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Understanding Transactive Energy

Chris Warren: Last July, Arizona regulators opened the country's first docket focused exclusively on transactive energy. In doing so, Arizona joined a host of other states and utilities in attempting to grapple with the opportunities and challenges associated with transactive energy. In a nutshell, transactive energy refers to the power and energy platform that facilitates decisions and transactions involving the generation, distribution, and consumption of power. For example, the ability of rooftop solar and electric vehicle owners to trade electricity and other energy services is one type of transactive energy, and as the energy system as a whole evolves to become cleaner and more distributed, the concept of transactive energy and how it could work in practice is becoming less and less abstract. Understanding transactive energy and its potential impact on utilities and customers will be our topic on this episode of Beyond The Electron: The Energy Cloud podcast series. I'm your host Chris Warren, and I'm pleased to be joined today by two guests who have unique perspectives on this topic.

Chris Warren: With us today are Dan Bradley, a managing director in Navigant's energy practice. Dan has a particular expertise on emerging energy markets, technologies, and business models. He spent the past 20 years at Navigant working with clients to develop and operationalize strategies for investments, business initiatives, products and professional services in the utility sector.

Chris Warren : Also with us today is Josh Wong. Josh is president and CEO of Opus One Solutions, a company that's deeply involved with helping utilities gain the visibility and control they need into their distribution systems in order to optimally manage distributed energy resources. Opus One has been in the news recently because it has teamed up with Illinois utility Ameren to test the viability of a transactive energy marketplace on a micro grid and evaluate the use of blockchain ledger systems. Well, welcome to you both.

Josh Wong : Thanks Chris. Happy to be here.

Dan Bradley : Thanks Chris.

Chris Warren : Okay, Dan, I'd like to start with you. There's been a lot of discussion in the utility industry lately about blockchain. Can you help us connect the dots between blockchain and transactive energy?

SPEAKER

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Navigant Consulting, Inc. (NYSE: NCI) is a specialized, global professional services firm that helps clients take control of their future. Navigant's professionals apply deep industry knowledge, substantive technical expertise, and an enterprising approach to help clients build, manage, and/or protect their business interests. With a focus on markets and clients facing transformational change and significant regulatory or legal pressures, the firm primarily serves clients in the healthcare, energy, and financial services industries. Across a range of advisory, consulting, outsourcing, and technology/analytics services, Navigant's practitioners bring sharp insight that pinpoints opportunities and delivers powerful results. More information about Navigant can be found at navigant.com.

Dan Bradley: All right. So transactive energy, it's a concept that's been around for a couple of decades, mostly in the academic and public sectors. And Navigant Research has defined transactive energy as a power system in which economic or market based platforms are used to make decisions involving the generation, distribution, and consumption of power. In other words, a two way grid management approach that addresses this future need. Well, in and around the 2014, '15, '16 timeframe, we began to see the convergence of a couple of technologies, and that's the convergence where blockchain was introduced to transactive energy.

Dan Bradley: Blockchain being itself a technology that has been around for some time and came to the world stage in 2009 when its first commercial application, bitcoin, came to be. So in this 2014, 2015 timeframe, these two technologies were put together and in combination they seemed to provide the two technologies that can underlie this future grid architecture. And those are the dots that have come together and connected the two early, and we have seen that the potential use cases and all sorts of things that can happen when you put these two technologies kind of explode. But we'll start there.

Chris Warren : Yeah, that's great. Well, I gave you the impossible task of boiling the ocean there. So I apologize and nice work. So let's drill down a little bit more. When it comes to what appeals to utilities about piloting projects involving transactive energy and blockchain, you mentioned use cases, what are some of those?

Dan Bradley: So first, let's take a look at blockchain. So blockchain architecture can be used to create a network with device level trust. And on this network, every interconnected asset on the blockchain would have a known, verifiable and trusted identity that is exceedingly difficult to duplicate or forge. So with this first aspect of blockchain, we're already seeing some very complimentary pieces to a distribution network on a utility grid. Now secondly, once the foundation of device level trust is in place, then you have the ability to add in smart contracts and distributed applications that are built into the blockchain architecture and can be used to automate systems or management processes to create any outcomes that you're seeking, whether it's grid automation or demand response or transactive energy. So when you first hear this description, right, it sounds disruptive, especially to the utility. This network that's kind of overlaying on a distribution grid network that is well over a hundred years old.

Dan Bradley: But if you take a step back and you look at the big picture, blockchain is just a piece of this complex puzzle, right? Other parts of the puzzle that would be required to really drive these big disruptive changes that we're talking about include establishing pricing functions. It's making sure you have the right digital nodes out there, like smart meters, certain grid modernization functions and technologies, big data analytics as well as control over the system if you are a system operator. So that's a little bit of the background when we then delve into where companies and utilities are today around these blockchain use cases, we see utilities and companies experimenting, learning and piloting different aspects either directly or in partnership in areas like the wholesale market. Simplifying the wholesale market processes, nominations, scheduling, transaction settlements and regulatory compliance of large bulk power system components.

Dan Bradley: Other areas are some of the renewable markets. For example, in Europe there is these European energy markets that allow renewable power generation to be documented and tracked and traded. So when you think about this environment, an environment that has diverse stakeholders operating, not knowing other trading partners, perhaps limited trust, lots of intermediate steps, high transaction costs, like this is the perfect set of conditions for a blockchain application, and we see this as a use case being explored. And other use cases are more futuristic. Vehicle to grid solutions. So when you think about integrating electric vehicles as dispatchable assets into the grid, blockchain becomes an application that can leverage, track and compensate the energy stored in those mobile batteries sitting inside that vehicle that can be used for flexibility or demand response from the vehicle is parked and plugged in.

Dan Bradley: We see use cases in meter registration and switching. If you're a customer sitting there in a liberalized energy market where you get to choose your retail electric provider, the behind the scenes transactions that go into switching providers and tracking that and who's where and what products they're buying, that's a potential blockchain application. And then lastly, just circling back to transactive energy. Transactive energy blockchain architecture is one of several of these transactive energy technologies that could play a role in enabling this two way decentralized transaction model that we've been describing on the podcast.

Chris Warren: Right. Okay, great. Well Josh, let's bring you into the conversation. I briefly talked a little bit about Opus One in the intro. Could you just take a minute and describe what you guys do and who you work with?

Josh Wong: Sounds great, Chris, and thank you for the opportunity again. So Opus One Solutions, we are a enterprise software company and we mostly work with electric power utilities. Really we see, as Dan was saying, that utility sector is going through a time of fundamental transformation driven by mega trends like digitization and decarbonization and decentralization. So we see ourselves as the software partner with utilities in this time of transformation to enable them to pursue the utility of the future. And essentially there are three key parts to our ethos. Number one is we are a grid to edge company. Here we appreciate a lot of momentum and drivers happening at the edge, but fundamentally we want to transform or evolve the grid into a platform to support the actions and the value that's happening at the edge.

Josh Wong: Number two is we enable that transformation to happen via basically big data and advanced analytics, specifically around power flow and optimization level of analytics. And last but not least is we don't just want to solve grid hype or technical problems or data problems. We see one of the biggest challenges in this industry is one of strategic or business mode based. So fundamentally we take our grid based analytics and we use them to inform new business models or strategies for the electric power sector.

Chris Warren: Okay, great. That's a really good foundation. So let's take it a little bit further. Can you talk about how your grid OS platform kind of brings some of these different strands together and how it kind of enables the concept of transactive energy in the real world?

Josh Wong: Absolutely. So first of all, let me just compare with Dan regarding the definition of transactive energy. We operate very much similar to definition as well, which is using economic and control mechanisms to balance supply and demand, especially focused on those that are happening at the edge including storage. So we see a massive transformation from what we call grid 1.0 to 2.0 to 3.0, 1.0 being basically a top down, one way power flow grid. 2.0 being the increasing penetration of distributed resources leading to two way power flow, increasing intelligence of the smart grid. And really 3.0 is taking that two way power flow and evolving from a direct control mechanism such as what you would see in a DERMS solution let's say into a market based or economic indirect control mechanism, very much like the bulk power system.

Josh Wong: So how can we take the value of energy to inform how distributed resources should operate? So fundamentally with GridOS, which is Opus One's software platform, we leveraged this using model based analytics. What I mean by model based is three phase AC unbalanced model of the grid and we turned that digital twin into a common information model and we've run advanced analytics on top of that. Now where transactive energy comes in is what we do with that model, and we take that model on a journey of five key stages. Number one is really around visibility into the grid. So we were blind. Now we can see things like power flow, voltages, currents, capacities, et cetera. Number two is around controlling what we can see. And number three is around optimizing that control. Three phase AC unbalanced security constraint optimization of that power flow.

Josh Wong: So what that optimization brings is not just optimization or conservative voltage reduction, but really it unlocks the computation of the value of energy. If we look at the wholesale market, pricing on the wholesale market is calculated by optimization as well. So we are taking that algorithm or that philosophy down to the distribution level to locate locational and temporal by time and by location, by place, valuation of electricity. And that is the key to allow transactive energy markets to happen, again going back to the definition, using the value of energy for control and operation, node mechanisms. And that's really where GridOS comes in.

Chris Warren: Right. Right. Well you have the benefit, there's been so much talk about pilots and just almost abstract thinking in a sense about transactive energy, but you have the benefit of having already been working with utilities in the US to better understand transactive energy and micro grids in particular. What are some tangible lessons that you've learned? I mean that could include what some of the unexpected challenges might be or opportunities that perhaps you hadn't considered before. Because once you have an encounter with the real world, things tend to change.

Josh Wong: Exactly. Exactly. Well as we always say, vision ideas can be very common, but making things real and making a business of it, it's different as well. So I would say number one lesson that we learned is that it works. We actually make it happen. We made it happen and our transactive energy market with National Grid was live as of last year and we keep upgrading and learning, learning lots from it. And we are now expanding beyond National Grid in New York and into Ontario, into our recent MRN project and many more projects that's in the queue as well. So it's a reality, it's not a vision anymore. And that vision is a big one and we are step by step creating into reality. I would say number two big lessons learned is transactive energy can take many forms and I think this is one of the biggest, I will say, if there's anything I can leave behind in this podcast, that's a key message, and that is it takes many forms.

Josh Wong: On one end of the spectrum as we have started with National Grid is the most advanced form of transactive energy, which is actual dynamic, same day and day ahead retail markets, locational electricity that you can bid and offer on. Now, on the other end of the spectrum, using economics for control, I would say non wire solutions is actually a very doable form of transactive energy right now. It's appreciating the value of distributed resources, whether that's a storage or micro grid or demand response, to provide value back to the grid. So more of a longer term timeframe planning type of a transactive energy.

Josh Wong: In the middle is the real time operational implementations. For example, advanced demand response, basically creating price differentiation by location or by time of demand response. Or evolution of feed and tariffs and metering. All of these are various forms of transactive energy. That's probably a second biggest lesson learned. Third, I would say always go for threes, third I would say is transactive energy is meant to be integrated. So number one is vertical integration from G to T to now retail and DERS. The other is back to the many forms as horizontal integration from planning to operations to markets and business models. So these are three major lessons learned for us.

Chris Warren: Oh, that's really great. Well, Dan, let's bring you back into the conversation. Josh just outlined a number of lessons that he's learned in some of the work that they've been doing. What have you observed in terms of how either regulators or utilities or both are seeing and understanding transactive energy? Do they have as expansive of a perspective as Josh just kind of outlined?

Dan Bradley: Well, first off, Josh, I will have to say, I wrote down a whole bunch of notes as you were talking and some of what you were describing I was shaking my head, "Right on." I mean that is it. I will start with, before I get to your question Chris, I'll start with I love how upfront you talked about, you described yourselves as the software partner to utilities, helping deliver that utility of the future. And to me, I personally see, bridging it back to the question you're asking Chris, is like that it's really right now at the core of where utilities should be in my opinion in terms of understanding that technology. First off, Josh, you and your organization have learned tremendous lessons by making it real, which I 100% agree is very important, right?

Dan Bradley: Making it real out of the lab in a real world situation like you're operating in the case of New York, up in Buffalo, we have National Grid. So when you take a step back and you look around the industry, I think you see a big mix of where utilities and regulators are. A lot of what we're talking about here on the transactive energy side, blockchain transactive energy side, in some cases it's made really some, some good footings, some progress, non wire alternatives, micro grid applications being some of them, and in some cases other grid edge based transactive energy platforms are somewhat nascent.

Chris Warren: Great. Well we've mentioned Ameren a bunch of times already. So Josh, I want to bring you back in and talk a little bit about that project. It's gotten a lot of news coverage and it's certainly generating a lot of interest. Can you just kind of give us the perspective of how you got involved with the project and Ameren's actually trying to achieve in the project.

Josh Wong: Great. Sounds good. So really it goes back to how we started, and also Dan highlighted it, it's Opus One trying to be a partner with utilities as they navigate through I would say fairly complex market evolutions, customer evolutions, regulatory reforms, et cetera. So we started talking Ameren a while back, but really I would say key drivers towards this project is two fold. Number one is the Illinois Future of Energy Jobs Act, FEJA, that's requiring certain areas of the system to move towards more of a transactive, as how we would define it, but more of a location value of electricity away from net metering when certain penetration of gets exceeded.

Josh Wong: So legislation is one key factor. The other is the MISO, Midcontinental ISO, being more and more progressive towards the DER space as well. And Ameren has been a phenomenal innovative utility and very forward focus as well. So our objective, I wouldn't speak on behalf of Ameren, but in our discussions, our objective is really to look at how to better understand the value DERs can have on the grid and tie that into planning, tie that into MISO, tie it to their customer strategy, and allow them to maintain the reliability and resiliency of the grid as well. So Opus One's role is one to navigate through these changes and this strategy, and number two is provide the software platform to enable it to happen.

Chris Warren: Right. Okay. And I've read in some of the coverage that the project has two phases. Is that correct I guess is the first question, and if so, can you give us some of the details about how Opus One will be involved with each of those phases?

Josh Wong: Well, it's two very high level phases, but I'm sure if you look at any project plan, you'll see more than two phases. But I would say the two phase is really encapsulated to two major steps of achieving the objective of the strategy. The first phase is really one of simulation and planning. What that means is even let's say in National Grid's case, we have made the market real, we have made it happen. It's live, you can transact on it. At the same time, what we recognize and Ameren especially is that there is a very much more pressing and urgent need to plan. And when we talk about planning traditionally is more of let's say planning for asset renewal, planning for expansion, capacity, asset management, et cetera.

Josh Wong: But now we are introducing a new function within the utility to plan for business model evolutions and how to engage in DERs and prosumers, and also the role that DERs can have and can play on the reliability, resiliency and adequacy of the grid. So really focusing on taking transactive energy to planning. The second stage is now that we plan, we understand the impact of transactive energy, let's make it happen. And so the second stage is really what we call a realtime shadow market, meaning that we are animating the market, but it's shadowed, meaning that it's live, it's operational, but we are not yet actually transacting monetary value on it, but we are running real time scenarios of how it would happen live.

Chris Warren: Right, right. You know, I want you to go back to one thing that you said, and I think it's a topic that's pretty interesting and it's exciting because when you talk about business model evolutions, I mean I think that that's where a lot of people see potential opportunity to deliver value to many stakeholders. And so when you talk about business model evolution in this project or just generally as it revolves around transactive energy, what kind of forms can that take? What opportunities are there?

Josh Wong: Yeah, I think the temptation is to prescribe a certain business model, especially at this time of market evolution. I think our approach to business model is more of one of discovery. So understanding the true economics and needs and constraints and objectives of the grid, how can we surface these value to inform various business models rather than, "Hey, let's choose one, let's bet on one and let's make it happen right now and that's it." So the business models that we are informing include that of a non wire solutions, so longterm asset investments or optionality to us at investments. Another one will be in rate design. So really can this inform where let's say a traditional feed and tariff or net metering program would evolve over time. Another one is demand response, basically taking it from an auction or one signal rules them all to one that is actually tied to the locational needs of the grid by transformer or by feed or et cetera.

Josh Wong: And then all the way to the business models of a complete DSOR or distribution system operator model. Whereas New York is contemplating under the platform, there will be a transactional fee and utility basically playing the broker or facilitating the marketplace to happen. So there are many forms and I think ultimately what Opus One wants to achieve, it's less surfaced of value and have a quality dialogue for I would say policy and regulatory making, and we are assured that TE or transactive energy will take place in many forms.

Chris Warren: Okay. Dan, let's get you back into this conversation. What stands out to you about the Ameren project?

Dan Bradley: So listening to Josh, you shared some interesting findings and interesting learnings. And one of the learnings that I was particularly interested in, in what you were describing was how you describe the surfacing and discovery of business models. To me that was very well put, right. As business models emerge from the application of these new technologies, we're finding originally maybe the discovery of a potential business model and then proof point to that business model. But it really doesn't end there. When we look within non wire solutions we have the core of the business model, which is deferral of utility capital expenditures.

Dan Bradley: But that's just really the beginning, and I love the way you put that. And another point, Josh, that you made that we've seen how kind of cross planning they are. The traditional planning functions within the utility, which were designed more for that linear system, begin to bump up against these cross planning technologies. We've seen in states like New York, the organizations of the utilities have begun to be changed and adapted to a cross planning element to it, whether it's called the utility of the future team or various teams, analytics teams, but it addresses some of the needs that you're finding Josh in your work with Ameren and other utilities. Really great findings. Thank you.

Chris Warren: That's just the sort of kind of industry knowledge sharing that is obviously going to be necessary as we move forward here, which I want to do. I want to get you both to weigh in a little bit on where you see all of this headed. But before I do, Josh, can you just take a second and talk about how you're going to evaluate the project with Ameren, what any of the metrics are, what's success look like?

Josh Wong: I would say it's quite early to define metrics of success largely because this is a discovery driven approach. And so I think the hypothesis is can we identify a value? I think we are using a micro grid right now. We're running simulations on multiple fleet feeders. I think the big I would say success factor for us is can we identify value number one and sufficient value, and turn that value into a potential business model. And does the value make economic case. For example, can we mine more efficiencies out of that value then to set up the system in the first place. So what's the business case around that? So I think right now, especially given it's a pie or demonstration project, learning those lessons will be the biggest success factor.

Chris Warren: Right. Great. Well let's look a little bit further out. We're still at a point where there's a lot of pilots and a lot of discovery and information sharing. Let's fast forward a bit and get out a crystal ball. Where do you see, Josh, we'll start with you, and then Dan, I want you to answer the same question, but where is transactive energy headed and what is the ultimate promise of transactive energy in your view?

Josh Wong: Thank you for that. Well, especially in our opinion, we might be biased, but with all my I would say experience and engineering mind, we do certainly see transactive energy in its various forms as being the end states of utility evolution. So right now utilities are going through a time of, previously it was actually renewal, then ER interconnections for the past five to 10 years or so, getting smarter with the smart grid. Now I think the biggest trend driving forward utility evolution is how the utility can transform its customer service model and its business model. And with that it hits basically what Opus One's core mission is which is achieving tripled sustainability.

Josh Wong: Number one, sustainability is environmental sustainability with especially driven by DERs and clean and green tech. Second is technical sustainability. So can we connect or interconnect such DERs while maintaining grid resiliency, reliability, quality, adequacy, et cetera. And third is economic sustainability, and I think this is the last gigantic modernization that needs to happen. And I would say in putting on an engineer's mind, I think with that we would have solved I would say the biggest questions that this industry has to see. So we do see transactive as the end state. And really what that means at the end of the game is a win-win between the utility and all market participants, a sustainable economic model.

Chris Warren: Right. Great. Well thanks for that. Dan, how about you? What do you see going forward?

Dan Bradley: So what we see going on in the future is a continued push of the mega trends from decarbonization to decentralization to digitalization, which ultimately drive the number of nodes on a network like the power grid into the millions and billions and beyond. These control these resources to enable these resources to shift value back and forth between these resources. It takes some pretty incredible leaps of technology to bridge that gap over the coming years and decades. And the [inaudible 00:30:51] and blockchain that we see today is a combination of technologies that provides the promise of a technology that can support this future. A future that will be more sustainable environmentally, more sustainable from an economic perspective, from a finance perspective, inclusive of customer sided distributed owned assets, as well as conducive to artificial intelligence and other future technologies. So as we see the utility industry with most industries entering into this complex age, we see this as being a promising technology that can become a glue in the future to hold it together.

Chris Warren: Thanks Dan. And I'd like to thank both you and Josh for a great conversation. We've covered a lot of ground here today and for me a couple of things really stand out. One is that any idea I might've had that transactive energy is just one thing is now completely gone. But what also stands out is that that's not a bad thing. As we're all watching this dramatic transformation of the energy system to become more sustainable and distributed, there are going to have to be a lot of tools to ensure that it's done in a way that delivers value to consumers, new energy entrepreneurs and utilities. We can see a version of what that can look like with the work Opus One is doing with National Grid and Ameren around blockchain and transactive energy. But the important thing is that the tools around transactive energy will continue to evolve along with the needs of the power system, and it's going to be fascinating to see how that all plays out. That's all the time we have today. Hope you'll join us for the next episode of Beyond The Electron.