Michael  Venne (00:00)

When AI hits hard physical limits, markets don't just innovate, they redraw maps. Electricity becomes a strategic asset, infrastructure becomes a geopolitical tool, and the race for power pushes capital beyond borders, beneath oceans, and into orbit. Today we'll weave together a story that spans power plants and subsea cables, borders and biomes, and runs from the depths of the earth to far above it. And at the center of that story is StepStone's head of responsible investment, Suzanne Tabble.

Michael Venne (00:39)

Welcome back to RPM, the StepStone Group podcast that delivers quick takes and sharp insights on the themes and trends shaping private markets. If you've been following the AI boom, you know the headlines are all about models and chips. But just beneath that is a quieter, more consequential battle, the fight for electricity, cooling, land, minerals, and governing bodies. StepStone has just published two white papers. The first, power play illustrates how private capital is being put to work to address the power shortage that if left unresolved will hamper the world's AI ambitions. The second paper, Final Frontiers, looks at the risks and opportunities that come with investing in the deep sea and in outer space. And when you put them together, you get a single sweeping narrative about the future investment landscape.

Is that about teed things up for you, Suzanne?

Suzanne Tavill (01:40)

Couldn't have said a better Michael.

Michael Venne (01:42)

All right, so let's start with where the rubber meets the grid. We talk a lot about scaling AI, but scaling AI means scaling electricity, right? I how much power are we talking about here?

Suzanne Tavill (01:56)

So look, the numbers are really tricky because they're completely unrelatable. As I speak, what I want you to focus on actually is the rate of change, because the rate of change or the speed in the growth of demand, that is what is creating the problem. So by 2030, we think AI-driven data centers will consume roughly 945 terawatts. Now that's about a 128 % increase over 2024, with the US and China responsible for nearly 80 % of that. And, you know, within those countries, it really is the hyperscalers that are driving the demand. But this is demand being driven on a sector that remember has trotted on for decades, barely delivering more than a percent or two of supply growth. So this is a monumental change. And the bottom line is this, AI's lifeblood is compute. And even considering efficiency gains from hardware and software, computers only feasible with electricity. So if you want to throttle AI progress, you constrain compute. And this, of course, starts to bring in a pretty interesting geo-strategic end.

Michael Venne (03:30)

So the story here isn't just AI eats power, it's rather it's eating it faster than we can expand the grid. The bottleneck is electricity. So demand is going vertical.

Suzanne Tavill (03:42)

Exactly.

Michael Venne (03:44)

The natural question becomes where does all this power come from? Not in theory, but in practice.

Suzanne Tavill (03:51)

So look, short term, natural gas and coal are going to provide about 40 % of the additional load being required. Midterm, think the 2030s, renewables really come to the party and they are targeted to meet about half the demand. Longer term, SMRs begin to play a meaningful role. ~

And here already we've seen the beginnings of this Microsoft and Constellation restarting the Three Mile Island, Amazon co-locating near nuclear, Crusoe and Redwood Materials powering modular data centers with Second Life EV batteries. So, we're starting to get indications of really what the future ~ is going to look like. ~ And interestingly enough, even with ~ efficiency and optimization of grid management, ironically, AI itself is probably going to be critical in really driving proper optimization of the grids.

Michael Venne (05:06)

to summarize, mean, basically because AI demand is simply too large for any single power source to shoulder alone, what you're describing is everything all above, all at once.

Suzanne Tavill (05:20)

Yes, and I think one point I should have added is that, you know, the composition of energy supply for the data center space, if you will, or the AI space, looks a bit different from the overall market. And that's because the big demanders, the hyperscalers, have resiliently stuck to their climate commitments. Yes, they've had to expand timeframes around these but they haven't reneged on them and that's why you're seeing this drive of different energy sources.

Michael Venne (05:56)

That's really interesting.

One of the big themes of your paper is that private capital isn't waiting for governments. It's building the runway as the plane is taking off. So let's get concrete. Where's private capital already stepping in?

Suzanne Tavill (06:16)

So if we trace the chain from energy generation through to data center delivery to AI application, private capital is everywhere. It's being executed through real estate, through infrastructure, private equity, private debt, and obviously venture capital.

And this is a key point that we emphasize in the paper. like, let's try bring this to life. microgrids. We've seen PowerSecure's 12.5 megawatt microgrid for Aligns in Aligns, Texas side. That's full backup and peak load relief. We've seen a range of battery storage in Second Life systems. As I mentioned, the Crusoe and Redwood materials have launched the largest Second Life EV battery microgrid in North America, Sweden and Australia financing BESS to support hyperscale clusters. We've seen the...

Michael Venne (07:21)

Before you move on, could you ~ define best?

Suzanne Tavill (07:26)

BASE is basically battery together with renewables. As we know, renewables

Michael Venne (07:31)

I see.

Suzanne Tavill (07:34)

to be more intermittent power sources. But when combined with batteries, what you have ultimately is almost like a complete no. And in terms of like renewable co-location, we've seen You know, the hyperscale is trying to get as close to the energy source as possible. know, Microsoft's AI green referencing putting the solar, putting modular inference nodes directly at wind farms. And we think that that's a trend.

Michael Venne (08:06)

~

a really interesting trend. It looks like the grid can't bring the power to the data center fast enough. Private markets are bringing the data center to the putting it right at the source.

Suzanne Tavill (08:21)

Yes.

Correct.

Michael Venne (08:25)

Even if you have the money and the land and the ambition, you still have to wait for transformers, turbines, high voltage cable, the real picks and shovels as you put it in the paper. Can you talk us through some of the practical bottlenecks?

Suzanne Tavill (08:44)

Yes, so there's two big bottlenecks. One, let's call it parts and the other one, let's call it regulatory. So on parts, everyone knows gas turbines are running at over seven years sort of order book time. ~ Transformers similarly require years of lead time. So when you combine the parts problem together with an approvals problem transmission upgrades can take anywhere from five to ten years and you can build all the power generation source you want but you've got to lock into the transmission lines, the grid at some point. So that is a very clear blockage. Renewable projects themselves, as I said, the energy build or the generation build can be over five years, but relatively pretty quick, actually. Data centers are the quickest thing to build. They can take one to three years. ~ But that's why we see often a mismatch. And that's why data centers are getting built, but often are sitting vacant because they don't have either an energy source or the energy source has not yet got approval to link into the grid.

Michael Venne (10:04)

One additional ingredient in the AI resource stack is water. How constrained is water?

Suzanne Tavill (10:11)

So again, we hit the big numbers issue. So a hyperscaler site can use 550,000 gallons of water today. That's about 40 backyard pools of water a day.

Places like Scotland have seen a four times increase in water consumption since 2021. So again, we've got this theme of rapid speed of growth of demand. And this has really pushed operators to explore the use of closed loop systems, which is where cooling ultimately stays within a system ~ and does not continually suck fresh or new water. ~

Michael Venne (11:00)

Right.

Suzanne Tavill (11:07)

they've been exploring using recycled or treated wastewater.

Now the issue of water, it varies jurisdiction to jurisdiction, but given that we see data centers tend to get built in clusters, obviously it's hitting certain communities and jurisdictions a lot harder. And I think there's a growing recognition that this water issue requires a cost-effective, sustainable solution.

Otherwise, operators are not going to be able to maintain their social license. And fortunately, we've seen a lot of really interesting work, particularly coming out of the venture space, to address this problem. And there's multiple problems of attack to solve this problem. And I do think that this is one of the more solvable. ~ in a relatively short time of the issues that we will discuss today.

Michael Venne (12:10)

Before we move on, I want to pause on something that quietly links everything we've discussed so far whether it's a gas turbine in Texas, a subsea cable off the coast of Greenland, or a future data center in outer space, none of this exists in a vacuum. These are physical assets tied to territory, jurisdiction, and national interest.

And when AI runs into these hard limits that you've outlined, it doesn't just create engineering problems, it creates geopolitical ones. Electricity becomes a strategic resource. Permits become leverage. And infrastructure starts to look a little bit like sovereignty.

Suzanne Tavill (12:57)

Yeah, that's exactly right. What we really are describing is a remapping of strategic value or in fact geo-strategic value.

Energy security, digital sovereignty ~ and resource control are in fact all converging. Governments are increasingly aware that whoever controls power generation, transmission, data routes, and critical inputs isn't just enabling growth, they're shaping national competitiveness and security. And the point here is it's not just, not only do you want the most resilient of all of these, for example, like power generation. You want it also at the lowest cost.

Michael Venne (13:51)

And that pressure doesn't just stop at borders, right?

Suzanne Tavill (13:55)

No, because we clearly see this in cross-border grid interconnections, in export controls and chips and transformers, in the politics of water rights for data centers, and who gets to approve or block new infrastructure. The same dynamic plays out even more starkly in the deep space, deep sea and in space, where governance is fragmented. Enforcement is uneven and national interests are colliding with ultimate global governments.

Michael Venne (14:33)

I'm really glad you went there. You've teed up our second paper nicely. that paper, Final Frontiers, essentially argues that when Earth-based resources hit limits, new frontiers become economically viable. Paint the big picture for us.

Suzanne Tavill (14:52)

Bottom line, the cost of access to space and the deep sea has been falling that means we can now go there and seek what we need. Whether this is minerals, space for data centers, defense capabilities. These frontiers are fast becoming an extension of Earth's industrial base. This is a really important reframing. These are not separate spaces are out there. I think we need to reframe these spaces as the boundaries of Earth have now expanded.

Michael Venne (15:34)

And let's start underwater in terms of investing. What's investable today and where do you see the fault lines?

Suzanne Tavill (15:45)

So today, the key opportunities around critical minerals, nickels, cobalt, subsea cables. Remember, over 95 % of global data is actually covered, carried through subsea cables. Robotics for aquaculture and carbon cycle science. The risks are pretty clear. We actually don't understand the deep sea. We probably more understand space than we do the deep sea. We don't know who lives there. We don't properly understand how the deep sea sequesters carbon and interacts with our global weather systems. We don't understand specific ecosystems like the Clarion Clipperton zone and how fast it can recover if we disrupt or interfere with it. Then there's regulatory fragmentation with the International Seabed Authority lacking any enforcement capability and the US fast-tracking permits through the NOAA which is essentially part of its own National Chamber of Commerce.

Michael Venne (17:03)

So goes back to a point you made earlier that permits are becoming part of leverage, point of leverage rather for

Suzanne Tavill (17:12)

Correct.

Michael Venne (17:13)

countries to wrest control over global supply chains or just broader economic impact.

Suzanne Tavill (17:21)

Correct.

Michael Venne (17:23)

So the deep sea gives us resources and connectivity, but comes with ecological uncertainty and geopolitical ambiguity. What about above the waterline or above the atmosphere? What story is unfolding in outer space?

Suzanne Tavill (17:44)

incredibly exciting with launch costs down more than 20 times, suddenly lunar resources are in fact viable. Water ice, metals, ~ stable isotopes of helium are meaning that ~ moon mining, asteroid mining, zero-g pharma manufacturing, orbital data centers defense expansion, be that ASAT tests, maneuverable satellites, the proposed Golden Dome. All of these are suddenly becoming viral.

Michael Venne (18:27)

And that's really exciting. It's just taking, it's a new industrial park, just one with no air, microgravity and very unclear property rights.

Suzanne Tavill (18:39)

That's correct because you know, just like any industrial park, you cite it because of certain advantages it has. Space has some very, very interesting advantages which you've already referenced, which arguably ~ might make it certainly a preferable location for certain activities.

Michael Venne (19:07)

Before we talk strategy, let's talk about some of the rules. What governance structures are in place that help shape investor risk across each of these domains?

Suzanne Tavill (19:19)

Brace yourself for an alphabet soup. So in the deep sea, you've got things like UNCLOS, ISA, MSFD, then there's in space, you've got the outer space treaty, Artemis Accords, UNUSA, NASA, know, space sustainably rating systems you know, what you have has been a multi-decade long effort to try and create multinational efforts to manage these zones. But the governance efforts that have been created really were created with frankly the limited the perception of relatively limited activity for these zones. So now once again, what is happening is that the level and pace of activity is far outpacing, you know, the governance, these multinational governance, sort of like power demand outpacing the transmission But at this juncture, you know, the pressures on these multinational systems to respond because there is so much activity that is going on. It's also happening at the time where multinational cooperation, quite honestly, is challenged.

Michael Venne (21:06)

So with that backdrop, and by the way, if anybody wants to dig into any of those governance frameworks, we have a whole list of them in the paper, in the glossary. ~ Let's talk strategy now. What's the right positioning for the next 10 or so years? ~

Suzanne Tavill (21:28)

So near term, like the drive for reliable and cost effective electricity such as grid modernization, micro grids and best cooling and water solutions, subsea cable services, which includes protection or defense of those cables are all needed now. ~ Midterm, obviously, SMRs and geothermal, orbital servicing, debris mitigation, lunar and orbital ISRU tools, and low-impact deep sea robotics. Essentially, we have really the growth of entire ecosystems that is going to occur up in space. and in the deep sea. Every part of the chain really has to get built.

Michael Venne (22:32)

which means opportunities up and down the risk spectrum for private investors.

Suzanne Tavill (22:39)

Absolutely, absolutely. And obviously, as usual, know, particularly private investors tend to be pretty good at navigating complexity of governance challenges.

Michael Venne (22:53)

Yeah. Every gold rush has its leverage point, something that looks small but turns out to be decisive. What's the edge here, Suzanne?

Suzanne Tavill (23:05)

So we start the paper, you know, particularly about the power, power space and electricity, reminding readers of the success of the picks and shovels strategy in the gold rush. And the realms that we've spoken about, they are filled with so many of these types of investment opportunities. Ultimately, critical will be teams that have execution capability ~ or have the ability to map their previous execution capability to these new realms. It's teams that have regulatory fluency and navigating, as we've discussed, the complexity of these risks, which will ~ encompass, no doubt, a range of sustainability risks such as water, orbital debris, emissions, mining waste, these all will become critical to unlocking value. And in fact, you know, so many of the key success factors will definitely again, we have to reaffirm circle around complexity of sustainability factors and governance factors here in addition, of course, solving some key technological problems.

Michael Venne (24:37)

thing at a time, right? Suzanne, this was a veritable tour through the physical backbone of the AI age.

What looks like a technology story is at its core a resource and governance story. As power, data and critical materials grow more strategic, investors aren't just underwriting growth. They're navigating questions of national interest, regulation and control. Thank you so much for joining.

Suzanne Tavill (25:11)

Thanks Michael.

Michael  Venne (25:13)

Thanks for listening. To read either paper we discussed today or to view the rest of our Thought Leadership Library, head to stepstonegroup.com. And please follow RPM on the podcast platform of your choice, including YouTube.