TFTC 399

**Marty:** [00:00:00] Rick and Isaac we're live. Sweet. Is this your first podcast? Second?

**Isaac:** It is, yes. Well, I, I, I do some, uh, some podcasts on the side with friends. We, uh, we, it's called The Disagreeable and we, uh, sort of, uh, disagree well as sort of the play on words there. Yeah. But o other than that, yes. Nothing, nothing formal, nothing Bitcoin specific.

So this'll be my first Bitcoin podcast.

**Marty:** Re I, I can recall one you did with Tom a few years ago.

**Rete:** Oh, dude. That, that was, uh, a while ago and I've taken a hiatus ever since. But you know, it's been a while. .

**Marty:** It has been. And I'm happy to bring you out of the hiatus and to bring you away from disagreeable to Tftc Isaac.

**Isaac:** Oh, love It

**Marty:** freaks how to preface this. I mean, obviously. [00:01:00] If you've been listening to the show a while, you know that I've been involved in mining. Oh yeah. Um, not you too. I'm talking to the audience right now. Uh, they know I've been into mining, but I'm really, uh, the ugly face in front of the mining operation and everything I've been involved with, with in the mining space, whether it be great American mining or cathedral and some side projects.

Uh, these two gentlemen that I'm speaking with today are the brains behind the operation actually plugging in the machines, setting up the management systems, really designing a process and farm management and what else? Logistics to make everything work. I think you guys are two of the volted unwanted individuals in the space who have done a lot of work that, that many people don't, uh, really know about yet.

So I'm excited to get you guys on. To highlight what you've done cause you guys have done some incredible stuff. [00:02:00] I think we should start with great American mining re particularly like talking about that first pilot container that we had up in Utah.

**Rete:** Oh yeah, the ugly one.

**Isaac:** Yeah, you could barely call it a container.

Uh, but, but yes, it did mine some Bitcoin. So go have that going for it. Uh, yeah, so I mean, REIT and I, we met back in, uh, 2018, we were working on a hydrogen project together. This was before great American mining, uh, is like a pure r and d phase. And, you know, we reached a point in 2018, I mean, this is the depths of the bear market when, uh, you know, we were trying to integrate mining tech with this, this hydrogen tech and it ended up, uh, you know, just not working out.

We, we decided to move in a different direction. So we're, we're d mobbing this, this site, pulling out the miners that we were using. Um, Yeah, uh, the, uh, the dragon Mint T one s is what we had on [00:03:00] site. So, um, r i p, uh, anyone who bought Dragon Mint, T one s. Um, but yeah, basically we're pulling all these miners out and put 'em into storage, and I was just like, gosh, I wish there was something we could do with these things.

And so I was chatting about it with reit and you know, he, uh, he was driving home one day, looked at this giant flare, uh, out in Utah. He's like, wait a minute. There's a bunch of energy there, maybe that we could do something with this. And so this is before, um, before REIT and I were formally working together, we were from.

Two different companies working on this r and d project. And so, um, I, I went to, um, you know, my, my boss and was like, Hey, look, I think we can do this. He's like, all right, look, I'll put a bunch of money into this. It hasn't worked out. Uh, you know, I mean, drag him in T one s. I mean, come on. I can't blame him.

And he's like, all right, look guys, I'll, I'll let you do this crazy thing. I've never heard of anything like this. You got five weeks and [00:04:00] you still have to demo up the site. And so re's like, how the heck are we gonna get gas in five weeks? Like, like, this is just a just crazy tap.

**Rete:** We got it in three

**Isaac:** days.

You know, it's like three, look, you're our guy. You know, if anybody's Yeah, yeah. Well that, that was all reit. I had nothing to do with that. And so he's like, he calls up hi his buddy at a, um, wastewater, um, or a water processing facility, you know, from the produce water. That comes up when you're, um, pumping oil.

He's like, Hey, you know, can you, uh, just give us some of this, this gas that's entrained in your water that's coming in? He's like, ah, it sounds crazy. I, I guess well, we'll try it out. And so, uh, he was like, all right, sweet. We got a place to do it. Now we just gotta go. So like literally in the morning we'd go to this site, this r and d place, I would be taking out miners, you know, electrical panels, wire, you know, we're taking apart the site, right?

I'd be taking stuff out, loading up, [00:05:00] carrying it over to, and, uh, oh, this is the other bit. Re had a buddy out there and he's like, Hey, can you just give us a, uh, a patch on this gravel driveway, uh, that you've got just so we can just, you know, build this mining thing? He's like, ah, I, I guess sure. And so literally had load up in the morning, take the the parts over to his friend's driveway and we would like unload it and start, you know, and we'd be, we'd be building, we had a, like a hand crank generator for power.

There's no internet. So, yeah, that was, uh, that was kinda the origin. That was the genesis . Yeah. And, and every now and then re would look at me like, this is, this is crazy. Like, like, why are we even doing this? I'm like, look, it's just like, uh, like, like the, the first Ironman movie. We're in the cave. We got a box of scraps and we, it doesn't need to be pretty, it just needs to get us out of the cave and then we can build better stuff.

Yeah. And we did it, did it in five weeks and it was enough to justify [00:06:00] building a second one. One that we actually had a budget for. We weren't just using par spare parts. And um, yeah. That turned into great American mining. . Yep.

**Marty:** Is a great American mining origin. Story freaks. Re what were some of the Yep, yep.

What were some of the main lessons we learned on that first proof of concept deployment?

**Rete:** Well, , if you think mining is sexy, . It's not, it's hard. You get bloody knuckles, you get everything else, and you don't know where, you don't know what questions to ask if you haven't done it before. Um, because all the iterations that we went through on those containers, like the second one was our air, air intakes on the first one were like that big.

Then the second one, it was the entire wall, you know, than bigger [00:07:00] fans, bigger, you know, just everything got scaled up, uh, because we found problems in airflow. And then we realized that the first Christmas tree design was a horrible one because it took three hours to change out the, the filters . Whereas, you know, a different orientation took 10 minutes.

So, Everything was, you know, you, you can put everything on on paper and it's, it's gonna look okay. But when it comes down to actual functionality, it's like you have to have user experience. You have to have, um, you know, the right engineering that goes into it. You have to have, um, especially if it's going in remote sites, functionality that you can do from your couch.

Right. And all that has to layer on top of each other. Yeah. And so, and that only comes from [00:08:00] experience.

**Isaac:** Yeah.

**Marty:** And to that point, I was gonna say to that point, doing stuff from your couch, that, that includes building remote systems that allow you to, to tap into the, the site and control fans control, um, the, the airflow walls, like if it's cold mm-hmm.

like that Christmas tree design, maybe it was hard to change the filters. It did keep snow out, correct?

**Isaac:** Yep. Uh, yeah, sort of after just two or three, uh, two or three repairs. Yes, it did. , yes. Yeah, I mean, oh, sorry. Go ahead. No, you go ahead. Go ahead. Yeah. Um, I, I mean, really what one of the things that, that I've sort of come to is you can solve these problems with one of two ways.

You can do it with people or you can do it with technology. So, you know, in, in general, you can think of, uh, as mi you can think of mining facilities as falling into largely one of two camps. [00:09:00] Either you have a campus style, uh, bitcoin mining center where you've got, you know, everything is in one central location.

You have, you know, big beefy power lines bringing in power site or, you know, it's, you've got one, you know, sort of hut where, you know, people camp out. You, you can do your repairs out of there. And you're, you know, something goes wrong. You send a guy down to whatever aisle it is and they go and fix it. Uh, then you have sort of these more remote, uh, style builds and that, that's what we were doing at Great American Mining.

You know, you've got a pad, uh, two hours away from, from the nearest airport, and if you gotta go out and do maintenance on that, it, it, it's tough to get out to. And so we, we had to have, you know, command and control systems where you could adjust the temperature. Um, I mean, the very first bills we did, nothing was automated.

We, we hadn't figured that out yet. And, uh, you know, uh, props to Austin on that. He did a really great job taking, [00:10:00] uh, some of those long nights that, that we did at first and, uh, you know mm-hmm. automating like, okay, you know, this is how the miners work best. What are you guys doing when, let's automate that.

So, um, you know, you did a great, great job. You know, really, really helping us, um, you know, scale up great American mining. And yeah, it, it was just, uh, you know, you're not going out to a site easily, so you need to have good information, uh, so that you know what's broken if something breaks or you know what the problems are.

Um, cuz you gotta figure that all out remotely. Yeah. Because if you're driving out there, you've gotta have the tools, you need, the parts, you need, you know, whatever it is before you're, you're going out there. It, it's really time intensive. So, you know, remote control and good information are key if you're gonna have a distributed, uh, style build.

Yeah. Yeah.

**Marty:** So what would you guys, I mean obviously upstream data was around cruso, um, was around when we were building the first iterations [00:11:00] of the Great American mining boxes. Uh, and more and more players have come to market since then. You have giga. a bunch of other players that I can't even name off right now.

But, uh, what, yeah. What would you guys say is the state of the market of off grid mining, particularly with these containerized systems and the control systems? Is it night and day from where we were in 20 19, 20 20? Or are people still learning on the go

**Isaac:** here?

**Rete:** Everybody has gotten better. I, I have to say, like even gift props to Steve.

Usually when I look at a design, I can say, okay, I know what he did and why he chose to do it that way. If it's a good design, right? Like it, everything is a trade off. There's no such thing as a perfect design. It's saying what are my hierarchy of needs? And, and they're clearly defined downwards. These [00:12:00] remote boxes are not the cheapest boxes on the market.

So, um, you know, Right now, cost for most people is at the highest point in, in their, their needs. Like, oh, I can get a box cheap. But that doesn't mean that it's going to function remotely in the way that you want it to, or even in a campus style for that matter. So if cost is at the highest and you need to have more automation or you need to have more data, that's not gonna be your cheapest option.

So you're gonna trade off, as Isaac said, the people component is gonna be a bigger portion of your operating costs at that point.

**Marty:** Yeah. And so what do you guys think is the, the Goldilocks perfect trade off model for these offsite boxes or off-grid boxes? Excuse. [00:13:00]

**Isaac:** well is

**Rete:** the perfect one. I mean, you have to have automation, uh, like on, off, on the, the, um, out each outlet, right?

Like that's, that's number one. But, you know, our new design has like PLCs, kind of lots and lots of variability with it. I think you can get away with kind of like micro controllers and get something a lot more scaled down, um, and still make it work. So, you know, cost is gonna be h how can you get the same amount of automation for the lowest cost and, and really hone in on all the data that you really need.

And that's kind of where the, the step is right now, saying, all right, how do I pair this down to what I need and what resources can I use? because a lot of these boxes that, that, especially like Steve, even digital [00:14:00] shovel, they have heat recirculation for cold areas, right? Like that's, that's something that we've done since the beginning is like we need to recirculate some of the heat if it's a super cold area and bring that into the intake so that we're not blasting the miners with like negative 20 degree, negative 40 degree air.

So all the, the, all the manufacturers who kind of listen to their customers have said, okay, here are the problems that we've seen. And then they start adding on some of those, those functions. And that has, that has been very apparent over the past couple of years.

**Marty:** Yeah. And you touched on a very good point there, like not all off-grid mining is the same, obviously if you're mining in the bachan up in North Dakota.

Yes. , your, your needs, your pressing needs are gonna be different than if you're off grid mining in West Texas. And how do you design a

**Isaac:** system for that? Yeah,

**Rete:** it's really hard to [00:15:00] make a one size fits all system, um, period because in Texas, your pro, your bare minimum, you're gonna need to have like a water curtain and cooling.

In North Dakota, you don't need that period, but you need a lot of heat recirculation. You need to have kind of environmental protection measures. The biggest thing, the biggest enemy is really dust for a lot of these miners as well. So environmental control. The minute you put in filters, you're gonna have pressure drop, you're gonna have, uh, resistance to airflow it, but you're protecting your investment, you're protecting your min.

So is it really worth it? Yeah, in my mind.

**Isaac:** Yeah. Yeah. So I, I mean, REIT brings up, you know, a, a spot on point, which is that, you know, every site is, is unique. [00:16:00] You know, in particular, if you're doing, uh, flare gas mining, you need to get a gas analysis. Sometimes you need to treat that gas. Uh, there's a, a litany of, of tiny details that come crawling out of the woodwork.

Anytime you say, oh, I, I just want a mine here. It's like, okay, well, uh, you know what? We would look at things like, what's the prevailing wind direction? You know, what, what's the, I mean, like, we, we would just, uh, re's really good on that sort of thing. What, once we sort of identify, hey, we wanna do this, he just goes, he's like an electron microscope.

He goes right down and we'll find the smallest of things that are, he didn't know were important. It's like, oh, wow. I, you know, I didn't think about that. Uh, you know,

**Marty:** you could, uh, you could call him an electron microscope or an, an fucker like

**Isaac:** he, uh, . There. There it is. There it is. Yeah. What is, and fucker.

**Marty:** Yep. What is the definition of an an fucker REIT in your mind? ,

**Rete:** well, let me put it this way. I don't consider myself an expert, [00:17:00] but I definitely know what has caused me pain. And so , I, I would consider it as, alright, that's caused me a lot of grief. How do I fix that and how do I bring that and make that next iteration better so that, that's why I would consider an ant fuck.

Yeah. It's like all the things that make, have kind of led up to this point of where you wanna focus your energy because it has either caused you a late night or freezing cold temperatures, or just time really.

**Marty:** Yeah, so the answer, the very small details. And so I guess we always, what you're getting at is the very small details and these off-grid operations are very important.

Yeah.

**Isaac:** Yep. I mean,

**Rete:** you know, one thing for example is when a gas well, or the gas from a well becomes [00:18:00] unstable, you don't wanna have your gen sets running at full tilt, right? So, you know, do we look at the generator and see, oh, is it gonna shut down? Or do you look at the gas and the gas supply pressure? And so like, kind of figuring out where you need to look on the, the energy supply system, that's where you can get a competitive, uh, advantage because you need the containers or the miners or the load on the containers to pair down shut off.

And go into self-protection mode, because if they don't and you don't have eyes on it, you know, we've seen the, the horror stories of, of, you know, caked on snow into machines because the door wasn't closed. You know, you don't want

**Isaac:** that.

**Marty:** A very small [00:19:00] actionable detail that everybody should, should close your fucking doors.

People you want the snow or the dust getting in. Yeah. But, uh, I mean, you touch on something else there, like we've, we've been talking predominantly about like working within the box and the whole mining operation, but you mentioned the whole other side of that, which is the power generation gen sets, which is like a whole other Pandora's box of problems and intricacies to work through.

**Rete:** Yeah. Your primary goal is to keep the gen set up and running. mining is actually your tertiary thing, so you wanna make sure you have gas, your gen set, stay up, and then your miners are on, right? Because without that cascading sequence, you're

**Isaac:** not mining, right? Uh, uh, the big thing is, you know, if, if you don't think about how these systems integrate with one another, you're gonna [00:20:00] pay for your, your lack of knowledge or lack of planning with downtime.

I mean, you need to have an understanding of how is this well working? How do the generators work? How does that all tie into the container? Uh, it all matters, right? And, uh, you know, for instance, if you turn miners on too quickly, on and off, off grid site, uh, you can, you know, basically. Cause the generator to suck down gas faster than the pipeline can sometimes provide it.

And then you, your whole site gets shut down and then you're sending technicians out there to get things back up and running again. It, it becomes a mess pretty quick. And so you can automate some of these things, but uh, you know, really since each site is sort of unique in terms of the systems you're tying into, we need to do an analysis of, well, how does this system work now and is our current build a good fit?

And, and going back to your, your question about, you know, hey, what's the sort of the goldilock zone? I, I think probably so in, in general, I think the space is still developing a [00:21:00] lot. I don't know that any, anyone has sort of cracked the code of, Hey, this is a one size fits all build. And part of that is there's a litany of little details you have to think about.

I, I think probably what will end up happening if I was sort of a, you know, try and pull out my crystal ball and, and uh, say, Hey, I think this will happen. I think you'll probably see some sort of a, a base model that that suits, uh, most needs. And it will be built in such a way that you can easily have these bolt-on solutions.

So, you know, regardless, uh, you know, you have to have a rack that the minor sits on. Yeah. You have to have wires that bring power to that minor. There are certain things that don't change too much and it, I, I can see a world where people, you know, where, where somebody figures out, Hey, this is the base model, this is the bare bones, what we need.

Uh, you know, in, in most markets, and here are these simple add-ons. You, you can quantify exactly how much they'll cost and say, okay, if we're gonna go [00:22:00] down to West Texas, here's, uh, you know, here, here's a water curtain, or, you know, a water Mr. Bolt on, uh, you know, with maybe, you know, some kind of water collection on the roofer or something, right?

And then you go up to, to North Dakota and all of a sudden, you know, heat recirculation becomes, becomes more important. So you sort of create these different bolt-on, uh, you know, technologies. Um, you know, and, and, and also, you know, in terms of, you know, remote control of, of power cycling, I think the industry's gonna head toward, okay, here's your, you know, think about like, you know, an ant box where it's just, you know, bare bones, basic electrical.

Okay, well, let's get something that would allow us to do automation. As a, as a bolt on technology. So if you don't need automation, cuz you're in a campus style, you always have have it staffed, you don't need it. But then if you wanna do a remote deployment, here's this bolt on package, you can just add it to an existing container and then you're off to the [00:23:00] races.

I, I, I think that's where we'll head making all of that work. Well is, is a really challenging task because there's so much going on that it's not as simple as you might think once you actually start getting into the details of it. But I, I think that's where we'll end up heading. Yeah.

**Marty:** So the, uh, the market for purchasing containers is gonna be similar to the market for buying a car or eat the side.

What, what gadgets and upgrades you

**Isaac:** want, right.

**Rete:** Exactly. Walking through dealership, so to speak.

**Marty:** What does it feel like for you two to be on the cutting edge of this budding industry, like tinkering with this stuff? Some of the first. two individuals. I mean, I, I, I imagine the population of people working on the particular problems that you guys have worked on is relatively small.

**Isaac:** Yeah. I mean, in the beginning it, it was, it was nuts. I mean, there were no YouTube videos a about the, this stuff. It was just like, [00:24:00] okay, you know, here's this sort of electrical video on YouTube that sort of says something about what we need. Uh, you know, looking up articles on hvac, um, you know,

Thermodynamics, uh, you know, textbooks from, from way back when. Yeah. Um, yeah. I mean, it, it was, it was pretty crazy cuz there weren't like good resources. It was just re re and I, you know, sometimes we, we felt like, uh, you know, dumb and dumber. I, I'm telling you like, because we're just sitting there like, I don't know if this is crazy or if maybe this'll work and, and we just had to try it to find out.

Yep. Um, yep. You know, but it was, but it was always the case of, look, we just need to make enough Right decisions. And, you know, part of that is just staying really humble and, you know, just when you're in the thick of it, when you're, you're in the pain, say, okay, you know, reality is gonna tell me, uh, what it, what it needs to, to make this work.

Yeah. And I just need to listen and, and stay humble and, and just work [00:25:00] hard. Yeah. Uh, you know, sweat, sweat equity will go a long. If you're willing to stay humble. And I, I, I think a lot of, a lot of other minors, uh, a lot of other people in the space, they're in that process and, you know, people are putting in the sweat equity and, you know, they're gonna, they're gonna make it.

Um, it could, I mean, that's what we had to do. It was just work hard, stay humble and, and, uh, you know, be alert. You know, the information's all over the place if you know where to look. Yeah.

**Rete:** Listening to what, what the data is showing you. So you, you have to kind of overbuild to gather that data and kind of, I mean, we didn't know, I mean, one of the mistakes that I made was I sized the fans incorrectly because I didn't think about the expansion of air on the hot aisle by 11%.

Right. So my, uh, like the fans couldn't keep up. The, the hotter air expands in volume [00:26:00] and. , you know, it's like I'm just not quite there yet. And, and so everything after that was, you know, had a, at least a 20 to 30% margin, so. Yeah.

**Isaac:** Right.

**Marty:** It's crazy to think of mean, you guys mentioned it earlier, a lot of people think like, oh, that's simple.

You find a strand of gas, well you find a generator, you plug it in, it works. But this is again, a cutting edge engineering problem that a lot of people are trying to solve right now. Like when that was like the most fascinating part about working a great American mining, um, working with you, Austin, Tom, now you guys continuing that at Cathedral, like I've learned more about like physics, uh, petroleum engineering, uh, electrical engineering.

You're telling me in the last five years than I ever would've expected. Like if you told me, I [00:27:00] would've learned. This, uh, about this particular domain when I was 21, I would've told you were crazy, but that's what Bitcoin mining, particularly in this off grid environment, forces you to do.

**Rete:** But it's energy, right?

Like it's, it, it's how do we get to energy? And, and that's really how I got into the Bitcoin space is like, there's such, this beautiful relationship between energy and, and bitcoins. I, I just see a lot of waste that goes on in the energy space that it, it's, uh, as much as I hate saying is like, Bitcoin fixes this, right?

Like, energy has this, this,

why waste it when you can use it for something? And it's, it's not a scarcity thing. It's saying how can we be more efficient in the way [00:28:00] that we use it? and, and there's no

**Isaac:** better way. Well, at, at a fundamental level, uh, just, just one of my overarching principles in thinking about this stuff is, you know, look at, look at nature, you know, some of humanity's best inventions comes from, from mimicking what, what nature's doing.

And, uh, you know, what does, what does nature do with energy? Uh, and if you look every waste product of, of an animal or a plant, any organism on this planet, any waste product is food for something else. That, that's just, that's just how nature works at a fundamental level. And so you say, okay, what is Bitcoin food?

That it just, you know, and it, it's very rudimentary, but at a fundamental first principle level, Bitcoin requires energy, you know, specifically electrical energy. And it's like, okay, well I need electrical energy that doesn't, you know, just. , you know, pop out naturally in, in the world. So we need to find other energy [00:29:00] forms.

But still at that fundamental first principle level, you say, okay, where is their wasted energy? What, where is that the waste product? And, and that's where Bitcoin can

industrial scale. You can do that with flare mining at a, a very small scale. You can use Bitcoin miners to heat your home, right? Because that's something that you need anyway. Uh, and you know, I mean, in New England we just burn oil in a, in oil burner to heat homes. You know, we don't have, usually don't have gas hookups.

you know, worst case you have, you know, just there's literally people buying, uh, you know, space heaters, just electrical space heaters. And I just prefer mine to be subsidized by Bitcoin. Uh, but, you know, but the point, the, the, the point is, uh, you know, there's wasted energy all over the place. I mean, I just think about clothes dryers, you know, like just tumble dryers, Tumblr dryers in the US use more power than the Bitcoin network currently.

I mean, what if you just dried all your [00:30:00] clothes with Bitcoin miners? Just integrate the chips in into a, a dryer. I mean, you know, a anywhere you see just energy being expended for its own sake. Bitcoin can insert itself there. And that's, it sort of gets at what we, uh, our mantra at Cathedral. Hey, we, we like to be the cockroaches with the cockroach model.

Cuz there's all these little nooks and crannies where energy's being wasted and, and Bitcoin can thrive there. So it's just sort of the, the ethos of it. Yeah. . So

**Marty:** we're not crazy to think that Bitcoin fixes this. Is Bitcoin gonna make us as energy efficient as humanly possible? Yes. If

**Isaac:** we put in the effort, yes.

I mean, the use of the use of energy is what allows humanity to thrive. And if you want humanity to thrive, it means you need more energy. Uh, I mean, people use heat for lots of different things, and that that's the primary waste product of, of Bitcoin. So, you know, again, that fundamental principle, okay, what's the waste product?

How can that be a primary input for [00:31:00] another task? And, and Bitcoin can thrive there. So, um, yeah, Bitcoin fixes. This

**Marty:** gets me all bullish. Why don't people realize this yet? ,

**Isaac:** you know,

**Rete:** that's a good question because it's out of the norm. It's outta the box. I mean, I've kept my hot tub warm all winter using waist heat from a minor.

just one I subfloor heating gets preheated by a Bitcoin miner. Like do I pay for the electricity? Yeah. Well I also am experiencing, you know, zero degree weather, so I need heat too. Yeah. So I mean, off-grid Bitcoin flare gas mining is just another step removed from the electron is just one step above that, so to speak.

So it's just finding where the forms of energy [00:32:00] that's useful and how to harness that. It's a no-brainer. Yeah,

**Marty:** it is a no-brainer. We, uh, we have some asymmetric, asymmetric information here, um, which brings us the topic why I really brought you guys on. Right now we've been focusing on like the actual design of a mining operation.

Um, but you guys go even deeper than that and, um, you've been doing a lot of research on under clocking and overclocking, particular Asics, uh, posted, uh, a big thread from the Cathedral Twitter account a few weeks ago that got hot. And a lot of people seem to, to love it. But I think to highlight the, the breadth of knowledge that you guys have in this space, like we just described, designing and architecting these environments of which the miners live, but then once the miners are plugged in and running [00:33:00] and you have a stable environment, there's more that you can do at the machine level that you guys have been tinkering with.

So, uh, obviously you've been tinkering for years now. Um, what, what have you guys found,

**Rete:** you know,

the bear market gives you an incentive to change your perspective. I, I do have to say that. , you know, everybody looks at a big, you know, when you say aftermarket firmware, everybody says, automatically thinks overclock. Oh, I'm, I'm just gonna push farther and farther and farther. It's not necessarily that.

So, you know, N helped me kind of see this. When you start conventionally, when you say, Hey, I'm making a container, you are physically restricting the [00:34:00] number of, and I call them parking spots, but Rackspace and saying, I have X many rack spaces for X mini machines, and I need to then size my electrical to that and say, okay, this is how much power this container is going to use.

but what if it was a flexible thing? So it was saying, I am restricted, what, what you're saying is I am restricted by my Rackspace. Well, right now the dollar perera hash of machines is cheaper. I'd rather buy a second machine at a more efficient a and run it more efficiently because that's gonna increase my operating profit period.

So the, the way that we were looking at and, and sizing things physically was, it's a static [00:35:00] number. But what this aftermarket firmware has been able to do is that it's given us a knob, a, a, a kind of a, a fourth dimension knob to say, well, what if it isn't? What, what if you had more Rackspace? If you already have it, then why not utilize it?

Especially if you're gonna get more efficiency out of it. If you've already bought machines and just don't have the enough power to plug it in, but you have Rackspace, why not utilize it? So it, it, it's, it, you know, in the cockroach mentality, how can I maximize all the assets that I have, whether that's power capacity, whether that's Rackspace, whether that's, uh, uh, you know, restricted by power costs, whatever it is, you just kind of look at all those variables and say, is it really [00:36:00] something that's static?

And it's, it shouldn't be. That's a long one way of saying

**Isaac:** it, but yes. Yeah, I mean, uh, . I, I think I often think in terms of, you know, uh, love your neighbor as yourself. And I, I find that that same kind of logic works in, in systems. So if you, uh, if you just treat somebody as, uh, as a vendor or, uh, just say, okay, this is just the service you're gonna give me.

This is how it is, then that, that's the end of it. And you're just using that service as is. But if you sort of get into, uh, into their perspective, you can unlock additional potential. And it allows for a creativity and hard work to flourish in a way that it wouldn't otherwise. So, uh, just to kinda give you an, an example.

So, uh, some of the, the generators that we would use, they're, they normally provide [00:37:00] 480 volt power, the Bitcoin miners, uh, For, for I, we'll get, uh, I'll spare you the details, but in most of these bills, you need 400, uh, 415 volt power delivered to the bill. Um, you can either buy a big transformer, uh, which has additional, you know, capital expenditure to transform that, or if you know a thing or two about how the generator works, you can get around that.

And so what you can do is you could reduce the stimulating voltage on the generator and then it will output 415 volts with a certain D rate associated with the generator. So by paying attention to how that system works, that's not necessarily, uh, a system you'd think about. You can, you know, save a bunch of money and, and that same kind of concept trickles up and down the, the chain here.

So when you think about, okay, a minor is plugging into a, a given set of infrastructure, okay, [00:38:00] well, how does that infrastructure actually work? How, how can we. You know, you know, fully integrate in, in a way that takes into account, uh, all the little nuances. And, you know, this, uh, this under clocking journey that REIT and I went on, w was born out of, uh, out of a problem now that we had.

So we had a bunch of pre-ordered S 19 J Pros that were delivered and we're trying to get these things plugged in just as soon as possible. Well, we had have this legacy site outta Washington State, and I mean, this thing is from back in 2013. It's a really old site. It was originally designed for s nineteens way back in the S nines.

Oh yeah. Sorry. Sorry. Thank you. And, um, I, I, yeah, so you have tons of Rackspace, but the PDOs are relatively small for, you know, what you would, uh, you know, today consider a, a standard mine. So, uh, basically we were, uh, when [00:39:00] we got these S 19 s, we're putting 'em on the rack. The, uh, stock power draw on an S 19 is about 3000 watts, and these PDs were rated up to 5,760 wa

that two of them on, on a pdu. Yeah. Right. And so we, we start with just plugging one per p and it just seems like ridiculous, right? Because here's this PD design, it's got eight plugs on it, you know, designed for up, you know, for, for a bunch of S nine s and we can only fit one s 19. She's like, this is ridiculous.

And so then we sort of got clever and realized, okay, as long as all the phases match up, we can put one and a half miners, you know, uh, per, per pdu. Yeah. And so you'd split, you know, cuz the S 19 s have two plugs, so you could split one over two PDs if it was on the same phase. Yeah. And so then we got, you know, oh, 50% improvement, you know, but we still had a bunch of minors that were trying to get a home for.

It's like, okay, we, we have to fix [00:40:00] this. And I was, and I, um, was like, okay, what if we could under clock the miners a little bit and then we could fit two miners of PDU that would be much more efficient. And so we, we started, started thinking in that way, and we were doing some, some testing and it's like, Hey, you know, we can do this.

Yeah. And then, uh, you know, I, I'm between the two of us, uh, between REIT and I, I'm probably more of the cowboy. And so I just got to thinking, well, hey, wait a minute. What if we under clock 'em even more? What, what if, what if we just stuffed three or even four on a pdu and everyone on the team just like, Isaac, you're freaking nuts.

Like, what are you talking about? Yeah. You know, we can barely get one and a half and you wanna put four miners on a pew? I'm like, yeah, I, I think we can try this. And, and this comes from, uh, you know, again, having an intuitive understanding of, of the way this stuff works. is really, really helpful. Yeah. And a lot of that comes from pain as, as Reid pointed out.

So, uh, uh, [00:41:00] brains had put out this really great, uh, piece of research on, on how temperature can Yeah. Uh, affect the, the wat draw on, on an S 19 model. And I was like, huh, okay. And, and, and at a fundamental level that makes sense. So just to give you a kind of a first principle, uh, approach, you know how I think about this, uh, I, I think of, of chips as these little cities and electrons are like the little cars driving around inside the city.

Uh, you, you, you get to change volts and frequency. So frequency is, is how fast the stop lights turn red and green. Those are the logic gates and the voltage is, uh, the kind of engine you're putting on the electron. I know there's lots of other models. You can think about it as, you know, water pressure and you know how big your hose is.

Lots of ways of thinking about it. But that, that's, this is the model that I, I sort of use. Yeah. And it's like, okay. These chips are, are smaller. So now you have to start thinking about the quantum [00:42:00] physics o o of this, because you're at a scale now where, uh, electrons can quantum tunnel through the logic gates,

Like you, you're, you're getting to a point where you need to think about like what's happening, you know, at the electron level. And it's like, okay, well what is temperature to an electron? So think about driving down the road in your car and somebody's shaking the road like, like an earthquake back and forth and back and forth.

That that's how an electron perceives heat. Cuz temperature is, uh, is vibration. It's vibration at the, at an atomic scale. So an electron's just trying to go a along its merry way down, you know, the, uh, you know, the, the path on the circuit board and it gets hot and all of a sudden the road's shaking all over the place and it's veering and hitting on the gas and coming off the gas.

You know, it's, it's very wasteful, but if you can stabilize the road, Make it, you know, nice and cool on the chip level, the electron can get to where it needs to go without using as much energy. [00:43:00] And so, okay. Uh, you know, brains puts out this piece of reer research and says, Hey, these chips are very susceptible to temperature.

It makes sense. They're a smaller chip, they're more susceptible to vibrations. You know, it, it's the difference between, okay, I'm gonna be on an eight lane highway that's shaking back and forth versus, you know, I'm going down, uh, you know, a little cobblestone street in, in, in Rome. Right. You know, like I'm, I'm trying to squeeze through cuz it's a tinier chip.

You're much more susceptible to vibration. So how can we reduce heat? Well, I mean, you could, you know, immersion cool these things, you can, uh, you know, feed it liquid nitrogen use all sorts of things you could do to keep it cold. But one way that people don't often think of is, if I run less power through this chip.

Yeah, there's gonna be less heat. Yeah. Right. I'm reducing the, the heat density cuz I'm reducing the power density. So if you use less power, uh, it's more stable from the electrons perspective, which means it should get more efficient. [00:44:00] And so, um, you know, brains was doing this with like a, you know, stock clocks and overclocking.

It's like, well what if that concept holds downwards as well? So what if we could make it more efficient? Yeah. So that, that's just, you know, a first principles, you know, what we're, and uh, we, we tried and it, it seemed to work and we, we ended up getting four miners of PDU at this legacy site because, you know, we, um, yeah, we were able to, to reduce the, the power going through each individual machine.

Yeah. Makes, makes a more stable environment on a per chip level and you get more efficiency. So if you think about your site, uh, said, okay, I have, you know, X power. coming, uh, to this site. And then the why output your, your hash rate. Um, you just need to stuff it with more machines. But then you're getting more incremental hash rate for the given power draw, which means your margins, I improve.

So it, it's better to [00:45:00] think about in terms of, Hey, how can I get more money out of, of, uh, respective site? Then how can I get the most hash rate, you know, during a bull run? I mean, if Bitcoin goes to infinity, you can afford to mine at any price. So you just want every hash you can get. In a bear market, you want the most efficient builds.

So you wanna overclock in a bull run under a clock, in a, excuse me, overclock in a.

market. Yeah. Um, so now that opens up this whole possibility. What if you can have these flexible clocks that respond to network difficulty and hash price. Uh, maybe, you know, your ambient temperature so you can start to get pretty sophisticated in, in thinking about how all these things are affecting your, your net profitability.

Um, but anyway, maybe I've said too much, but, but go ahead. Someone else talked.

**Marty:** I don't think you said too much. This is fascinating. Rick, do you have anything to add to that?

**Rete:** It, it [00:46:00] comes out in necessity, right? I mean, for me, you know, the, the, the four miners per PDU at a legacy site, I was like, oh, come on man. Like, seriously? Like how do we do that? Um, , I'm a visual person. And that's where all these maps came out and said, okay, well let, let's look at what this machine does systematically, right?

And, and, and is there a sweet spot? Is there some way to quantify this? It's easy to kind of pick and choose things, but if you don't have like a good roadmap to it, the data doesn't really mean anything. Okay, glad you got to under clock. It's more efficient. Cool. Is it the best way to operate? And the answer is not really.

So if you can find this channel, so we found that there was [00:47:00] a point if you under clock too far, it wasn't as efficient. There was a kind of a de minimus point of saying, here's kind of this area that works better. And that's kind of the range that we want to operate in. . I think that's true on the high side as well.

We're still, I'm still going through step by step on the, um, the overclocking side. It's a little bit different, but not that much. Same concept is that there is kind of this, this channel where it works the best and that's, you know, using the kind of cars and lights analogy is that you don't wanna have too fast of a car because then they, the, the lights are gonna be out of sync.

You kind of wanna have them in sync and that's gonna be the best place regardless of whatever volt frequency, um, combination you have in the most efficient ban. [00:48:00]

**Isaac:** Uh, yeah. So, so just kind of, kind of leapfrogging off that one, one more thing

**Rete:** to, to Isaac's point y that the just mapping things out is only the first layer.

you can continue that in saying what machine mix do you have? And you just keep on layering machine over machine, over machine. And then you start to get the shifting map and saying, this is how I want to do it. And if you have two different power mixes, for example, site one and site two, you can start optimizing how you wanna place your machines and at what wat perera hash.

So it gets lot more, you know, that that's essentially what we're working on, uh uh, is how can I use this fourth dimension of the machine's capability and how can I make a good [00:49:00] decision off of it? That's essentially where it's gonna go. Yeah. .

**Marty:** So we're at like the, like even though Asics have come very far, and are extremely advanced now, producing a lot of hashes, getting more and more efficient on the management side.

It seems like we're still in the stone Age or the bronze Age, where we're figuring out like the, the, it seems like what you guys are describing paints the potential for like a crazy integrated system that Yeah, like in the future there will be processes and software that basically like Isaac, like you mentioned, will look at difficulty and hash price at any given point in time, and then manipulate the operation to be as efficient as possible from a profitability

**Isaac:** perspective.

Yeah. Yeah. And that, that sounds wonderful. Except then you need to figure out, uh, how to [00:50:00] calculate uptime, because it starts to, because you've got your ha like, oh, well our target hash rate was this at this time, and something else another time. It's like, okay. Uh, you know, and, and most people, they're, you know, saying, okay, this was our uptime.

I expect a machine to produce this much hash rate. I expect my power bill to be exactly this every month. And it's like, okay, now we're gonna just, you know, mess up, uh, yeah. The, the account. Yeah.

**Marty:** Well, at that point, you just changed the KPIs, right? Like maybe optimal hash rate production per machine isn't the right kpi.

Maybe it's profitability per machine. And if you've, you sort of target profitability over, um, optimal or not optimal profitability would be optimal hash rate, but, uh, uh, as much hash rate as possible. Maybe that's something the industry should, should move

**Isaac:** toward. .

**Rete:** Well, you know, and, and, and you have to kind of consider macro conditions in too.

It's like, depends on when you bought your [00:51:00] machines, right? Like, did you buy at the top of the bold market at a hundred dollars a tea or did you, like, do you have cash right now? And are you buying machines at 15, $20 a tea? Right. You know?

**Isaac:** Well, and, and, and here's one of the implications of, of, of this, you know, from a, you know, minor allocation standpoint.

Like, you know, what do you wanna buy? I mean, you know, today, uh, like an XP goes for about $6,000 in S 19 J Pro is going for about 1600, 1700. So what if, uh, what if you can under clock an S 19 J Pro and get not quite as good, but get comparable efficiency to an xp? Very similar are do you wanna spend 6,000 to get that level of efficiency or do you wanna spend, you know, $4,000 to get something of comparable efficiency [00:52:00] and comparable hash rate?

Yeah. Uh, and, and now the downside is you need two rack spaces instead of one rack space. But presumably you could, uh, you know, get that rack space for less than what the difference is, uh, you know, which would be $2,000. So in terms of, Hey, what machine are we gonna buy? Uh, you know, it, you know, if you use techniques like this, it can unlock, um, you know, capital allocation in a way that you may not have looked at.

So, yeah, it, it, it's just about saying, you know, intuitively what is each system capable of and how can they integrate well? Yeah. Uh, cuz you know, someone who isn't using this kind of, you know, firmware take and they just want the best efficiency, they're gonna buy the xps. But if you can, you know, kind of use this firmware hack, uh, you know, then you can get that for for less.

Right. And that, that's what it's all about. Doing more with less.

**Marty:** There's gonna be whole teams dedicated to figuring out , like the, [00:53:00] the correct capital allocation. Rackspace. Yeah. Cause there's so many, there's so many variables. Rackspace, electricity cost, hash terror, hash per machine. It's . It's insane to think how complex.

Is it complex? Yeah, it's complex. It's a complex system, like how complex this is gonna get and how, how much brain power is gonna be dedicated. Like you're gonna have a whole like trading desk trying to figure this

**Isaac:** stuff out. Yeah. Or, or, or chat G p t, you know, we'll see

**Rete:** Just ask chat. G p T. Yeah. Make sure you a ask it in the right way. ,

**Marty:** I mean, wouldn't be surprised within a few years, one of these ais ze you're able to be like, Hey, here's what I'm, here's what I'm trying to fine tune for.

**Isaac:** Yep. What, what should my strategy be? Trademarked , you know, [00:54:00]

**Rete:** but that's kind of the, the thing of where you like, this is the difficult part, right?

Is that do I buy more Rackspace? Do I buy more power capacity? Do I buy more machines? Do like, , it's all a process, and it all has to kind of work in this, this, um, flywheel, um, sequence, right? Like you can't have more of one thing and then not have the other. Otherwise you get, you know, kind of behind the eight ball and you wanna make sure that, you know, you, you might go make deals that you don't like or, or something else.

But if you kind of use this as kind of a tempering mechanism saying, what is Rackspace really worth right now? Containers, Rackspace, it's cheap because nobody's buying them, but the long term value of them, I personally, I think it's s [00:55:00] severely undervalued right now. Rackspace is severely undervalued right now.

Yeah.

**Marty:** And what you're getting at is that like these decisions are dynamic, they they're changing Yes. With every block that's produced with every, every tick of the, the price moving up or down, like so you have to have Yes. The ability to make the correct decision in a dynamic way on the go, depending on the market

**Isaac:** conditions.

Yep.

**Rete:** And, and I think eating smaller steps, so instead of saying I gotta go build a hundred megawatt facility, it might be, Hey, I'm gonna make these decisions in smaller increments and, and have the ability to do so. Um, and then kind of roll it in smaller chunks, which actually di if you take a 10,000 foot view de-risks, a lot of those decisions, I think.[00:56:00]

**Marty:** Yeah. That's one thing I've become partial towards over the last two years is I think these mega mines are not gonna be the wisest way to build out a mining operation moving forward. I think taking off smaller 5, 10, 20 megawatt chunks at a time makes much more sense.

**Isaac:** Yeah.

**Rete:** I mean, no problem with trying to go get a hundred megawatts worth of power capacity, but like the infrastructure and what goes into it and like when you buy machines, how you buy, uh, buy machines and then you start filling into it.

I think that process should be, I don't wanna say compressed, but kind of like concurrent. Yeah. Has to be. It's really hard to say I'm gonna buy 20,000, 30,000 s nineteens. You have to

**Isaac:** a year and

**Marty:** a half ago. Yeah. You have to develop like a just in time process. Yeah. Right. Where as soon as the electricity's up.

The Rackspace is up and you're able to plug [00:57:00] in, you should Yeah. Have that project management set up where All right. As soon as we electrify, uh, we, we are plugging miners in.

**Isaac:** Yeah. I I think that, uh, the, the under clocking play is gonna have, um, I, I think it'll have outsize effects on profitability relative to a more distributed model.

And what I mean by that is if, if you look at, uh, at a mine that's on grid, you know, one of these mega mines, right? They sort of have, uh, no penalty necessarily. I mean, every site's different, right? Sometimes you have a minimum offtake, what what have you. But if you say, all right, well, I'm allowed to reduce how much power I pull from the grid without penalty, then in a bear market, when hash price drops below whatever point the, the stock firmware machine would go unprofitable.

Well, what if, hey, I can under clock now increase the efficiency on a per [00:58:00] machine basis. I'm reducing my overall power use, but I'm still profitable as a site. That doesn't quite work. The same if you're off-grid, because in that situation, if you're renting a generator or you've purchased a generator, you already have your, you know, you already have that as a payment, right?

Like, and that doesn't change it. It's sort of like committed buying a generator. You can think of it as having committed to a minimum off take. Agreement, I'm going to buy exactly this much power and it, it, you know, it's pay or take if, if you will. Right? So you're committed to using whatever the capacity of the generator is.

So in that context, sure you can make the machines more efficient, but if you're using less power, you're just under utilizing something you've already paid for. So it may not make sense unless you can somehow pull generators off or maybe you could bring another container on, on site and there we go, use more of the generator.

Right. So it's, it's more [00:59:00] sophisticated. You can still use it, it's just, it requires more playing with the physical infrastructure and on grid site they can pu push an under a clock and they just stop using as much power from the grid. and their, their, you know, margins are improved on a, you know, on a per watt basis.

So yeah, there's a little bit of nuance there.

**Marty:** Yeah. Yeah. Now we're dovetailing in two, like bitcoin mining, changing the game of these PPAs, how they're structured. Yeah. What is allowed, like going and educating utility side of the equation. Like, Hey, we're gonna do this weird thing that probably no other customer you have wants to do, but trust us, it's worth it in the long run for you.

**Isaac:** Yeah. I mean, in terms of integrating with utilities, I mean, that, that's a whole other can of worms with, with the firmware side of things. I mean, so right now the way it works is if you wanna, uh, you know, participate in demand response, you're just turning off machines. I mean, that, that's how it works today.

You [01:00:00] suspend mining or if you have a smart pd, you just turn the minor off altogether. Um, but you're, you're, you're basically keeping your same rate of efficiency. Uh, when you participate. So, so if, if you're, you know, let's say, okay, you know, you're, um, you know, whoever manages the grid, whether that's an RTO or a municipality, whatever, says, Hey, we need you to turn off half of your, uh, your power to use

is half of the miners get shut off and the other miners are still running at the same efficiency. But what if instead you said, okay, I'm gonna reduce my power use by half on a per machine basis. So during that curtailment, you just make all of your machines more efficient. So, so you're increasing your margins in that curtailment, that that's more money

**Marty:** introducing your margins, right?

Because you're still mining with every minor [01:01:00] Yeah. More profitably. And then you're getting paid. Correct. For turning

**Isaac:** down. Yep. Right. So, so that, I, I think that's sort of where we're headed is, uh, having dynamic tunability on a per minor basis. I, I, I think that's gonna create huge margin boosts for, for a lot of these on grid sites.

Yeah. That's gonna

**Marty:** be massive talk about

**Rete:** profitability, which is how do even demand response, right? Like, well, it is a demand response, but it's not like a binary decision at that

**Isaac:** point, right? It's a, it's a, it's a dynamic response versus a binary response. You're, you're, you're scaling your hash right up or down and so you're, you're responding to the, you know, the request to curtail, but you're doing on a per machine basis.

And as you do that on a per machine basis, you're increasing your efficiency so you get more hash rate out of the power you are allowed to consume at that time. So, yeah, I, I, that's where we're headed. Uh, I think this is

**Marty:** like some sci-fi shit here.[01:02:00]

**Isaac:** Yeah, I, and half the time, you know, re and I have conversations like this, like, Hey, c, could we, could we do this kind of thing? Uh, I mean, one of the things that, uh, I we've been talking about recently is, Hey, what if we could be designated as like a virtual power plant? So we're a, a buyer on the per kilowatt hour market.

Oh God, we're a seller on the, um, on the capacity market. And so you just, uh, you know, if the grid is asking for more power, you, you just turn off you, you know, you don't even have a power plan on site. It's just direct tied to the grid and you're, anyway, we, we have these crazy conversations and, you know, nine out of every 10 just die on the drawing board cuz it's just two nuts.

But every now and then something comes through. Y you

**Rete:** know, I'm just a simple minor, let me mine . .

**Marty:** Well, I think that's what we're getting at. Like Yeah. Mining's much more complex and especially if you wanna be profitable and in it for the long run, like you have to have. , these types of discussions in, in this train of thought.

**Isaac:** [01:03:00] And I, I think, you know, I, I'm really thankful for Reid. I think we make this really interesting team where I'm just sort of this cowboy like, Hey, let's just throw stuff at the wall and see if it sticks. And, uh, and you know, he, he tolerates me enough to hear me out and then we'll calmly explain why I'm just so wrong.

And, but every now and then he goes, well wait a minute. Maybe there's something there. And then, yeah, so sort like, Hey, can we look here? And then he just dives down on the, you know, like an electron microscope. Microscope. He says, Hey, did you think about this? Like, oh no, that nukes the whole idea. Nevermind.

And then we just continue on. But this is sort of, uh, yeah, this great interplay. I'm just pushing the envelope. And he's like, whoa, whoa, whoa. And, uh, yeah. Well sometimes we, we fight like an old married couple about stuff, but we always not . Yeah, it it's great

**Rete:** that, that's an understatement, but Yes. Yes. Uh, I ideas have to be a able to be executed. So [01:04:00] when physics are defied, then I will put my foot down. But, um, you know it, when you get into this, I, I think there's so much potential in this, uh, firmware space and, and unlocking the potential of, of the machines. I mean, that's just one step, right?

Like, but you still have to make the, uh, environment conducive. That's where Bitcoin comes into a physical it, in contact with the physical world. So if you don't make the, the mining machines happy, they ain't gonna work for you. So, you know, we can do all this, this fun stuff, but like, as part of, uh, what we wrote.

like I could have the same vol frequency, uh, you know, [01:05:00] uh, on the graph, so to speak. Um, but if that temperature is way up here, doesn't matter. Right. And, and that's, that's controlling your environment, that's making sure that everything kind of works in concert in the way that you, you've hopefully designed the system.

**Marty:** Yeah. That gets to another point, like with all these efficiency gains and the games that you play with voltage and stuff like that, I, it's gonna be hard to tell because enough time has not passed yet, but you guys have inclinations on what this will do for the, the lifecycle of these

**Rete:** Asics, do you under clock them?

It's, uh, I don't have the back data, but my gut instinct is, uh, it will e you know, expand the life of that machine as long as you don't have. , you know, dusts going in and, and mucking it

**Isaac:** up like, right. [01:06:00] Yeah. I mean, it, it's, it's a very simple concept, you know, take care of, of your things when they last a long time.

Uh, it, it, you know, it's very simple. Take take care of it and then figure out what it needs to run well. Um, I, I mean, I just as a, you know, first principle concept, I, I look at the, you know, the S nine, you know, when Brains came out with this great firmware, it was an under clock, right? But that extended the whole life cycle of an S nine.

Mm-hmm. . And I, I think, I think what we'll see is that trend will continue with, with lots of other minors where under clocking pushes it into a more efficient regime, and then you can afford to run it longer. Um, so yeah. I, I, yeah. I think it'll change. Yeah. It'll, it'll change a

**Marty:** lot. Yeah. It's crazy to think that the average life cycle of an ASIC before the S nine was like 18 months now.

People are still running S nine s today. Seven, eight year. Eight years. Almost later.

**Isaac:** Yeah.

**Rete:** I mean, but now they've modded it to a double [01:07:00] shoebox, like one power supply for two. Like

**Isaac:** Yeah. I mean, yeah. You know, look, looking at, um, looking at what Bitmain did with their S 19, i, I really re respect sort of their take.

Cuz you look at the thing, it's like, why does this have two plugs? And then if you think about it, it's like, well, they've got their own minds as well and all of that infrastructure and including their customers too, right? It's all designed for S nine s. And you say, okay, I'm gonna double the power use on a per machine basis.

Am I gonna put, put a bigger plug? Am I gonna put that C 19 plug and make everybody gut their mind and, and rebuild all of their electrical infrastructure? Or am I gonna put two plugs? And anytime you pull out one s nine all, sorry, and you pull out two s nine s, you can put in one s 19, it fills the same space on the rack.

It works electrically. Right? And so thinking, I, I, I think, um, I think manufacturers are starting to [01:08:00] think more and more about the infrastructure side of this. You know, where are they gonna pl where are these things gonna go? And, and again, that gets back to. The concept of, of loving your neighbor as yourself, right?

Like, how, you know, where is this going and, and how can it be used? Well, um, I mean, B Bitmain coming out with these new three phase PowerUp supply, uh, sorry. Uh, yeah, ps uh, I can't talk. Yeah. Uh, P PDs, um, yeah, I, I think that's gonna be game changing for, for a lot of folks, right? Because when you build out this, this mine, uh, you don't necessarily have to do the same amount of work, you know, pulling all the phases apart.

You can just deliver the three phase right, to the pdu and then it gets, you know, the splitting up gets taken care of at that level. Um, you know, stuff like that where it's thinking about how it all works together, it's gonna become more and more important.

**Marty:** Yeah. And to that point, just due to like the limits that the asic industry is beginning to brush up against, do you think on that side, the ps u p to use side, we've [01:09:00] reached like a point of commodification where you don't have drastic changes from a model to the next.

**Rete:** It's e everything is size, really. I mean, you can make these really big, big things more amps, more, you know, it's gonna be really interesting in where, how, how the power side is going to, to occur for these machines. Whether or not they're gonna be like, Hey, we need bigger and bigger PSUs on these things.

If that's the case, we're kind of at the, the standardized plug limits already. Um, can't do it. So one thing that you can do is go to three phase power. Um, you will need to modify your, your farm a little bit for that. But I mean, I can still use 14 gauge power, uh, sorry, 14 gauge wire and push 8,000 watts through it [01:10:00] in, in three phase.

So,

**Isaac:** So it's Yeah. Sort of reaching that point, is that what you're saying? Yeah. Yeah. I mean, like, what are you gonna do? Put a, put a dryer plug on a miner? I mean, where would you put it? , uh, you know, , you know, there's just, we're we're reaching sort of the limits of what, uh, electrical engineers had thought up for, for quite a long time.

I mean, Bitcoin mining is pushing the Yeah. With these, um, you know, the, these specialty in industries, right? Um, like, like they're just, there is not a computer plug. Uh, I mean, maybe the L seven, but like in general, you know, the C 19 s your limits 20 amps, right? I mean, if you want to go bigger than that, uh, I mean, I, if you wanna go higher voltage than that, then you start reaching problems with, you know, arcing.

Uh, which is why everything is rated 250 volts or less. Right. That's a, you know, an electrical standard. Yeah. So, Um, when you start to say, Hey, I want [01:11:00] to increase the voltage for efficiency, or, Hey, I wanna put more, more amps through, you're reaching the limits of, uh, you know, what's permissible under electric code.

Like, there just isn't a plug that can handle these things. So you have one of two options. Either you put, you know, as these chips get more and more power hungry, or you know, they're putting more chips on a board as they get more efficient. Um, you know, if you want to use more power on a per machine basis.

You've gotta go three phase, you've gotta start doing direct wiring right into the unit. There is no plug. You know, stuff like that. Yeah. The other way to handle it is you just put less chips per machine and you keep the power, um, you know, data, the, the form factor the same. Right. Because of the limitations in, in electrical code and, and like what's physically possible.

So I, I think you'll start to see, um, I, yeah, I, I, I think either you'll start to see more three phase stuff come to market, or you'll see people using the same sort of power form factor and they just put less [01:12:00] chips. Yeah.

**Rete:** God,

**Marty:** you two are so fucking smart. Thank you for the education you've given me. Uh, over the years that we've worked together.

I think you guys, the two of you, Austin Tom, have really helped level up my knowledge of this space. Cause

**Isaac:** it's crazy.

**Rete:** But we've, you know, and, and that kind of boils down to. , the fundamental thing, like the team matters, right? If you have a lot of people or good people to, to kind of collaborate with and educate and kind of lean on,

**Isaac:** you're golden. Yeah. Well, it's just, you know, it's, it's, it's staying humble and working hard and, you know, part of being humble is, is listening. Uh, just recognize that, hey, you never know where the best idea's gonna come from and just being open to it. No, I, I think that's something you've done really well, Marty.

I think that's [01:13:00] why you're, uh, such a captivating, uh, you know, uh, uh, podcast host. You know, it's like you just, you, you, you, you know where to Yeah. You, you know where to let people just run when, uh, when they, when, when I go all crazy. So, I don't know.

**Marty:** Well, I don't think it's crazy at all. Thank you for the hosting compliment, but like, no, I, being earnest here, like talking to you guys is.

Multi-hour long phone conversations, trying to understand what the hell you two are working on. significantly upped my game personally.

**Isaac:** I mean, I, I assure you, like we, we feel that way most of the time. So it, it's not a, uh,

I, you know, like there's so much of this stuff that is like, you know, a master electrician, you know, they'll, they'll spend their whole life devoted toward understanding all these crazy nuances, uh, you know, harmonics and, you know, you know, phase shifts and, uh, [01:14:00] you know, there's all this stuff, right? It, it's a very, uh, you know, sort of enshrined discipline.

Any, any, like, you know, networking and data management, you know, uh, you know, you know, network security. HVAC systems, you know, structural engineering and welding. Like, there's all of these crazy disciplines that Bitcoin and bitcoin mining pulls on right down to economics and, you know, political theory. I mean, there's all of this stuff that, that just gets sucked into it.

And so you, you're never bored, but, um, but often overwhelmed and, and feel like the stupidest burst in the room. But it's just a matter of, you know, I I I often describe Bitcoin mining as just, uh, you know, just enduring pain. Uh, you're just like, Hey, I'm gonna just, uh, yeah. That's why I say you gotta stay humble if you got Yeah.

Yeah. It's very

**Marty:** masochistic .

**Isaac:** Well,

**Rete:** it, it's not, it, it's, it's always listening. I mean, you say stay humble stacks [01:15:00] at the stay humble is, is listening to your environment, listening to the. , uh, li listening to the market, listening to what is needed to make this ecosystem thrive. And so, like I said, I'm not an expert.

I am, I just know what has caused me pain, right? And, and, and that just keeps on stacking and stacking and stacking. So I can say, Hey, I know that you want to go this direction, but really what you want to do is go this way. Yeah. Don't, don't make the same mistakes that we did. Or, Hey, by the way, there's a pitfall right in here.

It seems like a good idea, but it's not. And, and that's just experience. So the more people we can get in here to get that kind of experience into this, like I'm an open book, I, I happy to bring more people in. [01:16:00] That's, that's what's gonna accelerate adoption and just make this ecosystem work.

**Marty:** would it be, I mean, would it go too far to say that like Bitcoin mining as an industry, considering all the different variables and core competencies, it, it pulls on, could incite like an engineering renaissance?

**Rete:** Wow. That okay. That is, um, good.

**Isaac:** Well, I be, because what, what bitcoin mining is doing currently is it's disrupting the idea of a specialist.

Because if you just have a, an, an electrical engineer specialist and an HVAC specialist and a, you know, data networking specialists, I mean sure you could go get all those specialists and get 'em in a room together and then like it's gonna take a while, right? Yeah. To, to get everybody on the same page and what you want to go [01:17:00] build together, because there's a lot involved in these, in these sites.

Or you can have somebody. That has basic competency in, in each of those respective areas. And they sort of, they're, they're more like a conductor Yeah. Than, than a musician. Right. They allow each of the specialists to do what they're really good at, and, and they, they have an understanding of, of, of the other disciplines, right?

And so I, I think Bitcoin mining is bringing back the Renaissance man. You have to know a little bit about a bunch of stuff if it's gonna work well. And it's great to have specialists in your court, but a specialist, you know, uh, on their own is not gonna be able to make a, uh, a, a good mine.

**Rete:** I think the specialist is absolutely there, but it's easy, especially as, say if you're a civil engineer, you're gonna talk to some other civil engineers.

You're not really gonna talk to the, the other guys. And if you do, it's through a consultant or [01:18:00] through some manager, project manager, I think. Having a diverse skillset team is very important, especially if you have a lot of different experts in the, uh, from those fields. But you need to make them to work together towards a common goal.

And if everybo well, I mean, hell, if you believe in Bitcoin and everybody believes like that's the future, then you already have a common goal in mind. , it's just about working together at that point. Yeah. So if you can kind of unite around the progress, um, platform. Absolutely. I think you can have a lot of different disciplines working together and, and, and as they do already, but more integrated in that way.

**Marty:** Yeah. Fuck, I'm bullish .

**Isaac:** It's, uh, [01:19:00] always

**Rete:** has have been. Yeah, we've never lost that

**Isaac:** bullishness.

**Marty:** No, no. But it's again, like sitting down and putting this all together, like the ren, Bitcoin mining could big bring back the Renaissance man in the engineering sector. Like, cause you have to, like you said, I really like the conductor analogy.

Like you have to be able to understand how the different parts interact with each other.

**Isaac:** Yeah, yeah. I mean, if you're always playing the same song, you know, every week, week in and week out, you know, uh, eventually you don't need the conductor, right? Because the musician just sits there and they're doing exactly the same thing, off the same piece of sheet music and it's like, it doesn't change.

So you go, okay, well we don't need the conductor. But once you start changing the song and like you, you uproot the, the, the status quo on the kinds of engineering you're doing. Cuz it's very dynamic. There's lots of systems at play here. And so what, what, you know, once you start doing that, you need the conductor back to, to.[01:20:00]

Keep everybody in sync. Otherwise, it's just a mess.

**Marty:** Uh,

**Rete:** I

**Marty:** think, I think this, uh, that's funny. I think this rip is gonna be very popular amongst the mining industry because again, I, I think a lot of people like have a, a rough idea about all these problems you guys are describing, and as you said, you're not experts. But I think the experience that you two have, uh, goes far beyond a lot of the individuals in the space.

I think that I, I, I mean we saw that too when you guys launched the thread on, um, the research that you did on the under clocking, the response to that was like, holy crap, I can't believe somebody did this. Thank you for sharing it. I, I guess that's another thing to touch on, like why share this isn't this alpha?

Um, shouldn't you hold this close to the chest? That was some of the feedback from the thread,

**Isaac:** you know. ,

**Rete:** we thought about [01:21:00] it in that way, but it, I think it's hard for if, if you're trying to promote this Promethean existence, like you, you wanna share the platform to do it. I'm not telling you how I did, uh, like how I'm writing my own algorithms or all, all that you need to go put in the work.

Sometimes it's just about showing, Hey, here's the possibility, right? I'm not perfect. I might have blind spots, but I would, I would respect the guy who uses that as the platform to say, Hey, I looked at it in a different way. How about this? And if he shares that too, then it, it perpetuates that, that cycle of sharing mutual, mutual progress.

**Isaac:** I mean, that, that's how a renaissance [01:22:00] happens. You need to get people talking. Yeah. And if everyone's, you know, covering their butt with proprietary jargon and, and, and patents, I mean, the, the industry won't move forward. Right. Um, I mean, like, I remember, uh, you know, when I first got into mining, I mean, there were no YouTube videos, there were no tutorials on, on how to build these things.

It was just like, okay, I gotta just google a bunch of random stuff that sort of has proximity to what I'm trying to do. And I mean, that, I remember back when I was building GPU rigs, like there was just no information on this stuff. It was just a lot like, just sheer pain banging your head against the wall day in, day out for months before you even, like, before I figured it out.

And there were a lot of people in the space who had built before and, you know, they, they were showing people how to, how to build these things. I mean, you know, go right back to Satoshi himself, you know, he. Put it, made it open source. He put it out into the public domain and said, here guys, that's what I'm trying to do.

That's what I'm trying to [01:23:00] build. How can you help me make it better? Uh, and that, you know, that's really the spirit of, of a Bitcoin is we're gonna build a better world together. And to do that, you know, you can't always be worried about, oh, someone might be trying to stab me in the back. Like, you know, part of this is, Hey, we're all in this together, you know, as, as Bitcoiners and we're, we're gonna optimize and build better together.

So, yeah. Um, and, and it, it's just about staying at the tip of the spear. It's about saying, look, we're, we're gonna, uh, be thinking about these hard things, thinking about these problems and, and try and be among the first who adopt the, these novel techniques and, and technologies. Yeah. And if you just are constantly staying there, everybody improves while you do well.

And, uh, you know that that's a better world. That's how you build a better tomorrow.

**Marty:** Hell yeah. We're gonna win.

**Isaac:** Always what? Uh, together we win. This is

true.

**Marty:** Yes. What, uh, what should we send the freaks off with? Any [01:24:00] final thoughts? Anything you guys wanna touch on before we wrap up here?

**Rete:** Just test, just, just work on stuff.

If something interests you, it's possible is, you might not know how, but that's part of the process. So, you know, there, there are a lot of resources, a lot of parallels that you can draw. I mean, I, I got my hot tub heating loop from a wood boy boiler stove idea, right? Like, okay, okay, that's the way I should design it and, and go from there.

So there are a lot of things that you can borrow from, just share, you know, I, I like the idea of sharing, uh, on some of those ideas. and just go test it. I want other people to, to have this, this graph and make their own graphs so that it's like, oh, well they did it a different way. [01:25:00] That knowledge sharing, I think is, is, is what I want to see out of that.

**Isaac:** Yeah. I, I would say, um, all hard work yields a profit and sometimes it takes a while, but there's, um, there's something that comes from excellence in, in, in any discipline. If you do something well, you will, um, you will inevitably discover a couple area. They're urgently involved and. It's just about being curious and saying, Hey, you know, what are the things that interest you?

And saying, even if it's 15 minutes a day, I'm gonna just walk in this direction because I'm fascinated. And it's just, you know, I, I remember my first GPU rig, uh, you know, I, I, I tried and tried for a couple months. I couldn't quite get it, you know, I, I, I was teaching myself how to build a computer here.

And, uh, I, I, I, I remember I stopped for a couple weeks and I just remember thinking, no, I [01:26:00] decided to do this. I decided I was gonna figure it out, and I went back to it and I finally got the thing going and like, there's nothing so sweet as Wow. Like, this was so hard and I got it. You know, I, it, it's like, you know, you know, I, I, I think about who's the first guy that made fire, and like, how crazy that must have been.

Like, I did it. I figured out how to do this. Right? Think about how long that must have taken. Like the, like the, literally, there's no YouTube tutorials. There's no one like the, somebody had to go figure that out for the very first time. , you know, and like that, that's hard. And, and each one of us has this, this sort of personal journey.

You know, I, I've got, I've got two young boys and there's just this like, crazy light in their eyes when they figure out how to do something for the first time. You know, like, oh, I figured out how to turn the light switch on, on my own. Oh, I figured out how to unlock the front door. Oh, shoot, mommy, uh, please.

You know, like that. But still there's this, this, there's this beauty, um, [01:27:00] yeah. In that. And so it's just work hard and, you know, stay curious and don't, um, you know, the future belongs to those who believe in their dreams. So just don't give up.

**Rete:** And Marty. Thank you for what you do and, and giving people like us a voice, right.

And being curious about what, what's going on. Because you above anybody else understand that it takes so many different people from so many different disciplines to make this all go forward. Pretty much. Yeah.

**Marty:** I mean, I was beautifully put by both of you and the thanks goes both ways. It's been a net benefit, massive net benefit to my life working with you guys and learning about all this stuff, and I'm extremely happy.

I can't believe it took this long to get you guys on the show. I know. I'm extremely happy that it has finally happened because I think [01:28:00] there is going to be a lot of aha moments for, for people in the mining industry listening to this, and like you said, again, Bitcoiners giving back. Uh, really trying to live close to the ethos that Toshi set forth when he launched a protocol is, was gonna create this cascading effect.

I do think particularly in the mining industry, there is a bit of, um, keep things close to the chest. That's your alpha. But I, I think considering the enormity of the problems that we're trying to solve, I think this will have a positive feedback loop sharing this information and really putting this out there.

So thank you gentlemen for doing

**Isaac:** it. Pleasure, . We, we we're in it for the Plebs .

**Marty:** Hell yeah. Well, it's been fascinating. We'll do this again, I'm sure. Sweet. Awesome. It's not gonna take five years this.

**Isaac:** I hope not. Oh my gosh. Has it been that long? Oh, my word. I must be all gray by then.

**Rete:** [01:29:00] Wow. If that that ever happens,

**Marty:** you'll be all gray and I'll, uh, I'll be joining you in the bald crew.

**Isaac:** So, .

**Rete:** Hey, bald is beautiful. It is, it

**Isaac:** is. Anybody tell you otherwise, .

**Marty:** All right, gentlemen. Thank you. Thank you, Jens. Cheers. Tha seriously, thank you. You guys are fucking crushing it.

**Isaac:** Hey, love you Marty. Love

**Marty:** you guys too. Peace of love

**Isaac:** freaks. It's fun.

**Marty:** Isaac, you wanna get it? Oh, I got this here now. Yep. Peace of love freaks, Dicky.