nine months or so, and we are not done yet. We have to do so.

So long story short, you're going to continue to see the need for talent in power industry, where folks bring in fresh perspectives. Folks are looking into how to manage the grid, solid technology understanding, bring in their perspectives that they're learning in the energy industry, especially the power background, energy background, renewable emphasis for master students has become a thing now. This didn't exist 20 years ago, that there was a renewable energy degree. For example, folks are coming in. So, I would say in short talent recruitment in the renewable space is going to continue to grow significantly.

Silas Mähner: Yeah. I think one thing, I would comment on too, that just to me seems, it's a bit kind of tilted in terms of a lot of people, like you and I have both seen there's a lot of people, a lot of immigrants who are in these roles and I don't see, it doesn't tend to be nearly as many like native America, people from America born and raised here in these types of roles. And I think that obviously you could look at it two ways. You need to encourage the next generation to get these degrees or maybe make the visa process a little different. That's obviously another more political type of conversation.

I do agree. I think that the space is bright, especially for electrical engineer. So, if you're listening to this podcast, deciding what to do, maybe talk to Bhaskar and learn a bit more about the grid and maybe go get your electrical engineering degree. But I think this has been a really, really informative conversation. There are obviously many things we could go deeper on. But me not being an engineer, it's, it's tough to go too deep. So, I think this is a very good place to end it. Do you have any final thoughts you want to kind of offer?

Bhaskar Ray: Yeah. I think what I would have my message to all the young folks that are starting out their career, is don't be discouraged by thinking that oh, power industry is so old and boring. I'm going to go to this fancy electronics and computer world because that's really where it is. In reality that is not at all true, because I think there is a certain amount of glamor connected to computer science industry where people feel very motivated to go into computer science and think, well, power industry, electrical engineering is kind of old and boring.

That is not the case because the power industry is very bright. So, I highly encourage folks to take a look at the big picture, understand this, and enter the market because you're absolutely right. We see more and more people signing up for computer science degree because they think that Silicon Valley is the place to go and understand this way. In reality, which is not quite true. Power industry is evolving, brighter and better. It is not the old, boring utility world. You will be working in, not those old giant utilities anymore. You'll be working all across the renewable sector.

Silas Mähner: Yeah, I think, I would assume there's a lot of room for innovation within the space, probably especially on the material side when it comes to the actual equipment that it takes to build transmission lines. So very good. Well, it's been a pleasure having you on and I will definitely have to have you on again in the future. Maybe some big announcements come through with FERC or something in the future. We'll see how it goes but thank you so much.

Bhaskar Ray: Absolutely. Absolutely. Thank you. The pleasure is all mine. It's been a pleasure talking a little bit about this exciting market, so thank you.

Outro: We hope you enjoyed this conversation with Bhaskar. Again, anybody who doesn't find it interesting. I mean, maybe it's just not interesting to you in general, but I think that this is something that not a lot of people are familiar with in the space, just in general. So, I hope it was helpful. I hope you enjoyed it. If you do want to hear more of these conversations, please do subscribe and turn on notifications.

If you're listening on Apple podcasts as always, we really do appreciate reviews and ratings there. It really helps us to gain reach. And as always, please of course share this with somebody who you think could find valuable, perhaps some younger people looking to get into the space. Not sure what their career motives are and where they want to go. Perhaps they find this interesting, please, if you are interested, feel free to join our slack channel if you want to get further involved with other professionals in the climate tech space.

We have a newsletter that goes out the 27th of every month. You can subscribe to that. Connect with Bhaskar on LinkedIn, especially if you're a professional space. If you have any follow up questions for him, I'm sure he is glad to connect with you there. And then of course you can connect with me and reach out with any questions on Twitter or through the slack channel.

Quick shout out for the next episode. Our podcast will be with John King, the founder and CEO of hyperlight energy, which I would say maybe not perhaps revolutionary, but a very, very interesting thermal energy company that has recently announced its first pilot project in California. So, they're actually moving things forward from a technology that's been developed for a while, but really, really interesting conversation with John. So definitely that should be coming out later this week. Please give that a listen as well. But thank you so much for taking the time to listen to the podcast and we will to you next time on Clean Techies, the podcast.