Siemens Grid Software Podcast <de>coding the future of energy – Episode 2: Flex<ible> and connected with Thomas Kiessling and Seth Frader-Thompson

Speaker 1 [00:00:04] Oh, Richard, hold on a second. I have to check this.

Speaker 2 [00:00:07] Okay. What is it now?

Speaker 1 [00:00:09] When I hear the ringtone, I know that I got a message about our energy.

Speaker 2 [00:00:13] What kind of esoteric nonsense is that? Does your phone remind you when it's time for you to find your center, or what?

Speaker 1 [00:00:19] No. Much better.

Speaker 2 [00:00:21] Well, I was thinking we'd sit here in peace in this lovely restaurant and enjoy our paella.

Speaker 1 [00:00:26] It's already been sorted out. I received a message from the public utility.

Speaker 2 [00:00:30] And, what does our public utility want to know from us at 7:30 in the evening?

Speaker 1 [00:00:34] We have the smart washing machine. Remember, I told you?

Speaker 2 [00:00:38] So, tell me, what's smart about our washer?

Speaker 1 [00:00:41] The washing machine communicates with our energy supplier, the public utility company, via the smart grid. And they know that we want to do a load of laundry at 7:45 p.m. They're informing me now with a push notification that they're automatically postponing the wash cycle until tomorrow morning at 4:45. And if I had any objections to that action, I could have blocked it just now.

Speaker 2 [00:01:04] Huh. So, they're delaying the start time of our laundry. Seriously?

Speaker 1 [00:01:09] There's a power shortage tonight. If consumption in town increases, they will have to purchase energy from dirty coal power plants or switch off large power consumers like the factory.

Speaker 2 [00:01:20] Oh, and that will change by tomorrow morning?

Speaker 1 [00:01:24] Yes, exactly. There's probably a wind forecast for tonight or there will be more power available from the biogas plant tomorrow morning. That's why it would be better for the grid if washers like ours didn't start until 4:45 a.m.

Speaker 2 [00:01:38] Okay. Well, you know, they could at least show their appreciation.

Speaker 1 [00:01:41] Oh, they do. If I shift our load five times, and yes, that is what they call it.

Speaker 2 [00:01:46] Really?

Speaker 1 [00:01:48] We get a voucher that I can redeem with our electricity suppliers. That means that you could use the voucher tomorrow morning at the farm store behind the wind farm to get a jar of honey, for breakfast, for me.

Speaker 2 [00:02:00] All right, honey, that sounds good to me.

Speaker 1 [00:02:02] Good. Because after that, you get to hang the laundry.

Gerard [00:02:06] What you've listened to is our utopia. The best-case scenario, so to say, a potential future world full of collaboration across the energy sector. In all our podcast episodes, we will kick off with a short introduction to set the scene on what a bright future could look like. And then we dive into a discussion how to get it.

Welcome to Decoding the Future of Energy, the podcast by Siemens Grid Software. My name is Gerard Reid. I work in the finance industry with a focus on both the energy transition and the digital energy revolution. As your podcast host, I want to explore a range of facets on how we can move towards a fully sustainable energy world. Today's episode is all about flexibility and why it's important for the energy transition. For this topic, we have two amazing guests, Seth Frader-Thompson, co-founder of Energy Hub, and Thomas Kiessling, chief technology officer at Siemens Smart Infrastructure. Seth, maybe I just kick off by asking you a question in and around connectivity as a global megatrend, just to hear your thoughts on that?

Seth [00:03:19] Yeah, clearly, I would say that connectivity as a megatrend started maybe with the release of the iPhone about 15 years ago. And I think you could argue we're sort of at or approaching saturation of smartphones. But, on the IoT side of things where we're connecting not people, but devices, I think we're still relatively early. I think even in the most successful, kind of verticals of IoT, we're seeing maybe at best 20% adoption of connectivity, so there's a ton of progress to be made.

Gerard [00:03:58] And Thomas, maybe jump in on the theme of IoT. And what does this all mean for us? And how do you see that development going forward?

Thomas [00:04:08] Well, first and foremost, it creates value. It creates new business models. It improves the energy transition, for example. You could argue that there will not be a massive, ramped energy transition to electric without connectivity and digitalization. So, it's an enabler, really.

Gerard [00:04:29] One thing that strikes me when I look at energy is that there's no responsiveness on the demand side to what goes on in the supply side. And that's why you need to connect things together. I'd love to just hear both your views on how we do connect all these things together.

Seth [00:04:48] If you rewind to sort of the beginning of that connectivity megatrend, there was an assumption that you would sort of go through a wave of connecting things and then you'd be done. But, in reality, there are multiple waves. In the U.S., 78% of homes have smart meters. There was an assumption early on that the smart meters would serve multiple roles, that they would be a measurement device. They would be a connectivity path for pulling those metering measurements back to the utility. And then that they would also be a connectivity hub for DERs. And in reality, that's not how it played out. They were very successful in acting as that measurement, but the hub of the home or the hub of a

building did not go through the smart meter. That's gone through a completely different communications pathway, whether it's Wi-Fi or cellular or something else. The other point I'd make is that the shift to renewables requires completely flipping on its head. It's no longer the old model of matching supply to demand. You now need to do it the other way around, and you need an extraordinary amount of flexibility to be able to complement the inherent intermittency that you get with renewables.

Thomas [00:06:04] There are multiple areas where interactivity between the energy demand hubs, be it commercial buildings or factories, and the supply is happening, so I'm quite optimistic there. And 60% to 70% of all vehicles will be in fleets in the next decade or so. These hubs, we're building them from the get-go interactive, so they will listen to signals from the grid. They have substantial storage capacity that will act as an aggregated source of electricity back to the grid. And then the moving objects, i.e. vehicles that are managed by these hubs, they are also aware of the grid. So, we're really building this as a system of systems. Electric vehicle is a great disruptor for innovation, but commercial buildings, it's also starting to happen.

Gerard [00:07:11] And so just on the electric vehicles being the great disruptor, maybe just dig in to that and explain why you think that is, Thomas?

Thomas [00:07:20] Because it adds lots of megawatt of demand of electricity, which in many cases we don't have, so you need to be creative. You need to create solar-powered depots close to cities, where you have enough space to create the power needed for these kinds of electric fleets. Because a grid upgrade would take you two to three years, again, because the business case for the utility is the problem. So, there's lots of creativity happening as we speak to build these depots. There's going to be hundreds of them in a city, close to cities, air transport hubs and the like, as we convert into electric fleets. And you know that this is in full swing? We're going to convert in the next 10 to 15 years.

Gerard [00:08:12] Is the electric vehicle the big catalyst now to this future world of connectivity and flexibility?

Seth [00:08:19] One thing that I think is important to say is that the transition to electrified vehicles happened around the same time that cellular connected telematics happened with those vehicles. And so, every time an electric vehicle gets sold, you're sort of putting a DER out there somewhere on the grid that you can tap into. And the typical charging need for an individual end user, a homeowner, is relatively small, and it's very, very flexible. So, the car may be plugged in overnight, but only need to charge for two or three hours. And the customer may not care at all when that charge happens. And so, it gives you tremendous flexibility to determine, based on carbon signals or economic prices or grid conditions, when should we charge any given vehicle, and then how should we charge, in aggregate, a fleet of vehicles?

Gerard [00:09:17] I was recently in one of the big control rooms of one of the power systems here in Europe. And you see this big, huge control screen at the back, and then you see all these telephones, and the people are on the telephone. And I was looking at this going, this is really 20th century stuff. I mean, how do you take all these decentralized, renewable assets and ensure that this system actually stays in balance going forward?

Seth [00:09:47] What I would say on that is, first of all, it just drives home the need to get the grid operators comfortable with the new reality. Get them used to operating virtual power plants that they know are backed by fleets of DERs at small scale before they're

actually dependent on those virtual power plants to run the grid. Get them to understand, is the resource always going to be there? Is it reliable? Does it perform as I expect? I think DERs give grid operators the opportunity to sort of skip a generation to this sort of bottoms-up DER adoption that's happening — start experimenting with those resources, learn things, and then potentially take a lot of the learnings from operating VPPs and bring them back into how they run other pieces of their infrastructure.

Thomas [00:10:43] Yeah, to extend that thought, Siemens is powering about 1,300 utilities around the world with control center software, and that control center software is 20th century product. It is monolithic, because the processes of the utility are monolithic. Now, the reality of the next 10 or 20 years, Seth, as you said, it's going to be distributed, volatile. Wind and solar generation is going to change in seconds. That's going to trigger energy storage to release or store. The weather forecasts change. Decisions need to be made in seconds. You're going to have overvoltage events, where some agent in the system needs to act without a human, sort of clicking a button and say, “yeah, I acknowledge that's happening now.”

We recently launched the Accelerator Framework a few months ago, which is a completely different way of developing products with our customers. So really, it's a culture change at the end of the day, because it's the I.T. folks who are moving in with different paradigms and you have a full culture clash now, between the more operational technology and software folks. But when the dust has settled, what we're going to come out with on the other side, I think, is a very robust, distributed system with agents that will make standard decisions on their own. And then some digital operator, a human, will just acknowledge that.

Gerard [00:12:21] Thomas, as you're speaking there, what comes into my mind is this is the new 21st century type software. It's like an autopilot in a plane. You can use it, but occasionally if you need to override it, you can. Is that a good analogy of how you would sell into these guys or how do you do it when you're in front of the operator?

Thomas [00:12:45] Oh, yeah, the future is going to be sort of patient monitoring during heart surgery, with lots of vital signals. And that's exciting, it's highly relevant, it's like the lives of hundreds of thousands of people, their energy consumption, it hangs off that. I mean, it's highly relevant and that's how we sell it. And there's lots of co-creation and an open platform approach going on. We pull in data for third parties; weather forecasts, it's just a wonderful example. So, it's just going to be robustness by distribution and that's a software paradigm.

Gerard [00:13:28] If we sat up today and said, okay, we're going to do a new system, it's pretty easy. But you've got an old system and you've got old hardware in place and now you're going to put new controls, new software in it. How easy is that to do?

Thomas [00:13:42] Yeah, that's a tough one, because you need to estimate, guestimate the status of certain components in the network, and AI absolutely does come in here. To give you an example, the business case to instrument the last mile is just not there. It's just too expensive. But now, if you extrapolate certain pieces of information that you have, then we're working with customers to then be able to say, “well, there is an overvoltage event happening somewhere because of a resource generation system.” So, I think there is a lot to gain from a digital twin on the grid edge, which runs/simulates in parallel of the real system.

Seth [00:14:30] You can get comfortable with the idea that you might not have to upgrade certain pieces of old hardware because you can take advantage of the asset. The DERs themselves often have pieces of telemetry that the utility can use to get a sense of what's happening on the grid where they're just receiving the data and they're not necessarily in control of the hardware. And so, maybe a good example would be a service transformer at the neighborhood level. It may not make sense from a business standpoint to put a sensor on that service transformer. But if you're still trying to manage the maximum load within limits of that service transformer, you may be able to rely on the signals that you're getting from solar smart inverters, from EV charging and other DER sources, and ultimately fulfill the same goal, which is keep this piece of equipment under a thermal limit. But do it without having to go out and install millions of dollars of new hardware.

Gerard [00:15:34] I think it's a good thing to talk about in our buildings and our homes. I tried to connect everything together in my home, all the energy devices, and I'd love to see how you guys see the future of connecting.

Seth [00:15:47] Yeah, I think you might be surprised to hear that I'm a bit of a skeptic of whether this stuff is really all going to get connected.

Thomas [00:15:55] To complement that view, Seth, you looked at it from a consumer angle at the residential home. If I now look at the whole thing from a decarbonization, climate change, sort of fly in from the big picture, then 40% of the total CO_2 problem we have comes from buildings, and that includes commercial and residential. Now, the residential piece, the 80% problem is really my HVAC. It's a solar roof, it's a heat pump, and then connecting the whole thing to the grid in a net meter arrangement. If I have that, I just really 80% decarbonized the operations of my residential home.

How much connectivity do I need? Not a lot, really. I'm playing around with bidirectional at my home in California with my Nissan Leaf scheduled at this point in time. If you have an outage, you use the car battery, 60 kilowatt hours, whatever, to power your home. How often does that happen? So it's sort of the core the 80% problem of decarbonize is, put a solar roof up, go electric in your household and you have massively contributed individually as a household to decarbonizing the planet, really.

Now, the commercial space, I think their connectivity is on its rise. It's really happening. Today 5% or something of buildings are smart, i.e. connected. But most new buildings go in sort of connected from the get-go with an edge device and then you have about 30% to 40% energy efficiency potential, if you connect the building. And it's the simple stuff like the lights switch off if nobody is in an office building, the HVAC zones are automatically managed, the temperature is a function of the weather outside. And so, you do some serious capacity management in the building. If you just do that with most commercial real estate, you cut out gigatons of carbon emission. So, connectivity in the commercial real estate space is absolutely key. It's not expensive to do it and it's a growing business.

Gerard [00:18:35] Let's assume you're going to be building a new Gigafactory for batteries in the U.S. or Europe. You probably need two terawatt hours of electricity. You're starting on day one. What would you tell that manufacturer to do? What should he do to optimize his energy costs and his carbon costs?

Thomas [00:19:01] So, we recently helped a large automotive company to build a 100% decarbonized factory in the building phase. So typically solar gets you to maybe 20% to 30% of total demand, not more, unless you have a massive area around your factory. But

if you then add, obviously virtual power plant, green purchase of energy. If you add biomass, which in many areas is available and isn't particularly effective for high-temperature process industries, like chemical or others. There are people doing geothermal, where it's available. Hydrogen as a source is coming up. And if you're combining that all that into a decarbonization overall concept, that gets you a long way. So it gets you easily to 70%, 80% decarbonization of the whole operations.

Seth [00:19:59] I think your question gets at the the challenge that any customer has, which is how much of the decarbonization can they do themselves and how much should they be getting from the grid as a whole? And I think it needs to be a mix. The only thing that I would say is that I think any time you're building a new facility of any kind, you should be building flexibility into the systems of that that facility from the beginning. There's such a huge opportunity to make sure that every building HVAC system is connected and can be hooked into a grid program. If you're thinking about power backup, you're doing it with storage wherever possible instead of with generation, and making all of your purchasing decisions based both on your operational needs and the revenue opportunities that you can use to offset some of the costs of those. By assuming that you're going to lend some of your flexibility to the grid.

Gerard [00:21:00] Can I ask you just about a whole area of data? Because the more you connect, the more data you have. How do you deal with this complexity around the data that we have and also the possibilities that come from that data? Because, the amount of decisions that you could make increases probably exponentially?

Seth [00:21:21] I think the data problem is real in some ways, but it can be a bit overblown. If you think about what YouTube processes in terms of videos being uploaded every second, no one in the energy world is dealing with data at that scale. The real question is, given the data that you've got, what are you going to do with it? If you're trying to provide flexibility on the grid for the consumers benefit or for the grid's benefit, you have lots of choices. If a grid operator needs 100 megawatts of flexibility for a certain window of the day, they might have 10 different sources where they can get that flexibility. So there's a question of who is most able to provide that at the lowest cost to the grid, at the lowest convenience to the operator. The underlying value in that data is to try to figure out how do you answer that question in an automated way that nobody has to worry about in real time? It's going to be impossible for any individual grid operator to be thinking about all of these streams of data coming in in real time. So the question is, what can you do in an automated way using that data and what needs to be flagged based on some heuristics on needing operator attention and then putting that up in front of that grid operator.

Gerard [00:22:46] If you've got one thing that really excites you about the future of connectivity and flexibility, what is it?

Thomas [00:23:00] So what I find exciting is that we finally start to get the total picture together, how to reverse climate change. We know that it's five areas that account for the problem. It's buildings, it's the energy system, it's transport, agriculture and industry. That's it. The full picture is becoming available now. We know it. And IoT connectivity, digitalization and the like plays a fundamental role in enabling this. So that's super exciting. So, what we should do is explain to the community around us that you've got to cut this elephant pieces. And, we know the projects we need to do across these five areas. So, we know the path, we just have to execute it.

Seth [00:23:48] So building on what Thomas said, what's most exciting is how few barriers there are to making this happen. That the technology tailwinds are all there, the customer adoption tailwinds are there, the utility adoption is there. It's kind of just a matter of doing it. The problem is big. In the U.S. market, if you think about Biden's goal of decarbonizing the energy sector by 2035, that means roughly one and a half terawatts of renewables on the grid. To make the grid run successfully, we think you need about 500 gigawatts of flexibility. If you look at how much flexibility is here today, maybe we're between 2% and 5% of the way there. But every single factor that we depend on for crossing the 20x to 50x growth we need is already happening. And we just need to put it all together to deliver on that vision.

Gerard [00:25:01] So it's a very exciting future, let's be clear?

Seth [00:25:04] Very exciting.

Gerard [00:25:06] Thomas, final words.

Thomas [00:25:08] Yeah, I don't want to end on a challenge, but the incentives, the regulation, the incentives in the energy sector, they are not right. We have a problem there. It's hard as a utility to get approval for digital investment, OpEx based investment, to try out flexibility. It's much easier to get the usual sort of costs, so the whole thing has a regulatory incentive aspect to it as well. But there is no fundamental innovation missing that might take 30 years or 40 years. Current technologies are sufficient to reverse climate change.

Gerard [00:25:49] Flexibility and connectivity are a real key part of this energy transition going forward. I presume you agree?

Seth [00:25:59] That's right. The one thing we haven't talked about today that we should make sure we talk about is the role of the end user. All of the technology, like we said, the technology is there. I'm hopeful that the regulatory barriers will come down as the opportunity presents itself. But we need to keep in mind that there are hundreds of millions and ultimately billions of individual users who need to be kept in mind. And so it has to be simple. It has to be positive for users. The incentives for users have to be right. The messaging for users has to be right. And so we need to put all of this together the technology, the user story, the regulatory model and the decarbonization vision.

Gerard [00:26:58] And that sounds like an enormous opportunity for everyone in the energy world or the technology world?

Seth [00:27:06] It is a huge opportunity. Absolutely.

Gerard [00:27:09] Thank you very much for taking the time.

Thomas [00:27:11] Thanks, Gerard.

Seth [00:27:12] Thank you.

Gerard [00:27:16] My takeaways. As Seth pointed out, we are pretty close to saturation levels in terms of connectivity and digitalization when it comes to connecting people, especially via our smartphones. However, this is not the case with connecting devices. The so-called Internet of Things, where we are at best at around 20% of potential

connectivity. We need this connectivity and digitalization to enable flexibility in the energy system, and we need a more flexible system so that we can electrify and “renewable-ize” the energy system, while ensuring resilience and lower costs for the consumer. The big challenge is that the change to a flexible system must take place while the system is running. Grid stability must not be jeopardized. The good news is that all the technologies for sustainable decarbonization are available. The technology and customer adoption tailwinds and utility adoption are there, and it really is just a matter of doing it.

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