MacroVoices Episode 548

Feature Interview with Carly Anderson

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Carly: You can't understate the importance of hyperscalers and data center builders to opening up these new markets and creating the conditions for a nuclear renaissance, because you really do need somebody who's willing to sign a twenty-year PPA for a hundred dollars per megawatt hour, and that didn't exist until a couple of years ago.

Erik: That was Dr. Carly Anderson. I'm Erik Townsend, and this is Macro Voices, the free weekly podcast targeting professional finance and sophisticated private investors. Episode 548 was produced earlier in August 2026. We've got a special treat lined up for you this Labor Day weekend. Dr. Carly Anderson is one of the smartest and most interesting investors I know.

She's a PhD energy geek whose day job is being a venture capitalist specializing in early stage investments in the energy related technologies that have the potential to change the world. She's an early investor in Aalo Atomics and a frequent source of new and exciting energy related investment ideas.

We'll discuss the formative nuclear renaissance in both nuclear fission and nuclear fusion, turbine technologies, laser enrichment of uranium, and much more in this interview. Joining me now is Dr. Carly Anderson, who is the founder and managing director of Timescale.vc. Carly has a PhD in chemical engineering, although that's doesn't sound nearly as exciting as what her PhD thesis was, w-was on, which was actually creating s- miniature lightning in order to heal wounds.

Fascinating stuff. Carly, it's not actually all that surprising that you went from a PhD in plasma to eventually becoming my favorite champion of nuclear fusion energy. But why don't we start with something that we actually agree on, which is nuclear fission? What do you think are the most exciting things that are going on in terms of this nuclear renaissance?

What do investors need to understand about it?

Carly: Thanks, Erik. It's great to be here. As I think a lot of people have noticed, hopefully, it's been a crazy exciting year in terms of ground being broken on new demonstrations for some of the smaller reactors, as well as continued progress on the regulatory front and on supply chain maturing for some of the larger designs.

I know you've talked to many people on this show already about the happenings earlier this summer at Idaho National Lab. Fantastic to see so many new companies deploying technology, or at least at the first steps for showing that their nuclear cores work. In the coming twelve months, I'm sure we'll see many more milestones from some of these smaller reactor companies.

Again, I know we're both very excited about this space and being able to come down that cost curve and rapidly iterate on some of these new designs. On the larger end of the spectrum I think there's a lot of stuff that people don't hear about in the headlines around restarting, obviously, some of the older nuclear plants, potentially one of the fastest ways to get gigawatts of nuclear power back on the grid There's also some work going on to increase the power production at existing nuclear plants, and that's an area that I think is super exciting because it's also a way to bring more power online fast to meet the growing demand that we keep hearing about from the electricity sector to power data centers and all kinds of new infrastructure in the US.

Erik: Let's talk about what it takes to do that, deliver the goal, which is more power data centers, blah, blah, blah, so forth. Okay, but conventional nuclear power plants take at least a decade to build and sometimes longer than that to get permitted and sorted out and so forth. So what are the bottlenecks, and more importantly, what do you think are the technologies or trends or changes or whatever you wanna call it, that's going to allow us to not have to take upwards of a decade in order to deliver more energy using nuclear technology?

Carly: Great. I-- one of the key things that I think we're both very excited about is mass producing as many components for these reactors as we can. This is something that should shrink the lead time for everything from the reactor vessels to the pumps that move the fluid around inside these power plants, to the instruments, to the safety mechanisms, to days, if not weeks, if not months.

If you look at the time it takes to build a standard nuclear power plant, and standard is that kind of one thousand megawatt chunk, you have to... By the time you get through site works and then concrete pouring and then shipping these massive metal containers to site, Vogtle was way, way over schedule and over budget.

I think the best people in the world are installing these in five years. That's not as fa-- that's not where we wanna be, right? We're looking at designs on the smaller end where you could deploy in less than two years, ideally on months. A typical data center is go-- one building maybe goes up in nine months at this point, and you really want your power generation systems to be able to match that timeline.

So mass manufacturing, love to see that coming out of companies like Aalo Atomics and some of the other ones on the small end of things. In terms of other bottlenecks, it was great to see Part 57 released from the NRC to create a pathway for advanced reactors that looks different From the traditional methods for light water reactors, those regulations were set up very specifically for technologies and in a way that just isn't applicable to some of the s- some of the newer designs.

It's exciting to see some of the fuel supply chain mature, which we can talk more about, and the power generation side of things, and like all the other things besides and outside that, what we call the, the nuclear island, which is like where the magic happens and the fuel produces heat. All of these components have to come together, and we're seeing that happen a lot faster at that smaller one to 20 megawatt scale.

Erik: Carly, let's talk about how this nuclear renaissance market is coming together in terms of where the opportunity is. The way I'm seeing this, what we're seeing in terms of grid-connected energy is mostly discussion about more light water reactors, good old-fashioned Eisenhower era technology nuclear reactors designed in the 1950s.

Build more of those things. That's the thing to do. Advanced nuclear, the stuff that I tend to get more excited about, costs more. At least in the beginning it'll cost more, and that means somebody who can afford to pay up for it has to be the customer, and there's not a whole lot of those. It seems like what we're seeing is advanced nuclear is really finding three niche markets, which is the military market, where people have a Pentagon-sized budget for whatever special thing and, they can just afford to do whatever they want.

You've got out in the middle of nowhere, the market that is for microreactors that is now dominated by large diesel generator sets that run remote mining villages and so forth. There's a, a, a nuclear angle there. They can afford to... if you're-- right now if you're-- what you're spending money on is every week you gotta deliver another flight, goes up to the middle of the Arctic Circle someplace just to deliver the next load of j- of diesel fuel for your generators to run whatever you're running up there.

If you can replace that with a nuclear reactor, you don't have to make that weekly fuel flight, and it's a, a huge cost savings. There's a market there. And then the last one seems to be data centers for AI. Would you agree those are the markets? Do you see any other markets? And which of those do you think is gonna be most exciting, and which technologies do you think are going to drive the most profit?

Carly: Great, Erik. I think that's a perfect rundown of three key areas for our early nuclear deployment. And I'll touch on the first two very quickly. Defense is a, has been a fantastic enabler for so many technologies coming out of AmErikan labs. I think across our portfolio, they've been an early customer able to help buy down technical risk for things in the autonomous autonomous transportation space.

Think drone delivery in terms of new materials, in terms of satellite capabilities. That, that is a fantastic market. It is limited. I like to say global markets are bigger, and at some point we're in a place where there's only so many bases you run into export controls and, while this is a very important tool for-- these are very important markets, not just for scaling, but for national security.

From an interest standpoint, at some point you start bumping up against barriers If you are in those markets alone. They're also very well-suited to very small reactors. So again, these are the microreactors. These are less than five megawatts, often one megawatt, maybe even 200 kilowatts. Those, they map also very well onto remote communities.

So think about mining installations, think about Alaska, and again, like in those places, these are very important technologies. There often aren't alternatives. But if you think about the one, the, the trillion dollar broader energy market, those technologies aren't going to participate in a significant way, you need 1,001 megawatt turbines to equal one AP1000, and you do run into cost challenges when things are that small. You get a lot of benefit from mass manufacturing, but there is also benefit, particularly when you get to turbine systems and engineering systems, to having things be at a slightly larger size.

So I said that was gonna be short. It took a little bit longer to get here than I wanted to, but getting into the data center market, I think, that is where the real opportunity is from a from a return standpoint and from a change the world standpoint in my view. If you think about... And I think you can't understate the importance of what the entrance of hyperscalers and data center builders has been to opening up the, these new markets for nuclear and creating the conditions for a nuclear renaissance 'cause you really do need somebody who's willing to sign a 20-year PPA for $100 per megawatt hour, and that didn't exist until a couple of years ago.

If you think about what had to happen before that, individual utilities, energy utilities in the US are relatively small. Some of them operate two nuclear plants, some of them operate four nuclear plants. They're hyper-local. What you can do as a hyperscaler is you can help create those order books for a dozen plants or more, and you can cr- you provide a secure offtake you make the project financeable.

And so that market from like a size and like opportunity also to then start exporting to other countries is huge. Just to comment on that for a second, 'cause I think that's been something that's frustrating a lot of us in the industry and has for a long time, is watching like what's available to the broader global market for nuclear.

Today there are about 80 reactors under construction around the world. I think about 60 of them are Chinese design. There's something like 30 Chinese plants getting built around the world right now. They are gonna double their amount of installed capacity within the next five years. They're installing five to 10 gigawatts of nuclear power every year and will do that for the next five years.

They have a 10-year plan. If you look at the Russian designs, India is building most of its nuclear capacity out in partnership with with the, the Russian state-owned organizations, right? There's a split where an Indian company is in charge of the project and a GC is Russian. But if you're not in the US, your options right now are China or Russia.

The South Koreans haven't been participating in a meaningful way. How do we get to the point Where the US has a reactor model that we have proven that we can build on time and on budget. The timeline for starting today and getting an AP1000 online and getting the confidence behind that is, I hate to say it, I think it's 10 years.

If we're lucky, we can bring it into seven. If we are starting with some of these smaller micro reactor technologies where like you and me, Erik, like we're hoping to see one online in 2028, maybe 2029 if the timing slips. But once you have a plant like that, once you have a reference facility, you can build an order book much, much more easily, and you can start iterating, doing the things you need to do to bring the cost down, and I think you can get to a much more cost-re- cost-effective reactor in 2020, 2030, early 2030s very soon.

And that, that creates a pathway for larger reactors and scaling up from there based on the learnings earlier on.

Erik: Let's talk about what's most important in order for this nuclear renaissance to really succeed and change the world, as you put it. I'm very passionate about changing the world and making it a better place.

So I think the big, the killer thing here is factory mass production. And I think it's really important, Carly, to distinguish the word mass production. I'm not-- a lot of people in the nuclear business are talking about factory production. It's more efficient to do it in a factory off-site someplace as opposed to building it on-site.

I'm not talking about that. I'm talking about like assembly lines with hopefully robotics that are very quickly, very efficiently, very precisely and repeatedly with very careful quality control, assembling new nuclear reactors at a completely different pace than we've ever considered before. So I think that's the single most important thing, and frankly, I don't think anybody got it until the last year and a half or so.

Now we're seeing companies like Aalo in the larger space. In the micro reactor space, there's several companies. Radiant is one. You probably know more than I do and please tell our listeners what the others are. But we're seeing people, I think, finally catch on to the idea that we need to do for the nuclear reactor what Henry Ford did for the automobile.

I think that's the most important thing that gets us to eventually nuclear energy costs less than fossil fuel energy. Would you agree with that? And if so, what are the other bottlenecks? What are the things that we need to know about in order to get to the point where we can really seize this vision?

Carly: I think that's a huge component, Erik.

I think I come down more on speed to reference facility. I really wanna see these reference facilities up as soon as possible. And then after getting a references facility online, it's what is the cost of your reactor at scale? And I think we're both aligned that by leaning into that mass manufactured approach and building units that are small in space and can be shipped to site very easily, and where teams can iterate and learn quickly, I think you're gonna reach the cost you need to be competitive with diesel gen sets first and then with other forms of generation later much more quickly.

There are other bottlenecks as well. Nuclear fuel is one that gets, I think, a lot of air time, as it should for good reason. Very much a fan, and I think one of the things about Aalo that both of us recognized and immediately resonated with us was the ability to use fuel that is available today, like what's called low enriched uranium.

It is the same fuel that's used in every nuclear reactor, the ninety to a hundred nuclear reactors that are operating in the US around the country right now. That said, looking forward, across multiple parts of the nuclear fuel supply chain, there needs to be significant updating and additional capacity built out.

When you're making nuclear fuel, there's a number of steps, right? Once you've mined the uranium, you have to get it into a form where you can do enrichment. That step is a bit... it's a bit challenging from a chemistry perspective. It's also very concentrated. There are like five facilities in the world where we do that uranium conversion today.

One of them is in the US. That plant is very old. And looking forward, a lot of that capacity is currently in Russia. There are executive orders stating that we will get off that conversion supply by twenty twenty-eight. There is currently not an alternative, and multiple companies are running to, to fill that gap.

Erik: Let's talk specifically about what technologies are gonna change the market and make it better. So for something like enrichment, it was originally done with this technique called gaseous diffusion, then they moved on and eventually got to centrifuges, which is the current technology. The-- It looks like laser comes next.

So what-- let's go through whether it, it be conversion or enrichment and so forth. What are the technologies in nuclear energy that are maybe candidates for upgrades?

Carly: Great. Yeah. So just to... As, as a broad strokes, what the fuel cycle looks like right now is you mine it, you convert it to a form that you can enrich it into something.

You mine it, you do conversion, you enrich it You deconvert it, you fabricate it into fuel, and then you ship it off to your reactor. On the enrichment side of things, like you said, there's been some shift from, the OG gas diffusion technology to gas centrifuges. Now lasers have emerged on the scene.

I would like to believe that lasers are the future. It's not a foregone conclusion yet. General Matter has is working very hard on updating the more traditional gas centrifuge technology. Right next to them in Paducah, Kentucky is I think one of your favorites GLE, who are working on doing that similar separation separating the uranium 235 from 238 by exciting only one of them with lasers.

That looks potentially very promising. In terms of the number of like individual units that you would need like lasers can be much, much more efficient about only hitting one isotope, not two There are other processes as well. One of the companies I really like, Hexium, down in Texas, is using a different laser technology starting from lithium metal.

So now you don't need... The, the process of conversion and enrich- and enrichment typically uses fluorine chemistry, which people probably know fluorine from the dentist, but fluorine likes to interact with bone. The dentist is a good way. Usually, fluorine interacts with human bones in a very, very nasty way.

So by avoiding that and going through lithium metal, that removes some of the safety safety things that you might wanna think about or worry about. I think one of the things I'm excited about as we develop a lot of these new chemical processing technologies is there will be adjacent technologies that benefit.

Rare earth element processing technology, for instance, a lot of that could be done more efficiently with fluorine chemistry. Again, it's not something we do a lot in the US for some good reasons, safety, environmental, et cetera. But also that pushes it to other parts of the world where, it would be nice to be able to do a lot of that here for multiple reasons.

Erik: Currently, the heat energy that we get from nuclear energy is generally not usable as heat. We usually have to convert it into electricity first, and the process that we've historically used to do that, which is steam turbines, are incredibly inefficient. The thermal efficiency of a steam turbine's only about 30%, so more than half the energy gets wasted.

Is there any any hope for fixing that?

Carly: Yeah. In terms of technologies to turn heat into electricity, this is another area we've seen an explosion of companies trying to change how we're doing this, particularly around on one side, how do you manufacture turbines in a much shorter time period, but also what other types of turbines or power generation cycles are there for converting heat to electricity much more efficiently?

One of the technologies that I think we're both very excited about is using supercritical CO2 as the working fluid in these turbines If you do that, you can go to higher pressures and you can make the turbine equipment very small. And this again plays into that mass manufacturing argument where if you can make something small, if you can use less material, you can iterate quickly, you can come down the cost curve, and with that particular cycle, you can reach very high efficiencies of fifty percent even, which gets you much more power per heat source, whether that's a nuclear reactor or whether that's something else.

Erik: Carly, I wanted to start with a fission warm-up because that's where we always agree on things. Now let's move into the fun stuff. Nuclear fusion, I think the one thing we can agree on is it's gotta be the coolest kind of energy ever conceived. I think you gotta get to dilithium crystals on Star Trek before you can get to something that's cooler than the idea of nuclear fusion.

And just for any listeners who don't understand what it is yet, nuclear fission is when you've got a big, heavy element like uranium and you split it in half. Nuclear fusion is when you've got teensy-weensy small atoms like hydrogen or helium and you squeeze them together in order to make a bigger atom.

That also releases a whole bunch of nuclear energy. That's called nuclear fusion. Carly's a whole lot more bullish than I am on it. So Carly, first of all, you win hands down that it doesn't get any cooler than that. But once we set aside the techno-geek excitement about how fascinating that technology is, I like to focus on how we can actually make the world a better place, and I'm convinced that hinges entirely on making nuclear cost less than energy from fossil fuels.

I just don't understand why you and others are so focused on fusion when we've already got fission figured out. A-and it's clearly going to cost less or take less time using fission to get to the technology so it costs less than fossil fuels. Why do you wanna go do all this really cool technology that I don't think is commercially viable?

Carly: Ouch. Wow, Erik. Okay. So you said two things. You don't see how it costs less, and you don't see how it arrives in time. And I think let's start with that later one, right? We're both excited about microreactors and having some operational in, in twenty twenty, maybe twenty twenty-nine. But most of the new nuclear reactors, at least in the US, aren't gonna come online until the early to mid-twenty thirties, at least for the larger plants.

And so by the time you bring-- We installed six gigawatts of natural gas last year in the US By the time you get to six gigawatts of new nuclear deployed, I mean include two restarts, include, okay, X-energy's unit, maybe one terrapower, maybe one of some of these larger three hundred megawatt SMRs, and then include the time to ramp up to even a hundred megawatts, and we do think it will go well beyond that.

We're all talking about the same time period here, early twenty-thirties, and that's when we are going to see fusion power plants operational, which to me is incredibly exciting. I know, Erik, you're-- you like to say "Why are we already breaking ground on these things?" But I think a lot has changed in the fusion landscape that people aren't aware of.

For one thing, a lot of the component technologies have gotten much cheaper and much better. To take a, a quick dive into fusion technology, short I promise, you can confine a star on Earth with magnets, or you can shoot fuel with strong lasers and compress it into a mini star that way. On the magnet side of things, high temperature superconducting magnets, you'll see HTS written around, have totally revolutionized how you build electric magnets.

Not rare earths, but electromagnets and that makes your fusion device go from something the size of a football stadium down to something the size of maybe a normal residential house, maybe even smaller. This is why Commonwealth Fusion Systems is one of the leading comp- like fusion companies in the world, is they figured out how to make tokamaks, a type of fusion power plant, small.

On the laser side, the way that we do lasers, if anyone has even thought or heard of the ASML hitting a droplet of tin ten thousand times a second twice, like laser... You, you-- it's obvious that laser technology has changed a lot. There are many different types of laser technologies.

One of my favorite is a group out of Denver called Xcimer Energy, which literally took the lasers from the Star Wars program and finished the job, and so now you can get laser energy for an incredibly low dollars per watt value. And then if you get into solid state diode lasers, if you get into the simulation side of things, like it used to take years to run the simulations you needed to design a new type of nuclear plant, let alone like fusion power plant.

You can run those simulations in hours today, maybe less So there's been a ton of game-changing technology advances that are not conceptual. They've been built, they've been demonstrated back to mass manufacturing. Theia Energy is starting to mass manufacture very small pixel magnets that you can control with AI to basically dial in what you want your your fusion reactor bottle to look like.

Just the level and pace of innovation that in that field is incredible. So I think we'll start seeing fusion power plants in the mid-2030s, about the same time as we'll see some of these SMR designs come out.

Erik: Why do you think that they are better? In other words, there was some pretty good arguments to be made for why fusion energy would be safer, better, less waste and so forth, than light water reactors.

I get that. But if you look at what advanced fission can offer, I don't really see that much benefit of fusion over advanced fission. So what is it that makes you like it better? It seems to me it definitely costs more, right? Do you expect it to cost less than fission?

Carly: Yeah, I expect it to cost less.

You take out your entire uranium mining conversion enrichment and then decommissioning storage so much of that goes away when your fuel is hydrogen. That's a significant part of the cost right there. Otherwise, we're looking at two basically two kettle systems made of metal, and you can get a, yeah, high power density out of the fusion reactors.

I don't see that being necessarily much more expensive.

Erik: Hang on, Carly. The fusion reactors that I'm familiar with run on a kind of hydrogen called tritium, a specific isotope of hydrogen, that currently has a market price of $30 million per kilogram. So you can't make a, a cheaper fuel argument here.

Carly: I disagree. I think there are a number of fusion supply chain companies that are coming up with ways to produce the amount of tritium you would need to start a fusion power plant very cheaply. One of the key things in fusion power plant design is closing the fuel cycle so that the power plant produces the tritium that it needs to then use as the fuel.

That works in a part of the fusion power plant called a blanket, for lack of a better word, that's what we call it, which is basically lithium, where when your fusion happens, the thing that it makes runs into a lithium, and then that falls back apart into tritium again. So you literally, at the end of the day, end up back with tritium, so your only input into the process is deuterium, which is a different flavor of hydrogen, but a much more common one that is found in seawater.

It's actually used in the Canadian CANDU nuclear plants today.

Erik: Okay. So with respect to fission, when we talked about fission, you were discussing specific reactor companies like Aalo Atomics and Radiant Energy and so forth. I noticed that when we switched to fusion, you started talking about things like Xcimer, which is an enabling technology.

So do you think the plays in fusion are on the fusion energy companies, which would be the, the companies that are actually building the, the fusion reactors, or do you think it's at the enabling technology level?

Carly: I think it's both. Several of the companies that I just mentioned are building the integrated power plant.

That's Commonwealth Fusion Systems, Thea Energy on the magnet side, Xcimer Energy, Focused Energy on the laser side. There are other very interesting companies, though, that are doing the enabling technologies. Some of them are making the superconducting magnet materials Some of those are taking those technologies and using them in other areas.

For instance, one of my favorite new companies, Spinner Energy, is using the superconducting magnets to solve problems for data centers and on the grid. 'Cause if you have a material that can move megawatts of energy in a tiny package that doesn't break the roof of your data center, that's pretty darn cool as we go to higher and higher energy needs in a very small for each data center rack.

Erik: Silicon carbide comes to mind when you said that as the specific material science advance, which I think is really going to have a big impact on nuclear energy and the nuclear energy industry. Do you agree? And if so, how do you see this? What are the reasons that silicon carbide and what things do you see silicon carbide getting used for?

Carly: Oh.

Erik: And I guess you should start by telling our listeners who are not familiar, what is silicon carbide and why should they care?

Carly: Silicon carbide, okay, wow. It's a solid material that you can use for a ton of things. It's gotten really cheap because of the electric vehicle industry, thank you, Elon Musk, and now has also moved into a lot of power control devices.

It's amazing because you can switch it back and forth at high voltages, so you can make your devices really small, and it has very good thermal tolerance, so you can use it in systems that are hot. That's why we like it for other things. It's also great as a, as an insulator for fuel. But we're gonna see even other materials coming out in the next couple of years.

These-- they're sometimes called wide bandgap semiconductors, big mouthful of stuff that means materials that can make electronics smaller, cheaper, more thermally tolerant and we're looking at a couple plays in that space that we think are just totally gonna revolutionize power management.

Erik: Carly, is there an opportunity in silicon carbide specifically in terms of developing that material and using it for more things? And I think it would be particularly cool if somebody figured out how to 3D print it. Is there an industry for developing the silicon carbide technology, or is it really the people that make products that use it?

Carly: So there's many steps in the silicon carbide supply chain from wafering. So companies like Halo Industries have figured out how to very efficiently slice and pattern silicon carbide, both for things, like electric vehicles, but also for processing chips, which is pretty interesting. You could also use it for cladding in materials 'cause it's very chemically resistant.

So basically use it as a protective layer around your nuclear reactor. One other area that's seen a lot of attention for good reason is in solid state transformers. Back to what do we need to hook up a lot more power, including nuclear to the grid, all those c- devices to connect the power plant to the data center, one of the limiting ones is transformers.

Several companies are working to make these, again, mass manufactured, cheaper, bring the le- lead times down to, months or weeks instead of currently years. And silicon carbide is playing a big role in allowing these devices to be low cost and small.

Erik: Let's talk beyond just nuclear energy.

The data center industry and just everything else that's going on in the world is going to require more and more energy. What are the other technologies that relate to energy that are the hot things to know about that-- where you see opportunity in the market as a, as an early stage investor?

Carly: Thanks, Erik. Yeah we've talked about a lot of them already, so things like turbines Things like solid state transformers and other power management technologies. Going upstream into producing materials rare earth element refining, mining, magnet production, those are very interesting. Getting into even commodities like aluminum refining, that's something again where most of the US aluminum f- refining went away.

There are great supply chains for recycling aluminum in other places. When you look at the timeline for bringing new mines online, it is a bit scary as a venture investor. So how do you shrink those timelines? That's something we're thinking a lot about for both copper, aluminum, and other materials that go into the electric grid, as well as many other manufactured parts, products, components.

Erik: Carly, let's talk about turbines, the things that convert the heat energy that's made by nuclear and many other energy processes and turn it into electricity. You mentioned earlier the supercritical CO2 turbines are the ones that replace water with carbon dioxide as the fluid that gets circulated. It makes them much more efficient, lighter, cheaper, easier to mass produce.

Where are the other opportunities that improve the efficiency of energy?

Carly: So on the turbine side of things, to mention one other use case, we talked about supercritical CO2 turbines matching potentially very well with some of the smaller nuclear devices to create a package that can be shipped and installed in a matter of months Another thing that is looking more e- even near term for some of these supercritical CO2 turbines is to attach onto existing equipment and make it much more efficient.

That's often called a, a bottoming cycle, and so it unlocks another 10, 15, 20% of power generation from the same assets. This is a recurring theme that people are looking at. How do you get more energy out of the assets that are already installed? As we think about how are we gonna possibly meet the, the data center demand doubling between now and 2030.

Another area where there's a lot of design work going around-- on for is to meet NVIDIA's roadmap to getting to 800-volt distribution in data centers. What this means practically is the amount of energy coming into these data centers is becoming absolutely mind-blowing. Somebody was describing how you build these data centers and, just a 40-megawatt data center is the size of six Sam's Clubs.

So the, the scale of these things is just mind-blowing. And now you think about bringing one megawatt, which is basically enough energy to power, give or take, 1,000 homes, to a single cabinet. And that's just insane. And so this is why you get to, again, a lot of these power management devices at the rack level backing up to right outside the data center.

How these data centers interact with the US electric grid is very difficult. You need basically a box that can On the grid side, show it like a very even, nice, smooth seas. If it turns off gradually, like very nice smooth line for how the energy is being demanded. On the data center side, you've got these AI training models that are going all over the place, and they're jumping from 80% down to 20% in some cases over, a second timescale.

And so we're looking at a lot of technologies that allow that match to happen in a very low-cost, efficient way. It's very interesting, and we talk to a lot of people working on how this is being standardized so that, again, you can get back to, not a bespoke device for each time you interconnect a data center to the grid, but something that you could roll out across, you know, not just one utility area, but ideally over, over most of the US.

That's a super interesting way to do things. Also looking at a lot of companies that are aggregating demand. So again, like rather than building out additional power plants, can you create these virtual power plants that can turn on and off just like a, a real power plant effectively to reduce the peak load?

That's another area that's super interesting. Geothermal and we're gonna see a lot more geothermal activity coming online. That does take time. There's a lot of subsurface engineering that has to happen We have much better tools for characterizing the subsurface, and again, modeling. Can't say enough about how modeling and simulation have totally changed how we build hardware companies.

It has been just the most massive unlock that you can-- I honestly, I would even go so far as to say this is what now makes deep tech an investable sector, is being able to actually simulate and design these products on a very short timescale.

Erik: Pardon the pun here, but let's go a little deeper on geothermal.

I think ge-geothermal is the coolest idea ever. But hang on a second. What you have to solve in order to solve geothermal is somebody's got to figure out how to drill holes through four hundred degree granite several thousand meters below the surface. That's a fairly hard technical problem. We're not quite there yet.

Let's suppose we solved it. Okay, where will we be? Where we would be is similar to the fracking industry in oil. We would have the ability to send these very expensive teams of people out to very remote, expensive, hard to get to places in order to, go and create some geothermal wells.

Okay. How does that ever get mass-produced in a factory in order to bring the cost down? I don't think it does. Whereas with nuclear, I can see that path, factory mass production. Do you see a path to geothermal that achieves that, that big step function of efficiency that might make geothermal competitive with mass manufactured nuclear?

Carly: It's a great question, Erik. As an early stage investor, I would love to just take the cop out and say that I'm an all of the above- ... energy person. You

Erik: got a slice of all of

Carly: it just in

Erik: case.

Carly: Exactly right. But I guess to double click on some of that you said something that I think is very important, which is four hundred degree heat.

And if where that appears near the surface where you can get to it now is way out in the middle of nowhere. There aren't that many sites. Fervo has bought them all up because they're very smart about how they, about their business plans. What would need to happen for a geothermal to get really attractive is to be able to, like you said, cost effectively drill me- very far underground to where you can hit four hundred degree heat, not just in the middle of nowhere, but next to a in, in closer proximity to a load.

And Quaise is a very interesting te-company that is working on technologies to do that. There are some other folks poking around there. That solves, one of several challenges for geothermal, and people are working on all of them. So you have to drill through the rock quickly, cost effectively.

You have to create enough surface area with your heat source to get enough heat out fast enough And then you have to find an area that's then there's a volume question, right? Where is there enough heat in like this, I don't know, mile square chunk underground where all that heat can come up your pipe.

So there are a number of questions to be answered. There are people working on all of them. Those projects, again, like it's the density of power you get from an individual site is something that needs to go up quite a bit, I think, for the, for these things to get to your five to seven cents per kilowatt hour cost target.

But I think there's definitely situations where that could make sense. I'm excited to see what happens with some of these new drilling technologies. And there's material opportunities as well. A lot of the cost of drilling is broken drill bits. One of the things that we're looking at are materials for, not just these silicon carbide tools for data centers, but when you're using a really hard thermally conductive material, it also shows up as useful in mining.

We love these synergies between industries where the, the market makes the market bigger, you can learn faster, and you can access new markets without having to totally rebuild a manufacturing technology.

Erik: Carly, this has been a fantastic interview, but before I let you go, I wanna touch on one last topic, which is a little bit outside of your wheelhouse as a early stage energy investor, but I know it's one that fascinates you as much as it fascinates me, and that's the direction of robotics.

What I used to think is, okay, industrial robotics is really cool, really important. The, the robots on TV, movies, and so forth, the humanoid robotics are probably just an amusement. But, the robotics that build cars and so forth, I thought that was really it. It seems like The world wants to go the other way.

It's-- humanoid robots really are gonna be a big thing, and we're going to invest big in that. Which way do you see the robotics industry going? Is it more important to stay focused on industrial robots that build nuclear reactors more quickly? Or do you think that this humanoid robotics, where people own their own robots and have robot assistants and so forth, is that gonna be a big trend?

Carly: Erik, thanks for giving that prequalification that I am not a robotics expert. I appreciate that, but it's a super interesting space, and there are just a ton of people, especially where I am in San Francisco, who wanna talk about robotics nonstop. F-for us in the industrial sectors, we pay way more attention to what's going on in form factors that aren't necessarily human.

How do you get robots into spaces where humans can't be or don't want to be because the materials they're working with are toxic, it's high off the ground, those type of things. And I think that's where we that's where we've been seeing the most robotics penetration, is doing a lot of these dangerous remote or difficult tasks.

One of my favorite companies, Pyka, is basically replacing-- They started off replacing the pilots in crop dusters, and at this point, they are covering tens of thousands of acres across South AmErika. They've flown in Central AmErika as well. I think this is one of the point-- things to point out, is that a lot of robotics use is happening outside of the US.

I think in the US, we rightfully have a lot of concerns about safety. An-another one of the companies that I know from my past life is Fort Robotics. They're in the process of SPAC-ing. Congrats to the team. That's awesome. And their whole focus is how do you have robots and humans be able to be in the same workspace and not run into challenges, right?

Tons of work to still be done on robotic safety. You have people working on soft robotics parts, trying to do things with pneumatics instead of actuators, in addition to having off buttons. In the near term, the industrial robotics space is super, super interesting. We're seeing all kinds of stuff in shipbuilding and in decommissioning and in construction Having robots in the home, I think we're five-plus years out from robots in the home.

This is my unqualified energy investor opinion on robotics, but I'll take a bet with you on that if you'd like, Erik.

Erik: Carly, I can't thank you enough for a terrific interview. But before I let you go, please tell our listeners a little bit more. You've got such a cool job. You do early stage venture investing.

You're a VC focused on energy... I shouldn't say it. I'll let you say it because you actually know the answer and can describe your role. But I think it's just super exciting that you're focused on such interesting technologies. It really is the stuff that I think can change the course of history if we get it right.

So tell me a little bit more about what you do, and particularly how you got into this particular niche of investing.

Carly: Thanks, Erik. Yeah. Timescale Ventures like you said, we're an early stage deep tech and critical technologies fund. Energy is a huge piece of it. We do a lot of investing in things like advanced nuclear and fusion and adjacent technologies in how do we power data centers.

Industrial robotics is also a big piece of it. We do things in logistics. We do things in mobility, manufacturing, compute and other critical technologies. I think, why did we start this now? We're at a really incredible moment where the talent stack has matured so much. After my PhD I helped build a startup for a couple of years, and the talent that was willing to go into startups, people hadn't built hardware companies before, right?

At this point, the people coming out of companies like SpaceX and Rivian and Tesla, as well as folks from industry who understand what startups are and that, hey, we might actually be able to do things on a faster timescale. And spoiler, this is why we named the firm Timescale Ventures, is because you need to be able to get technologies to market fast if you want to make a difference, both financially and from a, a human standpoint in the world today.

The, the capital stack has matured. There are downstream investors that we know very well. The tools to build companies have gotten e- extraordinarily better from simulation to prototyping to materials to full on robotics components that you can buy off the shelf. And like I said, like the talent going into this sector has ne- we've never seen the level of engineers in hardware that, that are building companies right now.

And so with Timescale, we're working with them from the earliest days. It's super, super exciting. You're gonna hear a lot more from us in the coming months in terms of having stuff out on Substack, having stuff up on the web, and I'm excited to, to see where this goes. Fascinating times.

Erik: And Carly, for people who might want to follow your work or learn more about what you want to do, what's the website?

How do they contact you?

Carly: We'd love for them to come visit us at timescale.vc. We have a Substack up. Again, the handle is @timescalevc, and they're always welcome to reach out to myself or my co-founder, Christina O'Conor, directly on LinkedIn or through one of our mutual contacts. Love meeting people who are as passionate about this space as we are.

Erik: Folks, that's a wrap for this pre-recorded episode. We don't have a post-game segment this week because Massil and Patrick are off this week. They'll be back next week with our regular show format.

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