The Rational Optimist Podcast

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Stephen McBride: So, Ethan, Bloomberg recently published an article where basically a bunch of VCs went to China to check out the leading battery manufacturers and they came back despondent. They said catching up is futile. It's not going to happen.

And in response to that, you said, "I've seen videos of CATL factories. That's China's largest battery manufacturer. And it does not deter me. The US can and will win by obsolescence. The future belongs to us. Ouros Energy will be leading the way."

Say more. Say more about what's going on in China. Say more about how Ouros Energy is going to lead the future and take batteries back for America.

Ethan Loosbrock: Yeah, so I think if you are not familiar with battery manufacturing, I could see how going to a battery manufacturing facility at a company like CATL would be very impressive. I would say, you know, to start, even among the legacy battery manufacturers, CATL is, you know, I would say not really ahead of even companies like Panasonic or LG.

LG has announced recently some of their work with Ford and GM on a novel cathode material, lithium-rich, manganese-rich oxide. I think a lot of the CATL announcements haven't had quite the same impact in the sense that the things that they say that they announce and are working on, I don't think will change much about the business. And there's no, like, real differentiation between CATL and Panasonic or LG.

What is different is CATL has massive amounts of subsidies and very, very low cost of capital, and that's what's enabled them to scale. Technologically, they're not ahead of even their Korean counterparts.

So what that means is there's an opportunity for obsoleting the current paradigm of batteries by using new materials, new manufacturing processes to both get to higher energy density and also to lower costs and thus better scalability. So that's sort of the gist of what I was hinting at.

Stephen: Maybe just to kick us off, explain a battery like I'm a 10-year-old. You mentioned cathodes—what do anodes and cathodes do? What's the most important thing that goes into a battery? Because I think people…this is one of those areas where people have not updated their thinking on batteries in maybe 20 years. And there's heck of a lot of innovation that's happened.

Ethan: Yeah. I mean, batteries you can you can sort of think of as a fuel, in a sense, as essentially like, you put energy in and you can store it for as, you know, nearly as long as you as you want. As long as you, you know, reasonably could want to store it.

And basically, anodes and cathodes are the materials inside batteries that do the work. They're actually storing the energy in the form of lithium ions. So when you put an electron in, you're basically pushing a lithium ion up a proverbial hill. And then when you use that battery, it falls down the hill and drives whatever device you're using.

The most Important materials in batteries today are cathode materials. They're the bottleneck in terms of the mass or the lightness of your battery. They're the bottleneck in terms of the cost of your battery. And so really, like, today's linchpin for further progress in batteries is cathode materials.

Stephen: Say more on that. What's kind of the… What's been the evolution of batteries? We all see those amazing charts with the learning curves and how density has gone up as price has gone down. So talk about that evolution. And also talk about why the state of the art today is not good enough

Ethan: Yeah, lithium-ion batteries were initially commercialized in the 1990s. Your anode was graphite. Your cathode was lithium cobalt oxide. Since then, basically what has happened is people figured out you can substitute nickel and cobalt—sorry, nickel and manganese for cobalt.

And so we've basically gotten to higher and higher nickel percent and lower and lower cobalt percent, still retaining a little bit of manganese for stability. And then in the early 2000s, a company called A123 commercialized LFP or lithium iron phosphate, which initially most people thought was not going to be sort of a replacement for NMC. And in some ways that was correct.

So for high-energy applications, LFP really like is not good enough. So that's why you see most drones or sort of long-range electric vehicles still using NMC cathode materials. But I think what people failed to see is that LFP had both the materials and the process to get to much lower costs.

So LFP has basically dominated some of the low-end electric vehicle batteries and also new markets like stationary storage, which are potentially massive markets. So fast forward to today, basically we're still in that paradigm of low-cost, low-energy applications are using LFP. High-cost, high-energy applications are using NMC materials.

And both of them use graphite almost entirely. Sometimes people will put small amounts of silicon oxide into their materials if they really want an extra bit of energy. But by and large, those are the two dominant cathode-anode pairings.

Stephen: Talk to me about the biggest problems to be solved today in batteries, and then, as a follow-on, what problem is Ouros, your company, solving?

Ethan: Yeah, so I think there's problems almost anywhere you look. I think for a lot of applications… So for electric vehicles, for example, there's still not a gas parity. Some people define it as the same range as a gas vehicle or the same cost. I think you need both to actually be at parity.

And so, like, your high-end electric vehicles are at range parity with gas vehicles. Your low-end vehicles typically are not. And so essentially, batteries need to get cheaper while still holding a lot of energy in order to get to true gas parity. And then if you go down the line, like no matter what application you're looking at, both of these issues of costs and energy density still apply.

People want their phones to last longer. People want their, you know, AR devices to last longer or to not have to carry an external pack. People want their scooters to drive farther. They want their EVTOLs to fly farther. So it's…I think a lot of problems are sort of a subset of these and there's sort of auxiliary problems.

There's some of the tier-two manufacturers have safety issues with their batteries. That's not as sort of structural or fundamental of a problem, but there are problems sort of abound in the industry.

And then there's an added sort of geopolitical aspect where, you know, China has export restricted some of their LFP, like advanced LFP cathode materials. There's like responses in the West with tariffs and our own sort of industrial policy. So there's kind of like fracturing and a lot of people think, you know, this stuff will sort of be localized.

I think there's a talent question of, “Can the US and Europe and some of these other regions build their talent base fast enough to build homegrown battery companies?” But yeah, those are a few of the issues.

Stephen: What would you say to those VCs that went to China and they looked at CATL and they said there was no hope? Or just someone who read that Bloomberg article and says, “Hey, China produces 75 % of the world's EVs and 80 % of the batteries and 80 % of the solar panels." How are American manufacturers like you and Ouros gonna catch up? What is the strategy to win?

Ethan: Yeah, so I think there's like, I would start at the high level, the philosophical, which is like, you know, China is very good at sort of copying or adapting a technology and then scaling it. And so I don't think the answer is for the US or Europe to become more like China and to basically do the reverse and copy the same chemistries that China is using and then sort of scale it up. Because that's not what we're good at.

So I think what the US is good at and Europe is good at is innovating. And so you know, we definitely need to improve on scaling our innovations. But I think a lot of people make the mistake of thinking that, like one new innovation is it's going to be sufficient for the US to have enough lead and time to scale and gain market share before it's copied either in China or elsewhere in the world. And so I think basically you need to stack multiple innovations and make something that's incredibly hard to copy.

There's a term for this, I think coined by Peter Thiel, which is "complex coordination," where you need to sort of pull together many different things that are very difficult to do, whether it's distribution or supply chain or multiple innovations, and pull it all together in the same product and then scale things from there. And that I think is a much more durable solution and also a better pathway for the West. Yeah.

Stephen: When I met our mutual friend, Eli Dourado, couple of months ago, said, "Eli, what are you most excited about right now?" And he said, "Well, there's this battery company and it's working on a battery that has 10X the energy density at one-hundredth the cost. And the key is this new cathode that they've been able to break through." That's what I believe he said. That's obviously you, that's Ouros Energy.

So tell me, just walk us through the technology, the material characteristics. You know? What's different about the battery than what the state of the art today, all that stuff?

Ethan: Yeah, I mean, I think what's different is like, almost everything. So kind of building on what I was saying before, it's like, you really like, can't just do one thing. So, you know, our cathode material is a basic…basically lithium oxygen. And so it's, you know, lithium-air batteries have been around for a long time.

We have sort of our own special twist on it. But lithium air is like the highest energy density cathode you can possibly make. It's the most energy-dense electrochemical couple. And, you know, as astute observers might notice, like, there's no nickel, manganese, cobalt, iron, or phosphorus in that material. So you can basically get to much, much higher energy densities.

And I think a lot of people in and outside of the battery world don't necessarily recognize what that means for the cost of the battery. So batteries have sort of a quirk where costs are measured in dollars per kilowatt hour. So if you have a material that's twice the number of kilowatt hours with the same material cost, your cost per kilowatt hour is now half. And same thing for 3X energy, you're at a third of the cost, 4X, et cetera, et cetera. And so you have to do that with the cathode and the anode, but that's basically how it structurally works.

It helps not only on sort of, like, the cost per kilowatt hour or the bomb cost, but the higher your energy density of materials, the lower your manufacturing costs as well. And the reason for that is basically, you know, process equipment or cell manufacturing equipment is sized for a certain amount of materials per time.

And so if you are processing the same amount of materials, but it's more kilowatt hours or gigawatt hours per week or per year, now your manufacturing cost for a given capital investment is much lower.

Stephen: What's the current state of the art in terms of kilowatt hours per dollars today?

Ethan: So for NMC materials, they're at about 70…like for cell level, you're at like $70 per kilowatt hour. For LFP materials, it's a little bit harder. Again, all that's done in China. It's a little bit harder to like, assess the true cost. But people cite numbers like $40 or $50 per kilowatt hour. You know… What the unsubsidized cost is a lot harder to gauge.

Stephen: And where do you think you can get to on those numbers with your technology?

Ethan: Yeah, think within the next few years we can get to $10 per kilowatt hour. Longer term, there may be a pathway to getting to even lower than that. But yeah, that's…I think, like with a high degree of certainty, $10 per kilowatt.

Stephen: And if I was holding your anode or your cathode in my hand right now…and then I was holding a Tesla battery or another state-of-the-art battery, would I actually see anything different or is it kind of all in there? Or is it all under the hood?

Ethan: Yeah, I mean, basically, it wouldn't look it wouldn't look any different. You know, if you if it's in the same form factor, it would feel much lighter, potentially. Actually, sorry. Yeah, it… I mean, it depends on sort of how we end up making the cell. But either for the same amount of energy, it would feel much lighter. Or if we decided to go for much higher energy in the cell construction, it would basically feel and look exactly the same. But you would only notice the difference when you start using it.

Stephen: Right. Talk to me about that because people hear kilowatt, kilowatt per hours and dollars and all these kind of abstract things. As you said, people want their phone to last longer. They want to drive from Miami to New York on one single charge. Talk to me about what's actually possible in this world when we have these batteries that are 100x better than they are today.

Ethan: Yeah. Yeah, think 100X might be challenging, but I think 10 is sort of the upper limit of what's theoretically possible. You know, like for your Tesla Model 3, the base models are starting around 300 miles on a charge. Those cells are about 300 watt hours per kilogram.

I think like our version one in the same form factor would come in around double that. So, you know, your, your Model 3 would have 600 miles per charge. Sort of in the vein of like further innovations, I think some of our, we have, have plans to sort of remake the cell form factors as well. And also like to push our cathode to much, much higher energy density.

And we also have an anode material that we're working on. I think if you get all of that in the same package, without too much speculation, I think we could get to something like 1000 or maybe 1500 watt hours per kilogram. And so at those kinds of levels, you're looking at, you know, over 1000 miles, up to 1500 miles on a charge. So your EV could go halfway across the US on a charge or certainly to from Miami to New York. I think some of the… For cars, it's like a pretty straightforward and almost in some ways boring.

Thought exercise? I think some of more exciting things are, you know, like your EVTOL, actually like having more range than an Uber. So today they have about 50 miles of range. If you can push that to even 100 or 200 miles, you end up competing with like short-haul flights. And it becomes like a lot, lot more interesting.

You also may start, like, affecting the distribution of where people live.

Stephen: Mm-hmm.

Ethan: So people can live farther from work. Because typically people optimize for, on average, it's like a 30-minute commute. And so, you know, if you can go 200 miles in 30 minutes rather than 50 miles, then it sort of pushes out the boundaries of cities quite a bit.

I think, like, some of the directed energy weapons are very sci-fi and very, very cool. Those are strictly limited by the battery energy density. You know, some of the robotics stuff is pretty interesting, like potentially much larger robots, humanoids, sort of, I don't know what the term is, but these dog-shaped robots.

Those may need some improvements to actuators and structural elements alongside batteries, but I think that's a quite fun thought exercise as well.

Stephen: I always remember the quote, “It was easy to predict mass car ownership, but it was hard to predict Walmart,” in the sense that it was a second-order consequence. Staying on EVs for a moment, what do you think are the most sci-fi second-order or third-order consequences of that kind of, a battery can get you halfway across America?

Ethan: Yeah, I firmly believe that, you know, like electric flying cars are the way to go. You know, like, I think both in terms of just the efficiency of electric motors, and also in terms of some of the sort of secondary issues that people have with electric aircraft, mainly like noise and…

And like, yeah, just so I think basically, like, the one of the big potential unlocks is getting like, our true, like, flying car moment. And so I think that that has, like, the potential to sort of remake almost everything we do, like whether it's commuting, whether it's delivering goods or where we live, how we interact with our friends and neighbors and how we plan communities, where we plan them.

So yeah, and I think like it's also, know, like the millions or billions of hours wasted sitting in traffic, I think could be unlocked. yeah, so I think like, you know…

One of the big barriers there is regulation. And so I'm hopeful that we can sort of strip away some of the regulation there and actually allow for that kind of future to happen. But I think higher energy density batteries are going to be the key unlock technologically for that tech tree.

Stephen: Talk about the other unlocks. Obviously you have drones, which certainly on the military side are reshaping things. And even on the civilian side, with Zipline now, I guess I love what Sam D'Amico is doing with Impulse Labs and the stove.

What other products can people—or technologies—can people look forward to in the next five years that kind of reimagine industries that we've, you know, have been around for years, I guess, or products?

Ethan: Yeah, I mean, batteries are sort of like a Swiss Army knife of energy, you know. You're basically moving energy through time and space. And so you can do things that used to be much harder with petrochemicals. And one of the main reasons for that is like, you can enter like…

Electric motors have gotten very, very power dense, while batteries have sort of marched along in terms of energy density. So, you know, you can now, have electric motors that are more power dense than even jet engines and can be, like, miniaturized much more easily. So there's like sort of an explosion going on in robotics, like…

I'm not sure exactly which products will make it. I don't think I have enough of a consumer lens to predict that well. But there's robotic trash cans that empty themselves. There was a kitchen knife that has sort of an ultrasonic element to it that allows you to cut more easily. I think, like, personal drones are probably gonna happen.

It may make sense to put a battery on a lot of your appliances. So especially in areas without reliable power. If you have rolling brownouts every month or every few months, you still probably want to use your fridge, you still probably want to use your stove, you still probably want to use all of your devices. so having that sort of backup power is definitely useful.

There's home batteries, like base power, building batteries for homes that are revenue-generating, so they'll buy and sell electricity for you. I think, yeah, there's… It’s something I think, like, hard to predict, like, you know.

I saw one device that was basically for valets. And so it's like just a skid battery-powered skid that would pick up the cars, it would park them, you know, super tightly around the lot. And then, you know, when someone would come with their ticket, it would pick up their car, bring it to them.

I think there's all kinds of things that you can do with the combination of batteries and electric motors. And I think we're just sort of getting started predicting all of the different combinations. I think it's like, uh, you know, it would be like a Sisyphean task, but, um, but yeah, I think like a lot of these are very fun and sci-fi, uh, applications.

Stephen: One vision that you could sell to my wife and a lot of you know our housewives out there is a cordless kitchen. They would love that. The cordless vacuum was a huge hit. Imagine no cords in your kitchen. That would be amazing.

Ethan: Yeah, totally. Yeah. Yeah, I think the cordless future in general is like something I look forward to. Like, you know, I don't like having to carry around a cord just for my phone. And, you know, it dies like in the middle of the day. And I think, you some people like, you know…

Fast charging has sort of been the rage in consumer devices and also in EVs. I think in some ways it's an admission of defeat because I think most people would admit that never having to charge is better than charging very fast. Yeah, I think there's…on the part of the battery industry, focusing on fast charging is sort of a defeat in that you're admitting to yourself that battery materials are not going to get any more energy dense from here.

Stephen: I guess you've given us two contrarian beliefs. So most investors would be max long CATL and most people would be like, hey, this fast charging is absolutely amazing. To Peter Thiel's question of what important truth do you believe that the rest of the battery industry disagrees with, what's your answer?

Ethan: It's hard to pick just one. I think almost all of the mainstream beliefs are wrong. But, yeah, I think that that last one is probably the most important is that like, you know, I think that batteries can get much higher energy density. And that like LFP is not the end.

I also, I mean, maybe another quick one is like, I don't, I think the sort of hype around sodium ion is misleading at best. I'm quite bearish on sodium as a whole.

Stephen: Actually say more because I was at a conference recently, and someone came up and they said, "Potassium ion is the only way forward. This is the way. Everything else is a dead-end." Just talk through the competitor technologies: sodium ion, potassium ion, and then I guess solid-state has a lot of a lot of hype around it. Just talk to those three.

Ethan: Sure. So for the alternative ion chemistry is basically the thing that matters is the mass of the ion. So each sodium, each potassium, each lithium stores one electron, but sodium is three times the mass of lithium and potassium is five times the mass of lithium.

And so like I was alluding to before, like if you get a material that's three times the mass. Maybe your sodium is 10 times cheaper and you come out net ahead, but you also need all of the other battery components, your anode, your electrolyte, your foils, your packaging to be three times cheaper to just come out at parity in terms of cost.

So with potassium ion, it's even worse because it's five times the mass of lithium. So your other components, if you want the same dollars per kilowatt hour, need to be five times cheaper. And so that's fine for changing from lithium to sodium, but for changing from aluminum to aluminum, it's not so fine.

Stephen: Yeah, just any more comments on—oh yeah, go ahead.

Ethan: And then for, yeah, solid state. I think, like, solid state is a bit of a miss.

Stephen: First of all, just what does that even mean to someone that might not know anything about batteries?

Ethan: Yeah. Right. So solid-state is basically having a solid-state electrolyte in between your electrodes. So what this enables, in theory, is a lithium metal anode. In practice, it is a lot more complicated.

You know, lithium dendrites are typically the problem associated with lithium metal anodes, which are these sort of spiky things that grow across…in between your electrodes and then ultimately short the battery.

And the thought was, you know, if you have a solid in between that it will better resist those needle-like things growing across. In practice, the electromotive force of those dendrites is, like, on the order of gigapascals. And so it will push through anything in between without much trouble.

So the sort of purported advantage in safety is not really well substantiated. The other issue is like, if you basically—well, there's costs—is basically like, you know, you have these technical ceramics, which tend to be very expensive to make and even more expensive to integrate. Those have to somehow compete with like a petroleum product, which is dirt-cheap, it's one of the cheapest chemicals in the industry.

And then on the performance, you essentially need an incredibly thin electrolyte, because we use very little liquid electrolyte to even get to like energy density parity. And so that's why you see like a lot of people struggle with this because, you know, there are things like silicon anodes that can do 90 % of the job of a lithium metal anode, but without a solid state electrolyte and can utilize liquid electrolytes.

So, you know, the lithium metal batteries end up basically topping out at no better than a silicon anode. I think like...solid state in that sense is going to be a challenge. There are some applications, like, sort of micro batteries, where solid state electrolytes are already used and probably will continue to…but for your electric vehicle, I think I wouldn't hold your breath.

Stephen: We have all these AI benchmarks these days, and we can debate the merits of them, but it's clear that on the benchmark, know, one model beats another model. When looking at battery makers, is there one or two or three metrics that you think matter above all else as a way for investors or people to stack rank the battery producers?

Ethan: You know, I think there probably are. I think, you know, your dollars per kilowatt hour is very important. Your watt hours per kilogram or watt hours per liter, depending on the application, are very important. And then I think, you know, your, your cycle life.

And people talk about the battery industry. It's really like not an industry in the true sense in that each application has their own set of requirements. So you can't use one battery across all applications. They each have different form factors. They have different power requirements, cycle life requirements.

And so I think it's at least knowing the requirements for what industries you care about or what industries that company is targeted targeting is, is probably like where I would start as an investor.

Stephen: And for Ouros, which industries are you going after first? And then is their goal to really make the ultimate battery that can do everything?

Ethan: So to the second question, the answer is yes. I don't think we'll try to compete with some primary batteries, but everything else, I think we can do. To the first question, basically we're starting with defense. So drones, some like, USVs, sort of like marine drones, and some of the like, basically, like, you know, like, sentry systems, things like that.

And, you know, the reason we're starting there is the US military recognizes that right now they don't have an answer to sort of the Chinese battery dominance. And so they're very interested in getting like a US-based or Western-based solution that at least gives them some independence in the case of a conflict.

Stephen: Why have so many battery startups failed over the past couple of years?

Ethan: Yeah, I mean, there's probably like two sides to the coin. I think on the one side, many startups try to sell into markets that are very big, very commoditized, and the competition is incredibly fierce. And I think that as a small company, that's sort of like a suicidal task.

I think on the technology side, like, typically things fall into two camps. Either it's basically scalability, which comes down to mostly cost. And it's like the scalability of your materials or your process. So a lot of times people use materials that will never be, like, on par in terms of cost with the incumbent technology, or they'll use a process that can never be as cheap as what the incumbent technology can do.

And those are sort of interrelated because you can't really make the materials without a process. And so I think, you have to really, like, take a hard look at how you make what the materials you're making and what materials you decide to make. But yeah.

Stephen: Many—

Ethan: And I think a lot of the challenge there is, like, people are maybe a bit too optimistic about their own ideas and not as critical enough of their own ideas and thoughts. And then once you get into it, the clock's ticking, so it's very hard to correct the early mistakes.

Stephen: Many people listening to this podcast will be familiar with the grid interconnect queue and how it takes years now to get power connected to the grid. Do you think batteries, as they get better, as they scale out faster, they essentially allow this microgrid / off-grid future? Do you think that's possible? First of all, then, is it going to happen?

Ethan: Yeah, I think it is possible. There's, there's a lot of I mean, I think batteries are a huge unlock there. Solar is, I believe in many geographies, is the cheapest source of generation. If you compare it with a cheap enough battery, then your levelized cost of energy is going to be the cheapest of any sort of energy generation you can find.

And it's also modular, so you can scale it up or down quite easily to whatever power or energy needs you have. The interconnect problem is a really big one. We may see sort of a gradual change because I think utilities…there are functional regional monopolies. They are also, like, investing in these same technologies.

I think in deregulated markets like Texas, you can have like a quicker turnover where, you know, people essentially… Like how this works out logistically is like each person that leaves the utility and builds their own solar and battery now makes the existing customer base for that utility smaller.

So they have, like, less customers to spread their capex over. your price, your power prices start to go up. And so there's probably like some critical tipping point where either, you know, utilities go under or, you know, you sort of need to break them up further. Or some, some… There's, there's basically a crisis point there.

And I think, like, you know, as power climbs the incentive for building your own power generation just goes up. So I think you see this in California where, not really due to like solar and wind, but California does have very high power prices. And so you see higher levels of adoption of personal solar and batteries there.

Now, like, I think places where the utilities are building large amounts of solar and batteries, it may take longer because there is just like a scale aspect to building out like a large solar farm and accompanying batteries that will always be cheaper than doing it on your house. But for businesses, think if you have a big enough factory, it can make sense regardless of whether the utility has built their own solar field.

Stephen: If Ouros's technology, say we're recording this podcast five years from now, 2030, Ouros's technology wins: What's the changes that I'm going to see in my everyday life? Am I going to have a $10,000 EV? Am I going to have, you know, a $50 a month, you know, power, power utility bill, a cordless kitchen? Just talk to me, maybe just the vision on what's possible here.

Ethan: Yeah, I mean, I think like, you know, you would get up in the morning and grab your phone and you may not have needed to charge it the night before. You would get in, like, your electric flying car, fly to work 100 miles away from your country home. And then I think, you know, you may have like robots assisting you at home if you want that sort of thing or robots assisting you in your factory or in your office.

I think like, you know, you may have like a battery-powered stove that cooks your, you know, heats up in a minute, cooks your breakfast, lunch or dinner. Maybe you have like robots cleaning or cooking for you or folding your laundry. Or yeah, it's the specifics I think are going to be very challenging to predict because it's ultimately up to us the consumers.

Stephen: Awesome. Maybe as we get towards closing here, Ethan, we could play devil's advocate. You could answer a couple of skeptics' questions just kind of, quickly. So people think of batteries— again, they haven't updated their thinking a long time—batteries are way too expensive.

Ethan: Mmhmm. I think like, you know, there are electric vehicles in China that are selling for below $20,000 US. I think I think, you know, the batteries are still the biggest part of the cost of the vehicle. And so, you know, it's…

I think we definitely will have very, very cheap electric vehicles going forward. And batteries—I forget the timeframe, if it's the last 30 years or something—but I think in the last 10, 15 years have dropped in price like 98%. And it's not all batteries everywhere. Like that's EV batteries and grid batteries. Maybe your drone battery won't be nearly free, but some of these bigger markets certainly will continue to drop in price.

Stephen: "Ethan, have you seen these batteries—these EVs, they're just a walking fire hazard." What do you say to that pushback?

Ethan: Yeah, I mean, think the rates of the EV fires are an order of magnitude lower than gas vehicle fires. I think they get outsized media attention. You know, it's sort of a, like, misleading problem. You know, I'm not sure if that's sort of willful negligence or something more malicious on the part of media companies.

The other part of it is like, you know, every year we get better at engineering redundant safety into the batteries. Like even within EVs, the rates of EV fires have been dropping year over year. So I think like, you know, this will eventually be just a discussion of the past.

Stephen: The last one, reliability. “Yeah, this stuff might work great in California or out here in the UAE where it's really sunny, but what about Norway and what about Minnesota?”

Ethan: Yeah, I think there's some really interesting work on... So most of the temperature stuff comes down to what you use as the electrolyte. There's some pretty interesting stuff coming from mostly space batteries, which operate in very low temperatures that could be adapted for the electric vehicle market where you're operating at -60° and don't have much performance difference.

And I think there's sort of a lower limit where if you get it, if you figure out, like, -60° Celsius, most places on earth are never going to get colder than that. And so if your performance is fine for that level then then you know temperature…low temperature is solved.

Stephen: This has been awesome. Maybe to finish, we could play a little quick game of overrated, underrated. So I'm gonna say five or so battery-related innovations and you can say overrated, underrated or properly rated. Ready?

Ethan: Sure. Okay, yeah.

Stephen: Battery swapping for EVs.

Ethan: Overrated.

Stephen: Used EV batteries for home backup.

Ethan: I think it's properly rated.

Stephen: Home battery walls.

Ethan: Underrated.

Stephen: 10-minute EV charging.

Ethan: Overrated.

Stephen: Wireless charging for your EVs.

Ethan: Properly rated.

Stephen: Battery recycling.

Ethan: Overrated.

Stephen: Battery-powered rockets.

Ethan: Um, probably very overrated.

Stephen: Well, that's all—

Ethan: If even, if even possible. Yeah.

Stephen: Yeah, that's one of the... I know we had the nuclear rockets going, but I don't know if we ever had the battery-powered rockets.

Ethan: Yeah. Well, I mean, every SpaceX rocket has a battery running the avionics. So in a sense, it's battery powered, but I don't, I don't think that's quite a, quite a battery-powered rocket yet.

Stephen: Well this has been awesome, Ethan. Where can people find more about what you do, what Ouros is doing and follow along the journey?

Ethan: Yeah, you can find us on our website, **ouros.energy**. We're on Twitter. There's a company page, Ouros Energy, and my personal page. I tweet a lot about batteries. And then we have a LinkedIn page that I'll be posting a lot more on in the days and weeks to come.

Stephen: Ethan, thank you so much. Can't wait to see what you and the team accomplish over the next couple of years.

Ethan: Yeah, thanks Stephen. Thanks for having me.