Super-deep geothermal drilling … with microwaves

A conversation with Carlos Araque of Quaise Energy.
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David Roberts

Hiya, this is Volts for October 10, 2025. Super deep geothermal drilling with microwaves. I'm your host, David Roberts. For years I've had my eye on a geothermal startup called Quaise, where other advanced geothermal companies like Fervo are seeking to better exploit resources at traditional oil-and-gas-drilling depths. Quaise aims to go deeper — as in several miles down, where water goes from hot to supercritical and holds considerably more energy.

Trouble is, conventional drilling equipment breaks down when it gets down that deep into that kind of heat, so Quaise had to come up with something else. And what they came up with is … well, it's not lasers. The people at Quaise absolutely refuse to let me call it lasers. So fine, it is "millimeter waves," basically a form of microwaves.

They shoot millimeter waves down into a well and pulverize the rock into dust, which is then sucked out of the hole. There's no physical contact between the drill and the ground. They claim they could get down as far as 12 miles with this technique.

It's pretty cool. The company recently demonstrated its drill in a real-world quarry and is currently constructing its first commercial plant. At Climate Week NYC, last week I had a chance to interview Quaise's CEO, Carlos Araque, about the advantages of going super deep, the challenges, and the path to rapid scale. Enjoy.

Hello, everybody. Thanks for coming. This is awesome. I'm very excited. So the point of Quaise is to go deep, deeper than traditional geothermals. So maybe before we talk about exactly what your machine is and how it works, let's just talk about what do we mean by deep and why are we trying to get there? So, like, how deep is typical geothermal? How deep are you trying to go and what is the advantage of getting that deep?

Carlos Araque

Wonderful, thank you. Before I answer that question, so very glad to be here. I think your article back in the day when you said "If you solve geothermal, you solve energy."

David Roberts

That was 2017, before it was cool.

Carlos Araque

That helped me fundraise, believe me. So thank you for that. And Maria, I think Maria Gallucci here, she probably wrote the first article about Quaise ever, back in 2019. So very interesting to see it come full circle. Glad to be here. So the goal of Quaise is to go hotter, not deeper. But they're related. We're trying to get to 300 to 500 degrees Celsius. That's about 600 to 1,000 Fahrenheit for a variety of reasons. Some of them have to do with industry at large since the industrial revolution works at those temperatures. So if you can access those, you can plug and play into industry at large, including power generation.

So that's the fundamental goal — access geothermal at those temperatures. And we want to do it everywhere, not in a few locations. And that then means we have to go deep.

David Roberts

How deep are traditional geothermal wells? Just to give us a sense of scale.

Carlos Araque

Anywhere from 500 ft to a couple kilometers, one mile, two miles deep. Right. And oil and gas is typically in that range too. So when you look at the oil and gas industry, they are usually operating in, that's their playground. But I'll give you two interesting data points. Humans have drilled 15 kilometers. That's almost 10 miles deep holes. That's ADNOC, that's not vertical.

David Roberts

Is that the one in Russia?

Carlos Araque

So that's ADNOC, that's the UAE with horizontal. The vertical ones — the Russians have the record — that's about 12 kilometers deep, it's about eight miles. That took 20 years. The Chinese just completed one 11 kilometers deep. It took 300 days to get to 10 kilometers and 300 more to get the one extra kilometer. So humans do remarkable things, but they're not hot holes. On the other side of that equation, people can drill very hot holes. How hot? 300, 400, 500. But not deep. So we're trying to solve for the two things with precedents on both.

David Roberts

Yeah. And one of the things I remember talking with you about before is I was like, "Oil and gas has been around forever. They've been drilling forever. Why can't you just use their stuff?" And it turns out they don't really go very deep. Oil and gas is not particularly deep down.

Carlos Araque

That is correct. And they don't need to. They make plenty of money staying in the shallows.

David Roberts

So how deep do you want to go then? So if normal geothermals are anywhere from 500 ft to a kilometer, how deep is a Quaise well?

Carlos Araque

Yeah, they are as shallow as 2 miles. So the first we're building, the first one now in Oregon. That one is only two miles deep. Only two miles deep. It's just really hot. It's really, really hot. So that's really the first unlock. Go hotter. Show the economics, show the metrics. Do more with less. Less wells produce 10 times the power. That's what we want to show first, two miles. But as you progress and expand the reach of geothermal, these hot geothermal, over the map, you go as deep as 12 miles. So that's the range — start at 2 miles, not 12 miles.

Start at 2 miles and go in the extreme case to 12 miles. That's the playground. You all travel more than that distance to get here, by the way, by a long shot. So it's not that far.

David Roberts

Yeah, we didn't have to tunnel to get here, though.

Carlos Araque

Oh, but I have the tool for that.

David Roberts

So help me understand. As you get deeper and deeper, you get hotter and hotter. Is the idea just to go as deep as you need to go to get to a particular heat? Like once you reach that heat, like that's deep enough, that's the idea?

Carlos Araque

Spot on. So the resource is 300 to 500 degrees Celsius. That's what we're after. We only need to drill as deep as it takes to get us there.

David Roberts

Right. And explain — I've had this explained to me probably like 50 times, and I still don't understand it — so one more time, explain to me, what is supercritical water? How hot do you have to be for the water to go supercritical? And what does that mean for power? For power purposes, for energy purposes?

Carlos Araque

Yeah, that's a very good point. So we get technical, but I'm trying to stay away from equations. So we know water as ice, we know water as liquid water, we know water as vapor. It's very familiar to all of us. Very few of us know water as a supercritical fluid. A supercritical fluid looks, if you've ever seen that CO2 ice, that looks really weird. Like if you look at CO2 ice sublimating, like in ice creams or food preservation, it looks like there's a fluid in there, but it's ethereal, it's light, it's like non-existent. That's what supercriticality looks like.

To do that with water, you have to get to 375 degrees Celsius. Is that hot? Let me use Fahrenheit. So twice that. It's a shortcut, right? It's about 700 degrees Fahrenheit. That's not very hot at all. Kitchen tools like pizza ovens go hotter than that.

David Roberts

Could you make supercritical water in your kitchen?

Carlos Araque

You need the pressure, so that's the only thing that's missing. But the pressure is for free when you're down there. So the pressure, you need about 22 megapascal, which is not huge pressure by oil-and-gas-drilling standards, but it's significant pressure for your kitchen. You won't be able to do that. But if you get the temperature, the pressure is given for free. Getting to supercriticality is only a question of getting to temperature, not pressure, because the pressure is just there.

David Roberts

And so I think the most important thing for listeners to understand is that as the water gets hotter and hotter, you get incrementally more energy out of it. But when it reaches this threshold of supercriticality, it's no longer incremental. You get a big jump. There's a phase change — 10 times.

Carlos Araque

10 times.

David Roberts

And is this literally like the difference between like 374 degrees and 375? Is it a phase change?

Carlos Araque

It's an exponential. Let's talk about what's currently available with the toolkit of the oil-and-gas industry, not with our tool, you can get to 150, 200 degrees Celsius. That's hot. That's hotter than a boiling pot of water. There you get a certain amount of energy. Right. The minute you start going to 250, 300, 350, 400, you start getting multiples. So by the time you get to 300, you're getting 5x what you get at 200. And it's only incrementally more difficult to do so. So why not go after that? If you are incrementally spending more effort but getting an exponential return back, why not do it?

So you do it and 400 then gets you to a 10x. This is proven. This has been established. We didn't come up with this stuff. This is just physics. Right. So that's really where the gold pot lies. Can you go beyond that? 500, 600? Sure. But you're getting diminishing returns. So really the supercritical point is the Goldilocks zone for water. And 10x, by the way, just to drive that point. Because 10x sounds like "Oh, is it a lot?" Well, driving versus flying somewhere is a 10x. So try to drive across the country; it's going to take you days. Flying, it's hours. So that's the difference. That's a 10x difference.

David Roberts

Does this just translate sort of straightforwardly into this — well will produce 10 times more energy than a, than a 500 foot well? I mean, is it that straightforward?

Carlos Araque

Yeah. And it comes not just from the fact that it's hotter, that's an important component. It's from the fact that your conversion of heat to electricity with turbines is more efficient. Thermodynamics.

David Roberts

When the water's hotter?

Carlos Araque

When the water's hotter, yeah. It's just thermodynamics. It also means that your parasitic loads are much lower. You don't have to pump into the ground for this thing to move through. It pumps itself by differential density in the cold, hot fluids. So many things happen from a physical point of view to make this thing just incredibly more attractive, you know?

David Roberts

Yeah, well, I was going to ask this later, but now that you mentioned it: How much power is required? I mean, we're going to talk about your drill in a second, but how much power is required to run it? I'm wondering, like, how much power are you using relative to how much is coming out to drill, just to run the drill itself?

Carlos Araque

Yeah, so we use standard oil field equipment. So a drilling rig from oil-and-gas already has all the power necessary to do this. We just use it differently. We're talking about a megawatt to 5 megawatts. Sounds like a lot. You know, a car is usually 100 kilowatts. A truck is probably a megawatt. So that's the range of power that we're talking about and that's readily available in these systems. Now, by the time you're done with this thing, it will give you back the energy you invested a thousandfold over the life of the asset. So if you want to talk about fusion and Qs, it's a Q of 1000. It's a good one.

David Roberts

Okay, so let's talk about the drill then. So I'm assuming that the reason oil and gas, the reason people have not gone down deeper than this is that the drilling equipment we've designed to go down that far will break, melt, fall apart, if you try to go deeper.

Carlos Araque

Quite literally grind to a halt. That's what happens. Several things happen. Your drill bit replacement rate goes up. So you have to run many more trips to go and replace the drill bits. To give you a sense, you're drilling for 10 hours, it's worn, then it's going to take days to pull it out and put it back in. So that drives a lot of the economics. The other stuff is that you can't get the energy if you're spinning the drill bit from the surface to get the rock destruction down there. It just doesn't get there. Like 1% of the energy gets there.

And the final one is that you can't remove the cuttings. You know, to make a hole, you have to remove stuff from the hole that you're making. You just can't flow that up over those distances when the cuttings are big. We solve all of that with different physics with millimeter wave drilling.

David Roberts

So did you work backward? Did you start from the idea that physical contact with the rock at this depth is not going to work? We need something that operates at a distance and sort of work backward from that, is that kind of your first principle?

Carlos Araque

Absolutely. So I used to work in oil-and-gas-drilling for 15 years. I worked with drilling tools. I knew exactly where the limits were and how much further they could be taken. So to me, when you tell me it's 300–500°C and therefore 3–20 km, it's a non-starter. You can do a very small portion of that, the beginnings of that with conventional drilling tools. But then you're leaving all of that resource behind.

David Roberts

And you think that's true for any physical diamond drill bits, any fancy sort of physical type of drill — you don't think is going to solve that?

Carlos Araque

Let's do a thought experiment. Imagine the drill bit doesn't wear. Imagine it's an impossibly strong, unwearable drill bit. So you never need to replace it. You still haven't solved the need to get energy down there. You still need to power it. You can't get that torque there. And you still need to solve the cuttings removal. Even with an impossible-to-defeat drill bit, you cannot do it.

David Roberts

So you need to do it at a distance and you've built a drill that does this. Disappointingly, it doesn't use lasers because I really, I really want to call these lasers.

Carlos Araque

These are masers. It's even better. You should popularize that.

David Roberts

You scold me if I call them lasers. So fine, they're millimeter waves. What is a millimeter wave? Basically, you have this machine that's straddling the hole. You're lowering this zapper down —

Carlos Araque

You're not putting the zapper in the hole. That's a key idea.

David Roberts

The zapper is at the surface and shooting these waves down into the hole. What are millimeter waves?

Carlos Araque

So they're microwaves. We're familiar with microwaves. The kitchen oven does that. These are the same kind, just more powerful. It's about 1,000 microwave ovens. That's really what we're bringing down. So take 1,000 microwave ovens and push them down through a pipe and then evaporate the rock. Sounds really sci-fi, but it actually works and we're showing it in the field right now.

David Roberts

Yeah, and one of the advantages we should say while we're talking about it is because all the equipment is on the surface, if something goes wrong or breaks or anything, you don't have to do that days-long, pulling the thing up out of the hole thing. It's right there on the surface already for repair. So the other part that I discussed and didn't fully understand when I visited you guys last year is there's some way in which these millimeter waves are tuned to the rock such that they will uniquely break the rock up. How does that work? What is that?

Carlos Araque

Yeah. So in a microwave oven, you have a frequency. So the microwaves are tuned to 2.5 gigahertz, give or take. And it's because that frequency couples very well to typical molecules in food. So it's a very effective way to transfer energy. In our case, well, rock is not food, so we need a different frequency. We use not 2.5 gigahertz, by the way, your Wi-Fi works at that too, but 100 gigahertz. This is the typical range of radar technology. So anything that has to do with airplanes approaching an airport and how you determine where — that's radar.

And that's about 100 gigahertz, give or take. There are several things. So that's really what it means. Our microwave has the frequency that the rock is thirsty for. So that means that we can put a lot of energy, we can transfer a lot of energy from the wave to the rock. And it just can't help itself. It will melt and vaporize in an instant.

David Roberts

We say melt, but it's not melt, sort of implies liquid. This is more like dissolving almost into tiny fragments. Tiny, dry fragments.

Carlos Araque

That's right. It's like dust. So when you look at a video, what you see is you don't see the beam. So the beam doesn't have a color like light. So you can't see it. But what you see is that, "Okay, beam's on." A second later, the rock is red hot, white hot. And if you remove it, there's a hole. And what happens there is that the rock itself, because rock is many things, including water and different substances, it just pulverizes. It goes puff. And the whole thing just becomes a cloud of dust, which we blow out of the hole.

David Roberts

And so how do you. So you're turning a pretty substantial amount of rock into dust. How do you get the dust out of the hole?

Carlos Araque

You blow it out with air or nitrogen. The very pipe that carries the microwave, it's called a waveguide. The very pipe that carries the microwave down to the bottom of the hole, that one also carries a gas. We're blowing, really blowing through the straw, and out comes the ash.

David Roberts

Is it a disposal problem at all? Is it a problem at all when it comes out, or do you just pile it up somewhere?

Carlos Araque

The mining industry spends gut loads of energy to try to pulverize rock to try to get what’s valuable in the rock. We get that for free.

David Roberts

Oh, so you can sell your tailings?

Carlos Araque

They're not tailings yet, but they will become tailings. It begs the question, who wants the dust and what's in the dust? Everything is in the dust. And now you have it in the form that is preferred for the mining industry to go after it and take the stuff they need. We think there's massive value in the cuttings.

David Roberts

Interesting. So you would sell your cuttings to what, a mining company or a metals company?

Carlos Araque

Mining refiners will probably start looking after those things. Now that’s not the main business model. The main business model is how do you create large infrastructure of power on a global basis. And that is a much, much larger business than the business of selling your cuttings.

David Roberts

Right. So this will not be a, call it a substantial part of your, of your revenue. It's just a side thing. So you blow the hole open with the millimeter waves. So then you have a big hole. You push water down it. Is it open loop or closed loop?

Carlos Araque

Closed loop means something very particular in geothermal, it means that you don't go through the fractured network of the rock. We don't do that. We want to go and sweep the heat from the fracture network in the rock because that's what's going to give you the hump to actually repower a power plant on the surface. And if you don't do that, you're talking about hundreds of kilowatts at best. But when you do that fracture network, you're talking about tens of megawatts per well. You're talking about geothermal punching at the weight class of nuclear and fossil.

And that's what's going to transform the economy. So let's back up a second. You drill conventionally to the basement. You don't use our technology, you get to the economic limit, then you extend it to the resource with our technology, you case, cement. You do all the things you need to do and are regulated. But at the end of the day, what you have is access to the hot rock. And once you have the access, you have the ability to pull — sweep heat away from that with water.

David Roberts

So the process of pushing the water down, pulling it back up, getting the power out of it, is the same as other geothermal — that part is more or less conventional geothermal.

Carlos Araque

Conventional geothermal today means hydrothermal. So most of the geothermal in the world means that there's an aquifer down there and you're sucking that aquifer dry. None of that. We bring our own water and we just simply go into the dry rock and sweep the heat. All we're looking after is the heat, not the water. The water we bring with ourselves and we keep looping it just like a radiator.

David Roberts

Is there any loss of the water?

Carlos Araque

In typical shallow systems, you do have a lot of losses because you have very permeable rock. You have sandstones and you have aquifers, but as you go deeper and hotter, it's tighter and it's not connected. So you actually, your losses go significantly down. Your water really is just looping back and forth to carry the heat on the surface. You have a power cycle, a power plant which has its own water loop cycle, and they're exchanging heat from one to the other. None of this is new, by the way. That part is all business as usual.

David Roberts

Sure, sure. And so I was going to ask about water as a constraint. So you need a finite amount of water that you bring with you to a site. You don't need ongoing infusions?

Carlos Araque

That is correct, yeah.

David Roberts

So, do you view water as a limitation at all?

Carlos Araque

Some places have water sensitivity? So it's always going to be a consideration. Now what we typically find is that there's more water in the subsurface than in the surface systems. I mean, there's more water in the rock down below our feet than in all the oceans combined, by far. So it's a fundamental question of where is the closest water? Is it called for? And if it is, you need to work through permits. And if it isn't, can we find it in another level? It should never be a technical limitation, but it's always a consideration from a permitting point of view.

David Roberts

Right. So probably you wouldn't like to target out in the middle of the desert for your first ... ?

Carlos Araque

Not for the first one, but if you have energy, you can actually pull a lot of water from the air, even in deserts.

David Roberts

Interesting. I guess that brings up geography. Is this totally geography-agnostic? I mean, categorically, or are there limitations?

Carlos Araque

We will make it so. The technology that we're developing will make that statement true. As you build a business, there are differences of where you start. So we have the lowest capital intensity, lowest capital at risk in zones that have high geothermal gradient. So we start there. Our first value proposition is let’s go to geothermal places and unlock a 10 times more powerful version.

David Roberts

Right. So all the geothermal wells that are already out there, you could go to any of those wells and just zap them deeper and get more energy out of those fields?

Carlos Araque

Go a floor down and you find a lot more energy. Yeah, you can do that. You can do it in new places too. But then you expand into the map because at the end of the day, it's not about those places, it's about the world. But the tool is the key to unlock the resource. I'm going to say something as well as a former oil-and-gas person is — I think getting hotter, going hotter is an incremental effort for oil and gas. There's no step changes, there's no quantum leaps in there. Except for the drill.

The drill is the gap that closes all gaps. So when you do that, when you tap the resource, when you can show it, everything else incrementally moves to enable it at massive scales. The first power plant we're building shows that concept at play immediately. We're already building it.

David Roberts

I hadn't thought of this before, but actually, are you inadvertently going to arm oil and gas with a way to get a ton more oil and gas out of the ground? Could the oil and gas people use this technology? Is there reason to go deeper for oil and gas?

Carlos Araque

I get that question all the time. I think the value proposition for oil and gas is not as strong because drill bits are perfectly good at getting that oil and gas as shallow as a slow temperature as it is. So could you use it? Yes, you could use it, but it's not going to make your job easier, more profitable.

David Roberts

I mean, there are some places where they go super deep for oil and gas. I mean, they're extreme, mostly extreme cases, but I'm sure they're —

Carlos Araque

Yeah, well, my proposal, my kind of proposal is "Why don't you go after the heat?" which is a resource that is much, much larger, much more powerful, much more profitable than that other resource. Why don't you do that instead? And why don't you unlock the capital structures that work already in the world at large to bring the 100 million barrels of oil per day that we enjoy? That's very much behind our thesis — we need to unlock geothermal at economic and power parity with oil and gas or better, because that activates that industry to want to do that when they grow up.

David Roberts

What is the total resource? Do we know that? What is the total amount of heat down in the core of the Earth?

Carlos Araque

10^{31} joules.

David Roberts

Okay...

Carlos Araque

So let me answer it like this: The sun will stop shining on us before the Earth loses its internal heat.

David Roberts

But so there's no, no possibility of tapping it out, draining it in any meaningful way, or running out of super-deep heat?

Carlos Araque

I don't think so. I don't think physics even allows you to because you're not going to drill to the core, you're only going to drill to the skin of the apple. So physics will put a limit on you, but even within those limits, you talk easily about the ability to power civilization for 2 million years at current rates. So I don't think there's a limit.

David Roberts

What about for an individual well? How long does it take to freeze an individual well? Can you tap the heat in a specific spot and run out?

Carlos Araque

You cool it down so it cools down progressively. And normally you design it so that it lasts as long as the power piece, the infrastructure on the top that you're trying to power. If it's a power plant and your depreciation is 30 years, 40 years, 50 years, you size it for that. So we're talking about decades' durability. And then the question I ask next about after that is what happens when you abandon the well? Well, it recharges.

David Roberts

First, before you get there: Are you talking about decades of slowly, incrementally declining output?

Carlos Araque

That's right. The temperature draws down over decades and at some point it's, let's say, 20 degrees too cold for the power plant. So you move on.

David Roberts

And then you just leave this big hole behind. Is there cleanup? Is there remediation?

Carlos Araque

So if capitalism accepted 100-year business plans, we could just simply say "Go to the other side." So if you're in the east side of the power plant, go to the west, do it again, and then to the north, and then to the south. And by the time you come to this one, it's fresh as new at 100 years per rotation. Of course, capitalism doesn't like that. So it's a gift to the future generations.

David Roberts

So you can't deplete an individual well. What is the surface footprint of a single well? Like, say you're going to build a power plant, you're going to build — let me back up: is the idea that a power plant is going to run on a single well, or can you also do multiple wells in a field like traditional geothermal does and get whatever huge output out of all of them?

Carlos Araque

You can do both. So the smallest size that makes sense for what we're doing is a couple wells at 30 to 50 megawatts. So if you asked me to do a megawatt plant, it's too small, can't do it. But 30 to 50, that's the minimum size. Now you can do two wells for that, another two for another 30, another two, and another two. And all of a sudden, within a dozen wells, you have a gigawatt power plant.

David Roberts

How much distance do you need between wells?

Carlos Araque

Durability of the asset. So if you're talking about draining it in 10 years, let's call that hundreds of feet, low hundreds of feet. And if you want it to be 50 years, you call that 300, 400, 500 ft. That's the distance between wells or actually not really the wells, because the wells can be in one spot. It's really the distance down in the rock volume that you're accessing this from.

David Roberts

So would the surface footprint look the same whether it was one well or two wells? Do you know what I mean? Is it just one power plant sitting on the surface and the wells, or are there little power plants on top of each well?

Carlos Araque

No, I think you can do one power plant for a lot of them. Absolutely. That's the way to do it. It's almost invisible. But you walk through the city and a block will have a power plant right then and there. And you say, how is this possible? Like, we think of power plants as this thing that's out there. No, no, it's right in the city. How so? Well, because of the power density of gas. This is the same. Now, will we build the first one in Central Park? No, no. But that's the true possibility because the resource is down below and the surface infrastructure is just required to convert heat to electricity, that's relatively small.

David Roberts

And so that size is going to be comparable to a fossil fuel power plant. Smaller than a surface, footprint-wise, smaller than a fossil fuel power plant?

Carlos Araque

We talk about tens of megawatts per acre, if you want to put that term right. So some companies out there are grabbing land. They're taking a million acres because that's what they need. We take a fraction of that for the same power output because the resource is much, much higher quality. So it's a less land-intensive play. It's also a less mineral-intensive and less labor-intensive per unit of energy. So it really hits all of the macroeconomic figures that matter.

David Roberts

And speaking of the quality of the resource, is the highest and best use for water at that temperature to make electricity, or do you envision selling heat directly also?

Carlos Araque

Both, both. So electricity is under-supplied in many markets. So markets are very thirsty for it. Our first offtake agreement is an electric offtake agreement. For that we need to build a power plant, which is a necessary evil to provide the offtake. But the heat is what many people are after.

David Roberts

And then you don't need the power plant, presumably, to make the heat.

Carlos Araque

You don't need the power plant.

David Roberts

What does that look like? If you're producing heat, like, what does that look like on the surface?

Carlos Araque

You are getting steam out of the ground and you're piping it through your manufacturing process wherever you need the heat. And you're not boiling or burning a fossil fuel typically to create that steam for that. Our unit of metric is cost parity with gas at $3 per million BTU — that's disruptive to the core because you have no fuel cost. But you're still hitting that metric for those processes, industrial processes that need heat. So you're not asking anybody for a green premium whatsoever.

David Roberts

Are there industrial processes that are, that demand more heat than this? Like how, how, how big of a chunk of industry?

Carlos Araque

About 50% of industry is good with 500 Celsius and below. And the other 50 is above that. That's combustion. For that you need to combust. Pick your fuel of en vogue. You know, is it hydrogen, is it a synthetic fuel, is it SAF? Pick it. You're going to need an energy input. Well, let me provide the energy input for that to be net zero and then burn it to create those temperatures. So I think it's really about primary energy supply what we're going after. To me, geothermal is not a filler. It is very much the workhorse. It's a hundred terawatt play where the world today only uses 20 terawatts.

David Roberts

And what about earthquakes? Speaking of questions you get every time you leave your home, what about earthquakes?

Carlos Araque

Earthquakes happen on very rare occasions with geothermal. Typically, it happens when people are going and taking shortcuts at the faults. So you're seeking the faults because that's where it's easiest to extract the heat from geothermal. It is a shortcut and it gets you in trouble. It's rare. Very, very rare. What we do instead is we go to the hot dry rock below those. We avoid the faults, we go into the bulk. To us, it's not about the fault, it's about the bulk volume of the rock below. So I don't think earthquakes will be our problem. And there are industrial standards there for that reason. I give the analogy of airplanes. If airplanes find rough air, they go above or below the rough air. We can do that if there's a fault. Go above or below the fault and it's incrementally more expensive because of the technology.

David Roberts

One of the big questions I had about this is it seems like this would be useful for other geothermal companies. Seems like it'd be useful for oil-and-gas companies in some respects. Seems like there's a lot of people out there who'd like to be able to drill deep. Why not license your technology to other people rather than becoming a power-project developer, which is a giant pain in the ass.

Carlos Araque

I think the primary reason for that very much has to do with what the company was built to do. Right? It's the world needs energy and energy transition. We will do that. Now there's ways to play the massive energy company at very low capital intensity. If you think about tier equity structures with debt leverage, which is the way large infra works in the world, we want those equity structures to replicate themselves as they exist today in oil and gas. So that means we're not building the massive energy company, we're just taking the most profitable position at very low capital intensity from those projects.

Simpler way to answer that: I don't think anybody wants our drill just yet. People are too entertained with the low-temperature shallow stuff. They're playing in the shallows and leaving all of the potential to somebody else. We're going to take that potential.

David Roberts

One of the reasons I ask is that I'm very intrigued by the geopolitics of countries that have traditionally been reliant on fuel imports becoming self-reliant and the wild and extremely unpredictable geopolitical consequences that might come from that. Like how fast can you expand? What's your sort of road to scale and how big of a scale do you envision?

Carlos Araque

This is a 100-terawatt play. This is more than total primary use. To me, this is not about bridging the gap or closing the gap or firming up renewables or storing a little bit of energy. This is a resource larger than oil and gas and it allows humanity to move into that next 10x step up in energy consumption. How do you do that fast? You don't do it by yourself. You actually use capitalism as the catalyst for that. That's why going hot is so important, because it unlocks the capital structures that the world is addicted to right now.

And they'll just deploy trillions of capital at that scale and we just get out of the way. All we provide is the keys to access the resource and the oil-and-gas industry takes these and large infra takes this at massive scales. That's the business model. That's the only way you can actually move the needle within a generation. If you try to do this one company, good luck, you'll get 50 megawatts here, another hundred there, maybe a gigawatt there, maybe 5 gigawatts like other companies are talking about. That's peanuts. You're missing three zeros there.

David Roberts

So you envision other companies developing stuff like this. Like I wonder, part of this is like how tight is the patent? Could other people build millimeter waves without getting sued by you?

Carlos Araque

Everything is replicable. The only thing that keeps you ahead is you outrun, you out-invent, you outperform. Business model, partnership models, they're all important to be in front. People eventually catch up. Nothing is impossible to protect forever. So that's not the play. The play is, can we incite that first domino to make this inevitable at tens of terawatt scales? If the company does that, it will be a very valuable company. But most importantly, as a human, we actually make a difference.

David Roberts

Do you expect once you have this power plant in the field which you're building now in Oregon, how big is that, by the way?

Carlos Araque

That one's 50. The site goes to a gigawatt, but 50 is the first proof point for an offtake.

David Roberts

And that's how many wells?

Carlos Araque

A handful. Not even five. Not even my hand. That’s two, three, four wells.

David Roberts

And do you anticipate, once you show that this works the way you say it works, that there’s going to be a shift change in the speed and scale and investment and et cetera? Is that sort of the idea here?

Carlos Araque

I think so. I think once you see the first one and you can look at it not as a vision, but as a real business with costs, with revenues, with profit margins, that's when it starts to become a thing that people will want to do at scale. And we divide the world in tiers. We don't say it's all the same. We say, let's unlock tier one first. That means that resource is within the first five kilometers. That's about 100 gigawatts. That's about 5% of the world population. Let's unlock that one. Let's do the one, two, three project.

That just unlocks it. Then do the next tier. Right. For that, you need the drill to be performing at maximum ability. And that one you repeat first, second, third project, and it goes, the third tier is a world push. That to me is more an industrial push. It's not the thing that one company does. It's like conquering offshore oil and gas or North Sea in the oil industry, after an industry decides to go after that. So that's how you really unlock this progressively going from shallow to deeper, but always hot. Always hot.

David Roberts

Could you do it on a floating platform in the ocean like they do oil and gas?

Carlos Araque

You could, you could. But the question is why?

David Roberts

I don't know why you would.

Carlos Araque

Yeah, I mean, you could.

David Roberts

Plenty of water.

Carlos Araque

Absolutely you could. Absolutely you could. But the question is why? Why don't you do it on inland? Right. This resource is also there. The reason you do oil-and-gas drilling on an offshore platform is because the resource is down there, not over there, but these resources are everywhere.

David Roberts

Right, right. Okay, I think we got to wrap up. Do we have time for a question or two? Like one or two questions? I think we can sneak a couple of questions in.

First Audience Question

Carlos, this has been great and informative, and I can see being caught up in your reality distortion field.

Carlos Araque

You like it?

First Audience Question

I do. It feels good. But you've talked for an hour and you've only mentioned the word dollar once. You said something about $3 per BTU. You've raised money from VCs, and I assume you had to give them a metric of some point. You can raise a profitable barrel of oil for $65. What is a barrel of 500 degrees supercritical, a barrel of heat worth?

Carlos Araque

So it's the same metric. We talk about economic and power parity. If you translate that to heat, that's where the $3 per million BTU comes in. That's a gas parity. And when you talk about electricity, people like a different unit. They like megawatt hours. We talk about 50 to $100 per megawatt hour costs. Firm at meter. No delivery cost, no storage costs, no transmission cost. None of that stuff's necessary. Look at your bill. There's a tiny portion for generation, and there's a gigantic portion for everything else. That everything else doesn't exist.

David Roberts

Wait, wait. Why doesn't everything else exist? Why don't you need transmission and all this stuff?

Carlos Araque

Because you don't need to move the energy. The energy is everywhere. You just put it where you need it.

David Roberts

So you just put it where you need it. So you don't need to transmit it long distances.

Carlos Araque

Right. And you don't need to store it because it's already stored.

David Roberts

You're prompting more questions.

Carlos Araque

Bring it on.

Second Audience Question

That actually dovetails perfectly with my question. A lot of listeners of the Volts podcast like to advocate for clean energy in our community. So I would love for you — we talked a little bit about geography, but if you could maybe expand a little bit on the siting and the impacts on the surrounding area, both during the construction and during, like, you know, when it's running. If I go to my community board on the Upper East Side and say, "Hey, I have an idea, you guys," they're going to have a lot of questions about that type of thing.

Carlos Araque

For sure, for sure.

David Roberts

Why go to the most NIMBY place, literally in the universe to start. Good God. They won't even let you build a bike lane. All right, good.

Carlos Araque

Yeah, absolutely. You need to be the first one for you to see it. Right. So what is it? You need to build it. That means you need roads, you need paths, you need a drilling operation. And that all goes away and gets replaced by a power plant. The power plant takes water, creates jobs, of course, and that water gets transformed into electricity. That's what it looks like. It's carbon-free, so there's no emissions. And it's relatively compact from a land use perspective. So I will be the first one to say that there's nothing that doesn't have an impact. But when I consider all the impacts of all of the options, this one comes very high at the top, I believe. Is it noisy?

When you drill, yes, for sure.

David Roberts

I mean, when you drill. But like just the operation of the power plant on an ongoing basis?

Carlos Araque

I mean, there are power plants embedded in New York City that are running turbines already and providing electricity. I think the traffic is more noisy. I think the subway is more noisy.

David Roberts

True. Let's get rid of cars and then worry about the rest.

Third Audience Question

Tell us about your company. Are you a technology firm, a drilling firm, a power-plant building firm, something else?

Carlos Araque

Something else. This is a large power infrastructure play at the scale and profit margins of oil and gas. So to us, this is really about activating the thermal generation, the oil and gas of the world, to do geothermal instead of oil and gas for a living. Our position there. Our position there is to provide the technology, to enable. And you make some profit from that. That's not the main business case. And to take a position in the top tier equity to put a chip on the table and earn those positions for the cash flows that come. So it's an infra play.

Third Audience Question

How many meters have you drilled today and how big is the hole?

Carlos Araque

So these demonstrations we're doing today are 100 meters, going to 1,000 meters. A thousand meters is commercially relevant for the first tier of project. More interesting than absolutes is the trends. So we don't see wear and tear, we don't see deterioration. We don't see anything that starts to show a worsening of the process. Quite the contrary. An improvement of the process. That one, we're using 30 kilowatts. The commercial is a megawatt. That's four inches in diameter. We can do six, eight inches as well. That's typical of geothermal because it's so low temperature. They have to do these reverse and extract aquifers. In this case, you're doing basketball-sized holes extracting as much energy as an oil well.

David Roberts

It would be a real historical twist if the way we beat oil and gas companies is by persuading them to drill for heat instead of oil and gas.

Carlos Araque

I think that's what's going to happen.

David Roberts

Amazing.

Host

Carlos, thank you. That was great.

Carlos Araque

Thank you.

Host

Thank you, Carlos. And thank you, Quaise.

David Roberts

Thanks, everybody. Thank you for listening to Volts. It takes a village to make this podcast work. Shout out especially to my super producer Kyle McDonald who makes me and my guests sound smart every week. And it is all supported entirely by listeners like you. So if you value conversations like this, please consider joining our community of paid subscribers at Volts.wtf, or leaving a nice review or telling a friend about Volts. Or all three. Thanks so much and I'll see you next time.