BATTERY + STORAGE PODCAST: THE INTERSECTIONALITY OF FERMATA ENERGY'S VEHICLE-TO-GRID TECHNOLOGY WITH FOUNDER AND CEO DAVID SLUTZKY
Recorded September 2022

Bill Derasmo:

Hello and welcome back to the Troutman Pepper Battery + Storage Podcast. I'm your host, Bill Derasmo, and with me today is Mr. David Slutzky of Fermata Energy. David, thanks for being here.

David Slutzky:

Oh, thanks for inviting me, Bill. Looking forward to it.

Bill Derasmo:

Excellent. Well, David, you've got a very interesting background; University of Chicago, BA and JD and some other graduate studies as well there. But more interesting than your academic background, you've had a really varied career. You've had an interesting career journey. You were with the White House for a while, academic world. You developed something called a Phase 1 Site Assessment, which is really important in the environment and energy legal setting. So why don't you take a few minutes and walk us through your career journey and how you got to Fermata Energy?

David Slutzky:

That's a long question and I'll spare you a long answer. The gist of it is my academic work was actually in philosophy at the University of Chicago. My JD is at Chicago-Kent College of Law, but otherwise I studied at Chicago. What I focused on was centering around the long-term protection of the environment. All of my professional endeavors have related to that purpose. The early one you mentioned, where I started in the industry of environment, site assessment was a process tool I had developed back in the mid-80s. Wrote Fannie Mae and Freddie Mac's original environmental policies and kind of got that thing going. That was tied to giving the private sector an ability to function like the EPA and look for and clean up hazardous waste sites.

Other things I've done, I've pivoted into public policy a few times. I worked as a senior policy advisor at the EPA in Washington and then later at the White House during the Clinton administration. At the White House, I dealt with free trade issues but through the lens of how are these free trade agreements impacting the developing country's ability to protect their environment.

And then finally, what I've been doing for the last 20 or so years is focused on energy and the environment. I started this company that I'm involved with right now, Fermata Energy, specifically with two intentions in mind. One was to accelerate the adoption of EVs because I thought that's very important, not just for geopolitical strategic reasons, but also because of its impact on the environment. And then I also had the intention of trying to accelerate the transition to renewable energies on the grid as the source of power.

What's kind of interesting about this space of vehicle-to-grid, or V2X, as we call it, is that it sits at the intersection of those two intentions.

On the vehicle side, V2X is a technology that liberates different value streams from a parked electric vehicle and presents them to different customers while the vehicle's parked. And most cars historically were a single use asset; mobility, for which the customer paid a lot of money and then they parked that asset most of the time. So it's a highly underutilized, fairly expensive asset that you can't do without. But because you've paid for the vehicle with the mobility use, any other use you can extract from that vehicle is free to access. And that's where V2X comes in because it allows a parked electric vehicle to provide storage to the grid and get paid for it, which really disrupts the total cost of ownership value proposition of an EV in a way that suddenly makes it more compelling than a traditional gas vehicle. And so that first intention of accelerating the adoption of EVs is satisfied by the technology of V2X.

On the grid side, the single biggest obstacle to scaling wind and solar is that you have a disconnect between when the wind's blowing and the sun shining, and the customer's actually need of the electron. So you need massive storage designed into the grid to absorb all that alternative renewable energy.

There's been a massive effort for the last 15 plus years in the US and globally to build out that storage infrastructure. Billions of dollars have been spent on subsidies, mostly in California. Mandates have been imposed trying to build out a storage industry. And through the middle of 2020, that's the last time I saw the numbers, there was about four gigawatt hours of dispatchable energy stored in mostly batteries and available for this fix for the absorption of renewables.

Just the Nissan Leaf, since it became bidirectional in 2013, it's a great car, it's done well, but they sell maybe 15, 20,000 Leafs a year compared to 200,000 Sentra. So it's a quietly very successful EV, way ahead of the rest of the industry that's now catching up. A lot of those vehicles, the older ones, had smaller battery packs; 24 kilowatt hours, 30 kilowatt. Now they're up to 62. But just that group of vehicles, the Nissan Leaf, since they've been bidirectional in the US, have more storage under the hood than the entire stationary storage industry. That's a really stunning data point.

Bill Derasmo:

Stunning statistic. Absolutely.

David Slutzky:

Basically, what Fermata Energy does is we enable electric vehicles to provide storage and other value to the grid, to utilities, to buildings, different customers so that the vehicle could earn money while it's parked and to accommodate their scaling of renewable energy on the grid.

Bill Derasmo:

It's a great journey. It sounds like you've got a moment right now, so to speak, with your company because you really hit on the challenge. We're really trying to scale up as a nation our EV fleets. And the entire legislative push this last session in terms of the Infrastructure Bill and then of course the Inflation Reduction Act, which is kind of one of the elephants in the room

right now, how that's going to be implemented, and there's such a push right now to figure out a way to get the United States to have a much higher percentage of EVs.

But at the same time, and here's the hook I think for your company, at the same time we're also in the midst of a historic transition of our entire generation fleet on the utility side, on the grid side. You've got massive amounts of retirements of conventional resources. That creates some issues obviously where we're cleaning up the air pollution and the carbon output and all that. But from a physics point of view, it does create operational issues.

Like you said, we've had a massive build out of storage and it sounds like your company could sit right in the middle of those two transitions. The transition of our transportation fleet, the transition of our generation fleet, and your company with this bidirectional technology can aid with both, obviously. I think your company right now is having a moment. Talk to me about the Utility Partner Program, or UPP, that your company talks about on its website.

David Slutzky:

Let me give that answer in a little bit broader context. The issue of traditional storage being the solution, the path, if you will, to transitioning to renewable energy as the generation source, is wrought with complexity partly because the cost to access that stationary storage is not insignificant. There's a lot of capital expenditure that has to be put down on the table to buy a bunch of batteries to put them in a building to then present them to the grid.

I like to think of a mobile battery as it's basically free. It comes with the leather seats and the air conditioning. It's paid for by the mobility duty cycle of that vehicle asset, but yet parked most of the time. What we're able to do is, I don't want to say undercut the storage industry, but provide a much better value proposition to rate payers on the utility side to be able to gain access to this disruptively scalable storage solution that will in fact enable an accelerated transition to renewable energy.

One of the challenges though, to make such a significant change, is policymakers. Not just the utilities, but policymakers and utilities struggle to keep up with emerging technology. We have a utility partner program designed to enable utilities to kind of kick the tires, pun intended, on the technology. We do some V2X things with them, but it's really about getting the utilities oriented in the technology so they can understand how much value it can provide them.

For example, right now, utilities have a blunt instrument they use to manage the system-wide peak load. On a hot summer day in the afternoon, to be able to buy the extra electrons they might need from the wholesale market is very expensive. So that's why they've been putting storage out to kind of manage their loads. They also, in the case of California, don't even have the generated capacity to keep up with loads at this point. When you take nuclear plants offline or you lose other aging infrastructure, if you can't displace it quickly enough with emergent technologies like renewables, you have a real load crisis.

We've run into that. We saw it in Texas a year ago February where it got real cold, colder than normal, so everybody turned up the heat and the grid kind of blew up. It really couldn't keep up with it. It couldn't generate energy as fast as customers needed it.

Think about how if everybody's going to go to electric vehicles and put them on the grid, they're going to be charging them. They're just more load. If we added a million electric vehicles to Texas a year ago February, it would've made what was effectively a load problem, a much worse load problem. But if we installed bidirectional vehicles and bidirectional chargers at

scale in Texas, we could have addressed a lot of the load challenges because we could have dispatched power out of the vehicle battery into the grid to be used by a customer somewhere else in the grid to substitute for the generation that was constrained by the cold weather and bad planning.

So getting the utilities to understand the use case that's for this technology, how they can derive value from it, is one of the reasons for the Utility Partner Program and one of the challenges of a newly emergent technology.

The other one frankly is regulators. Policy is being made in real time. You mentioned the recently passed IRA Bill. The DOT and the DOE are making the rules, if you will, of how the act is implemented. There's a subsidy for fast charging infrastructure. The agencies at the staff level make policy choices and regulatory activities to make those rules, so we know what we have to do to get the money.

They actually are doing something that's really bad for the emergence of electric vehicles and for the expansion of V2X. They're trying to require that all the chargers have a charger connector that's called CCS. There's really four ways you could charge a vehicle. In China, they use something called GB/T, which is kind of like what originated in Japan called CHAdeMO, and that is what the Nissan Leaf uses, and a few other OEMs. Most of the OEMs now are going in the direction of CCS because VW, when they deployed a lot of chargers through Electrify America, promoted the CCS standard. And now that everybody's looking, where can I get my vehicles charged; oh there's a lot of CCS chargers. I guess I better go CCS. That sounds good on the surface, but if the regulators dug down into the weeds, they'd realize that today there's almost 200,000 Leafs available that are CHAdeMO. Policymakers are in effect cutting off access if they limit the money to only go to CCS chargers.

Similarly, the actual operation of bidirectional charging, it works flawlessly with CHAdeMO because it was designed by a utility and an automotive maker and it was designed to protect the grid and to protect the car and to be saved. So it's a very well designed, bidirectional charging standard. But CCS has some technical flaws in the way it was designed, and the result of that is people who are trying to do V2X, or vehicle-to-grid with CCS chargers are struggling to make it work. That will be overcome eventually. I personally couldn't care less whether CHAdeMO or CCS, but I will tell you that in the near term, CHAdeMO works and CCS struggles, and there are a couple hundred thousand CHAdeMO vehicles out there and not too many CCS. So, policymakers making bad choices can sometimes delay things.

Similarly, utilities resisting as opposed to embracing a newly emergent technology because they don't understand it well and it's frightening to them and it's new and they don't like that, that's another problem. So by having a utility partner program, we got utilities to kind of look close up and personal at how the technology works. And we can work with the utilities therefore not only to do the obvious things like handling their load management. They already are doing that with stationary storage. This is just another form of storage you can drop into those existing programs.

But there are other value streams that can be extracted from a parked electric vehicle that utilities can use, but for which today there isn't a monetization mechanism in place to enable that commerce. So having a utility partner program with the utilities can work with us to understand the technology more deeply, makes it possible for us to, together with the utilities, figure out how to monetize their access to these additional value strips. Does that make sense?

Bill Derasmo:

It does. It does. Let me just turn that question around. In terms of bidirectional from a retail customer's point of view, from the person who goes out and buys the Nissan Leaf, how does it work in the sense of how am I going to be assured that when I want to go out and go to the grocery store, even though my battery's been feeding energy to the grid that day, when I go to start up the car, it's going to start and it's going to have charge left for the mobility application?

David Slutzky:

Bill, that's a great question. Let me put something out there for you to think about. Right now I mentioned that stationary storage was expensive and that mobile storage, electric vehicle storage is effectively free because it's paid for by the mobility duty cycle of the vehicle. That's true. But there are two costs, if you will, not monetary costs but costs associated with accessing electric vehicle as a storage source.

One, the one you mentioned, is the mobility duty cycle for that vehicle is what paid for it in the first place. So you absolutely have to dance around, if you will, or be very protective of the customers need to use the vehicle when they want to use it for as much time as they might need to use it for or they're not going to let you mess with their battery. Plain and simple.

The second cost that a lot of people don't think about, but the car companies do and that's the fact that US auto manufacturers are required to have an eight-year, 100,000-mile warranty on their batteries. They have to do that to sell cars in California, which means they do that across the country. The OEM, the car companies, have real concerns about battery degradation just like their customers do. Yes, the customer has a warranty coming from the car company protecting them, but the car company is on the hook for that warranty.

So it's the case that until literally last month, until September of 2022, I say that in case people listen to this conversation in the future, really if you did V2X, vehicle-to-grid, you probably voided your vehicle's warranty because the OEMs have designed their batteries to accommodate their anticipated mobility used. But if you now while the car is park start beating up the battery by discharging and charging it, they don't know how that's going to affect their battery, so they say "Uh-huh, you can't do that without voiding the warranty."

We've gotten a pretty advanced portfolio of IP around battery degradation. We've, as a company, got a lot of scientists who've studied it and we work with third parties to really deepen our expertise. And we have been able to demonstrate sufficiently to Nissan that we aren't going to hurt their batteries. And so they announced last month that we have the first and only vehicle-to-grid system that will not void the Leaf warranty. And we are in the process of doing that with most of the major OEMs around the world that we're working with.

I think you'll find over time that the OEMs become comfortable and it isn't actually that problematic for the battery. There are some ways in which V2X makes the battery healthier because you don't keep the battery at 100% state of charge all the time; you're keeping it at a lower level. That's valuable. And there's some other aspects of it. It's closely monitored. There are ways we can protect the battery by, for example, keeping tabs on the temperature of the cells. And in doing that, then we can manage the use of the vehicle for V2X commerce in a way that's protective of the battery. And similarly, we can coordinate with the vehicle operator to protect their mobility use and then we get the access to that storage.

So that's what we do. We always give the vehicle owner the choice of whether or not to drive. We give them the choice of whether or not we're going to use their battery at any given time, so that we do overcome that understandable concern that they might have.

Bill Derasmo:

You hit a lot on the warranty issues — and I'll just go off a little bit on a tangent — but I think it's relevant.

It's interesting that you get into the warranty issues and the cycling of the batteries because taking it out of this context and going to the, now it's kind of the quaint old world of 2015, 2016 when batteries were being installed in mass on the PJM grid, which is the sort of Mid-Atlantic grid operator where Virginia sits too, there were warranty issues that popped up because the grid scale batteries that had been installed at that time were being cycled up and down and being operated in a manner that really hadn't been contemplated by the manufacturer. That's always the case, and I think we've talked about it a lot in the past. You got to be careful on these warranty issues, whatever the use case is, that those are always issues to keep in mind. I'm coming at this from a lawyer's perspective. You're an attorney. I always have to stop and mention the warranty issues because it's a huge deal in the storage space and the cycling up and down.

It's interesting also that you made the point about in certain respects the bidirectional nature of the battery could be healthier because my understanding is when you have the battery at 100% charge and then you bring it all the way down to zero, then you bring it back up to 100%, then you bring it all the way down to zero, that's actually the least healthy way to deal with a lot of batteries. Probably depends on the chemistry to some extent too.

Anyway, that's just a little tangent on cycling of batteries, warranties and staying within operating parameters., I guess is the best way to put it.

David Slutzky:

Still, you raised an interesting point. The PJM, as you described, it's the largest node in the US power grid and it's from Chicago to New Jersey to the top of North Carolina. We, back in November of 2016, actually took four Leafs and four bidirectional chargers and aggregated. There are three different locations around the city of Danville, Virginia, which has been a fabulous test bed for us, by the way. They've been great to work with. We participated in those vehicles in the frequency regulation market at the PGM. Fermata is a full member of the PGM and a curtailment services provider in the PGM, so we participated our own assets in that program.

What we learned were two things. This is interesting to study these use cases. The frequency regulation program is designed to manage the sign curve of demand that sits at the top of the demand curve. So there's little oscillation of imbalance between generation and load in real time, can mess with the 60 hertz requirements of the grid, and so they have to have a program or a method to manage that. But what that means is they send a signal out every two seconds to charge your discharge, in fact.

And so, you have a lot of throughput. It's not a long duration event, but it's constant and it's typically at full power. So you're really working the batteries hard when you're doing that particular use case of frequency regulation and it's an around the clock program. So that's one

of the battery degradation concerns the OEMs have is somebody just parks my car and uses it for frequency regulation 24/7, they'll make some money and they'll kill my battery pretty quickly.

On the other hand, there's another problem with that market, which is the more vehicles you put into it, the more storage you enter into, it's not going to have that particular requirement of the grid grow, commensurate with the participation so you get less and less money per unit of participation. So that's an application that has its place on limited circumstances depending upon how the frequency regulation markets are designed. But we look for what are the different use cases, what are the different programs that exist today that can participate? And then, do they make sense? And if not, we would stay away from it even though we could participate in them.

Bill Derasmo:

I'm getting excited and you probably saw me where this is an audio-only production, but I'm smiling because now you're talking my language when you get into frequency regulation, and of course my favorite primary frequency response, if anyone's listened to past podcast episodes, because that was my entry into this space. I represented a company back around 2017 and we were trying to make the case to get compensated for primary frequency response for a grid scale battery. We got some good relief on that, and it led to Order 841. But that was my entry into this whole space. And obviously batteries, particularly lithium-ion batteries, the ones we were dealing with in that case, can respond in a nanosecond to provide primary frequency response support. So when we get into PJM and Schedule 3 and all of that, now you're getting me excited because that's my language.

I understand what you're saying. There are so many different use cases as the industry continues to take shape. But those are all the types of challenges that you have to continually take account of, important issues I think on the technical side. Let me just switch gears for a second and just ask you based on your experience I think some questions that might be of general interest.

You mentioned that you had a trade background at one point. You were involved in trade policy. I didn't plan on asking you about any of this, but what struck me when you ran through your career bio was that right now in this country we've got this real emphasis on trying to re-shore production technologies, et cetera, trying to shore up our supply chain. And there's a lot of reasons for that, but it's sort of like we've gotten into industrial policy here in the 2020s that's really centered around trying to have as much of this industry be homegrown. At least that's my impression. And if you look at the Infrastructure Law and the IRA again and some executive orders both out of Trump and the Biden administrations, there's a real emphasis on that.

So I was wondering just based on your experience, if you could give us a sense of where you think that's all going and also how your company fits into that picture.

David Slutzky:

It's a really interesting question. Of course, I'm not prepared to respond so I'll have to wing it a little bit.

I will say that one interesting thing that I think came out of the Trump administration is an awareness that if we invest public dollars into technologies that create domestic jobs, we're getting maximum value out of that investment of tax dollars. If we end up paying for infrastructure that's made overseas, we might be the beneficiaries of that technology, but the jobs that are being created aren't ours. And so there is an appropriate orientation I think across both parties towards let's make things in America. Let's put Americans back to work. That has its own challenges because we have so much of that that we've already stimulated and there's much more to come, that we don't really have enough workers to satisfy those needs.

So it's going to be bumpy. It's going to be awkward. We're going to try to bring onshore the manufacturing of these emergent green technologies that certainly include bidirectional vehicles and chargers, but it's not going to be easy to do. We have, for example, to develop our software platform to execute vehicle-to-grid. We're really struggling to get enough talent because there's so many newly emergent technologies across the spectrum that are competing for those same talents that it's very challenging for the startups to actually do what they need to do just because of the workforce challenges. And yet we are going to appropriately continue to push for domestication of manufacturing as well as domestication of R&D.

And so I think we're going to have to really look oddly enough at immigration policies again to make sure that we're allowing ourselves that relief valve of being able to access good workforce participants.

I'm not advocating for any particular policy outcome, but I'm just from the high level observing that we have to think through all of the dimensions of this domestication of manufacturer and emergent new technologies, particularly in the green space, and make sure that we have a workforce that can satisfy our appetite.

Bill Derasmo:

Well, I appreciate you taking on the question because I know I threw you a curve ball, but it just struck me as we were talking that that was a really interesting trend and I wanted to get your take on it and I appreciate that.

You mentioned software, and you said you've got a charger platform. I have in my notes that you worked with Duke University at one point on that. I'm just wondering if you could talk about your charger platform and some IP software that you may have developed around that.

David Slutzky:

Let me quickly set the definition of what V2X is and what it takes to do it. To do V2X, you need three things. You need a bidirectionally enabled vehicle, you need a bidirectional charger, and you need software to enable the interoperability between those two assets and the different grid facing revenue opportunities.

On the vehicle side, the car companies, the OEMs, have figured out that it's going to cost them nothing to make their vehicles bidirectional, but they're worried about battery degradation impact. So they've been holding back until recently on enabling that functionality. Now that they've gotten to understand it better, and now that Nissan, frankly with the success we've been having where the Leaf is paying for itself in a number of customer sites, now all the OEMs are starting to realize they have to be bidirectional.

Similarly, on the charger front... And I should add. My company, Fermata Energy, we're agnostic as to OEM. We work with all of them happily. Some, we've had public announcements about our working together, and others we're just working quietly together and it will become public. But we, like anyone else in the V2X space, should be vehicle agnostic.

The second piece I mentioned was the chargers. There's a lot of people who think it should be an onboard charger, some think it should be off board, some think it should be AC, some think it should be DC. A whole other podcast could be allocated to that discussion. But trust me that for at least the near future, it makes the most sense to be off-board DC. So you need somebody to make an off-board DC charger that can get the required certifications that will enable the utility to allow you to discharge into their grid system. You need bidirectional UL certified chargers that are off-board the vehicle and that are DC.

We needed those desperately in the early days and we couldn't get them. There was a company that did make some. We worked with their chargers. That company we thought wasn't going to make it, and they're no longer in business. We were right. We've tried to get major charger companies to go bidirectional, and they didn't understand the economic value. They didn't understand the benefit. So they were slow to do that.

So we ended up buying a spinoff from Virginia Tech called Power Hub where they had a design for a 25 KW off-board DC bidirectional charger using silicon carbide and some pretty advanced technologies, and we ended up acquiring them so that they could spend all their time making the first charger. And back in March of 2022, Fermata's FE-15 became the first UL97 41 certified bidirectional charger in the world. Not a small thing. But we're not a charger company and don't want to be. Hopefully, that's the last charger we will ever make.

What we're doing now is working with bunches of other charger companies around the world who get it finally, to help them homologate overseas products for the US UL certifications or start from scratch with a new design. We're working with many of them, bringing our power electronics experience and our UL certification experience to the table to help them get the right set of features and solve the technological challenges so that we can access lots and lots of chargers. And we are similarly, to the vehicle, charger agnostic.

The one thing that we absolutely want to keep proprietary is the software platform. The team that we started with had developed the software platform for Duke Energy's microgrid system, the OpenFMB. These guys understand how different power electronics things have different power electronics characteristics and different communications protocols for how they operate. You need your software for V2X to be able to have all of those different elements function as a single unity when you present it to a grid-facing revenue generating market opportunity.

It's deep in our DNA of our software team, this understanding of the challenges and opportunities of working with different power electronics elements. And we've added to that a lot of data science capability because you need to predict when the vehicle's going to need to be driven versus when it's going to be charged. And optimization because you need to know if I've got six things I could do with that vehicle today, in the V2X world, which is going to be most lucrative, so you can optimize the ability of that vehicle to earn money?

So we've got a pretty robust software platform that we've developed and we're using it right now at sites across the country using this FE-15 charger. And we actually yesterday announced our next generation charger, an FE-20. That, hint-hint, it's made by somebody else for us. It's

made by Heliox from the Netherlands. And that charger will be available early next year. It's also a commercial bidirectional charger, but it's 20 KW and has some other features.

We are working with other charger companies now so that we have the full spectrum chargers that we need. And we need to integrate their chargers with our software platform, which in turn needs to be integrated with the grid. So we use APIs if we need to integrate with an existing incumbent, let's say demand response program manager, or some cases utilities creating a whole new program, they want us to operate it, we're fine either way. We don't want to disturb an incumbent or they won't like us. Our business isn't to do that. It's to manage the vehicle assets, optimize their availability to the different customers who see value in that asset.

Bill Derasmo:

Well, there's a lot in there, but I appreciate you walking through that because I think I may have combined different concepts at the outset. So I appreciate you walking through that. I did see on your website that you had the FE-20 information on there as well.

For our audience, if you want to learn more about David and you want to learn more about Fermata Energy, it's fermataenergy.com, F-E-R-M-A-T-A energy.com. There's a lot of information on there. There's information about their management team as well. There's a host of information out there about the company. And you can learn more about David as well on the company website, or also you could go to the University of Virginia and check out on the academic side what David's up to.

I really appreciate you being on the program. It's a little bit of a different discussion for us today, I think, on this podcast. But it's an important one, because as I said, I think right now, and you've had a moment for a while, but right now I think there's really an inflection point. Maybe that sounds a little cliche, but I just think it happens to be accurate. You've got these two massive transformations happening. One in the mobility space, and the one that I admittedly am a little more familiar with on the utility side, the transformation of the generation fleet. And you guys sit really in the middle and can take part in both of those transformations. So I really appreciate having you on the program.

I'll leave it to you to get the last word if there's anything else you want to share with our audience.

David Slutzky:

Bill, I really appreciate the opportunity to share some of my experience with V2X technology and give it the light of day with a broader audience. It's really important technology. To your point, it's going to be very disruptive of the auto industry and of the electric power industry. We do sit at the intersection of those two transformations, but there's a lot of misunderstanding about what V2G is. A lot of people think that managed charging is the same thing, but it's not. It's just not doing harm to the grid. V2G is actually discharging into the grid, which provides value to the grid.

So getting the regulators, the marketplace to understand the technology is really important, and I'm grateful for your efforts to give this opportunity to your listeners to learn more about it.

Bill Derasmo:

Sounds really good. Sounds really exciting. We might have to have you come back on the program a year from now or something to see. We could talk about all the different changes that have happened, because I think the change is coming fast. Again, I use some of these cliches; "Life comes at you fast," but I think in this particular space, it's entirely accurate.

Thanks again, David. And I think we'll wrap it up there.