00:11

The core of the Earth is 6,000 degrees Celsius. It's the same temperature as the surface of the Sun, but it's not 94 million miles away, like the extra terrestrial sun is. It is right here beneath our feet. Really, literally right there. But we don't think about this, right? I mean, when you go outside, you walk barefoot, you don't burn your feet. The Earth's crust is an incredible insulator, and it keeps this massive, inexhaustible heat source beneath us invisible.

00:46

But if you've ever visited Iceland or an active volcano, you've got geysers and steam vents and lava. These are surface manifestations of the incredible amount of heat that lies beneath us. Anywhere and everywhere in the world. And we don't have to drill very far to reach temperatures that far exceed what we would need to power the world thousands of times over for all of civilization. Pretty cool, right?

01:18

So we got to get to it. How do we do that? Let's tap it. Let's tap it fast. I'm a climate activist. I am very worried about climate change. It keeps me up at night. So we need to make this happen, right? So how? So I'm here with good news about that and also a proposition. Let's do the good news first.

01:42

There are teams of innovators right now in the field that are working on figuring out how to most efficiently and effectively tap this enormous heat source beneath us. And they are running sprints, and I'm not talking about the type of geothermal that you find in Iceland. That's easy to get to. It's shallow, it's close to the surface, and in those places in the world, we already have geothermal energy. I'm talking about making geothermal energy accessible anywhere and everywhere in the world that energy is needed. But in order to do that, we've got to figure out how to mimic the conditions that occur in places like Iceland, right, that make geothermal easy to tap and extract and harvest. And those conditions are hot rocks, pore space in the rocks and water filling those pores. Those conditions seem simple, but they actually occur naturally in very, very few places in the world, right? And that's why we don't have geothermal energy everywhere. We have it in just a few places.

02:49

But the past couple of decades, there have been really disruptive and breakthrough technological innovations that enable us to engineer the subsurface to mimic Mother Nature's geothermal. So

technological innovations like high-pressure and temperature-drilling technologies that were developed for offshore oil and gas exploration. Technologies like directional drilling, where no longer we can just drill straight down, but instead we can actually turn and steer drill bits to reach very precise and specific locations in the subsurface, miles underground. And we can also fracture rock now, which means that we can create pore space where pore space does not exist naturally. So if you take these innovations that I just listed and you put them all together, you end up enabling an entirely new breed of scalable geothermal concepts. Geothermal concepts can be done anywhere in the world.

03:49

So, for instance now, we have engineered geothermal systems or EGS. In this concept, several wells are drilled, at the bottom of the well the rock is fractured. It creates a reservoir under the surface. Think of it as a pot where you boil your water underground, right? You send a fluid down, it percolates through the fractures. It comes back up really hot, and we use it for all sorts of interesting and important things like heating buildings directly. Or we can run it through a turbine to produce electricity. Now, EGS can take a lot of forms. This is an area of intense innovation right now. You can engineer these systems in a variety of ways, but the basic concepts stay the same.

04:28

Then we have closed-loop systems. Closed loops are pretty new. It's another really hot area of innovation. Same concept, basic is EGS, you have one or more wells drilled, you create a reservoir underground, but in closed loops, instead of fracturing to create that reservoir underground, it's entirely drilled, like a radiator in the rock. And they take many forms too, just like EGS, check it out. You can see in closed-loop systems how useful it is to be able to turn and steer that drill bit right? Totally enabling in terms of getting these concepts to work.

05:01

Another really cool aspect of closed-loop systems, another fierce area of innovation right now, is what we're putting in these systems as the working fluid to harvest the heat. Most of the time it's water. But what if we could optimize a fluid to perform better than water? So it heats up faster than water at lower temperatures than water. And the really cool thing about closed loops is the going candidate, right, one everybody loves right now to put in these systems to most efficiently harvest heat is actually a substance that's the center of our climate angst right now. It's around us in excess in abundance. It's CO_2. Super cool.

05:46

So then there's hybrids, not the cars, geothermal hybrids. You take the best of both worlds, right? You get the increased surface area and heat that you get from fracturing rock. You combine that with a closed-loop well design so you can use that optimized fluid. The goal of hybrid systems is to extract the most heat, minimize drilling costs. So that's what's happening right now. A lot of innovation. It's really, really cool. But these concepts, none of them are without their technology challenges.

06:17

But y'all, these are not moonshots. They are not moonshots. We are talking about making very incremental changes to existing technologies, methods and techniques with an eye on more hotter and deeper geothermal development. And these also aren't just ideas.

06:40

There are teams right now in the field demonstrating these concepts. Teams like Sage Geosystems, a team that I mentor. This is a well that they are demonstrating this summer in -- get this -- Texas. Not in Iceland, not on the side of a volcano, not in the ring of fire. This is a Texas pasture where you would never suspect the enormous geothermal resources that lie below. And this well is an existing abandoned oil and gas well that they have repurposed for this geothermal demonstration. If all goes well with this demonstration, by 2022, that is next year, they will have a geothermal power plant in Texas.

07:27

There are dozens of examples like this, right now in the field. These are all start-ups. They're out there proving geothermal concepts, new technologies, new drilling, the concepts that I showed you in the slides. We are in the midst of a geothermal renaissance. In the past 18 months, more geothermal start-ups have launched than in the past 10 years combined. If even one of these start-ups is successful at proving a scalable geothermal concept, we are literally off to the races in developing this massive, reliable 24/7 clean energy source anywhere in the world. And by off to the races, I mean that, right? Like, we got to go. The clock is ticking, we need scale. It's going to be cute if it works, but we've got to have global scale.

08:16

So how do we do that? It brings me to my proposition. So it turns out that there is an industry that is perfectly positioned to take us from the few geothermal power plants we have today to the hundreds of thousands that we need to meet demand. The industry that everyone loves to hate,

who cares about the environment and climate, is that industry. To scale geothermal, what do we need to do? We need to efficiently, effectively and safely drill below the surface over and over and over and over again. And who does that now? The oil and gas industry does that now.

09:05

The oil and gas industry is a global specialized workforce of millions, backed by almost 200 years of breakthrough technological innovation, all aimed at exploring for, drilling for and producing energy from deep underground. You flip the switch and you have green drilling. And oil and gas keeps its current business model, the business model that keeps them firmly rooted in hydrocarbons now. They're doing what they know how to do, which is exploring for, drilling for and producing a subsurface energy asset.

09:49

But what we're talking about here is a pivot from hydrocarbons to heat. A global workforce of millions, highly skilled and trained doesn't need to be retrained. They can keep doing what they already know how to do. But this time around for clean energy. If we're able to pull this off and team up to do it, we are talking about the ability to meet world energy demand. We are talking about the ability over the next few decades to put more geothermal energy on the grid than we currently have in dirty energy. Geothermal energy at oil and gas scale.

10:32

So I bet I know what some of you are thinking because I was that person to like, I used to think it. And so I will tell you how I got from there to here. I used to feel that we just needed to let the oil and gas industry go away. So I'm a climate activist and a lifelong environmentalist, the kind that would have chained myself to a tree if I needed to, of that flavor. I grew up and got a job, became an energy lawyer and then an energy entrepreneur, and entrepreneurship took me out into the field for product deployments, and I ended up living on drill rigs. And I had a complete epiphany, it was a total mind shift, bias out the door. Because I got to know many individuals in the oil and gas workforce. And y'all that grit. I mean, it is incredible grit. Those people are there for it. But I also got to know the amazing technological innovations of that industry. And what I've come to believe is those are assets. The workforce, the technologies, they are assets that we can leverage now to solve climate change. So what I do for my job is I recruit oil and gas veterans to the cause of geothermal. If we want to turn the ship, we recruit the sailors. And it's working. So there's good news.

12:04

Do you remember that slide I showed you with all the start-ups, the geothermal start-ups that are in the field? A good many of those teams are actually oil and gas veterans. Sage Geosystems with their Texas well. That is an all-oil-and-gas team with almost 300 years of collective experience at entities like Shell, BP, Halliburton and Weatherford. Y'all, that is really interesting, right? I mean, that world take notice because what this is is oil and gas brains actively reinventing themselves, using everything they know that they learned in their entire oil and gas experience to solve climate change. But it's also interesting because this new flourish of entrepreneur, you know, oil and gas veteran turned geothermal entrepreneur is helping the oil and gas industry engage actively with this problem set. They speak the language of oil and gas. They understand the business models of oil and gas. They are out building partnerships and relationships with oil and gas entities that are based on decades of trust and experience they have with one another. In the past six months, geothermal start-ups have closed more than 100 million dollars in funding deals with oil and gas entities as funding partners. We are at the beginning of a huge and exciting shift here. If it's the best and brightest minds in oil and gas who are off launching geothermal companies, then y'all, this very well may be the future of the oil and gas industry itself.

13:44

But here's my worry. So say oil and gas grabs the reins here, takes us to global scale fast, exponential growth. We put terawatts of geothermal energy on the grid. Are we going to fight about this? The thing that I love about geothermal is that it gives us all a way around ourselves, right? A way around extreme polarization. Environmentalists and drillers, dogs and cats, right and left, we all get what we want. Clean energy where we need it, climate change solved, energy poverty solved and drillers keep drilling. If we build the right collaborations here and unite behind a shared vision, we solve energy in the next 30 years. We change the conversation from worrying about whether we're going to meet 2050 climate goals to how they look kind of lazy. We can do this. We've just got to drill the limit.

14:55

Thank you.

14:56

(Applause)