SCOTTISH MORTGAGE INVESTMENT TRUST

Invest in Progress – Solugen

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Gaurab Chakrabarti (GC): What if you can take the precision of biology and what Mother Nature has created and apply it to the industrial throughput that you see with traditional chemical manufacturing?

Tom Slater (TS): It's an approach which actually consumes carbon. It doesn't emit carbon. I think that will be a really important contribution to the chemicals industry.

GC: I think there is a second wave coming, and I hope Solugen is part of that second wave, where we can make chemicals one of the high-growth industries again.

TS: The scale of the opportunity is vast. It's almost so big, it's a non-issue. Chemicals go into everything.

Claire Shaw (CS): Hello, and welcome to Season 3 of Invest in Progress, brought to you by the Scottish Mortgage team. I'm Claire Shaw, Portfolio Director. In this podcast, we take you behind the scenes to hear the conversations that take place between the Scottish Mortgage managers and the leaders of some of the world's most exceptional growth companies. As we are a UK investment trust, we can only market Scottish Mortgage to certain audiences and certain jurisdictions.

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Check out the podcast description to ensure this content is suitable for you, and as with any investment, your capital is at risk.

Look around. Every object you see, every object you interact with is because of the chemicals industry. It is a $6 trillion sector that has been the backbone of modern civilisation, touching almost every aspect of our daily lives. Yet, this immense size and scale comes with a heavy price. It's one of the most polluting industries on the planet.

And the issues don't stop at pollution. Companies operating in this space are riddled with inefficient processes that not only waste resources, but also exacerbate its environmental impact. However, whilst incumbents try and squeeze out more profit by making incremental improvements here and there, there's a company ripping up the rulebook and starting from scratch.

Meet Solugen, a company revolutionising the chemicals industry through its innovative use of bio-based technology and machine learning. What started as a homemade reactor using PVC pipes from Home Depot is now a tried-and-

tested business model catching the attention of industry giants and the US Department of Energy.

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So, today, we are excited to welcome cofounder and CEO, Gaurab Chakrabarti, to talk to Scottish Mortgage Manager, Tom Slater. Afterwards, Tom and I will discuss the investment case of Solugen as a holding in the portfolio, but until then, I'll hand over to Tom and Gaurab.

TC: Gaurab, we're delighted to have you with us here today. It's a long way to come from Texas, so really appreciate you coming to Edinburgh.

GC: Well, thanks for having me. It's my first time here.

TC: So, can you start by explaining what Solugen does, what problem it is that the company is trying to solve?

GC: Really, what we're trying to do is decarbonise the production of materials and chemicals. If you look at the chemicals industry, it's responsible for 30% of all industrial greenhouse gas emissions and 6% of overall emissions in the world. What we're trying to do at Solugen is ask a very fundamental, simple question, which is, what would it take to get that number to be 0, perhaps negative, and that's it.

And the way that we're solving this problem is, and before, we were talking about the Medici effect and bringing solutions from different fields, we're solving it, using lessons learned from the human body, from cancer, biology.

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And that, it turned out, is the best way to actually decarbonise this industry, to take lessons from Mother Nature that have evolved for millions of years and apply it to the industrial setting, to actually create products that are low-carbon, potentially negative-carbon, and actually more profitable to make.

TC: So, tell us, and you alluded to it there, the backstory to the founding of Solugen, because I think most people will be surprised to find out that it was a game of poker that brought you and your cofounder, Sean, together.

GC: Yes, so, let's see, 2016, the company spun out of MIT, but I was actually studying pancreatic cancer. I'm a physician scientist, and I discovered this reaction in pancreatic cancer that makes pretty critical chemicals like hydrogen peroxide and acids and things of that nature. And I thought it was just a very cool quirk of cancer. Cancer is a very difficult-to-treat disease, particularly pancreatic cancer.

And it just so happened that this enzyme, an enzyme is just something that makes reactions go fast, makes these chemicals, and that's all I thought it was,

an interesting curiosity at the time. But we had this longstanding poker game in medical school, and sitting next to me was my best friend, Sean Hunt, who was at MIT, doing his PhD on the production of hydrogen peroxide and acids at massive industrial scales.

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And we did what one does at poker games, which is, talk science, naturally. So, we started talking about science and what we were doing in the lab. And he stopped me and said, you know, that's really interesting. I said, why is that interesting? He said, well, that's just a very unique way of looking at the problem. So, we put our heads together after everyone had left the poker table because they didn't want to be around us anymore. We're insufferable together.

But basically, we started to scheme this idea that, well, what if you can marry the two disciplines? What if you can take the precision of biology and what Mother Nature has created and apply it to the industrial throughput that you see with traditional chemical manufacturing? And so, put our heads together. We entered the MIT 100K pitch competition, which we lost, which we did not win.

Basically, the winner would have got $100,000. We lost. We got $10,000, so we went to Home Depot, our local hardware store, bought some PVC pipes and built out first reactor. And that's really what started the company of Solugen. And really, the vision of that little PVC reactor, what it created was, well, what if there's a world where you can actually have more efficient chemical processes that actually, not only are carbon-neutral, but potentially, carbon-negative?

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And the way that you do that is a distributed network of production facilities. And so, a long story short, that's really what got us going, was this vision that, hey, we can solve this problem in a very leftfield way that no one has thought of before, but do it in a way that actually attacks the core of what the issue is, and that's the chemical process.

TC: And you were a physician scientist, but you actually come from a family of people interested in the chemicals industry?

GC: Yes, interested, it's a minor way of putting it. my family is married and entrenched in the chemicals industry. My father, his story is amazing. Basically, I've learned everything about hustle and everything about execution from him. He came from India to America. He was valedictorian of his class in the engineering college, but he didn't speak English very well, so he couldn't get a job at any of the big chemical companies.

So, he worked at McDonald's, flipping burgers during the day, and at night, he would push carts. And then, one day, there was a recruiter from one of the big

chem cos, and naturally, he always had some version of a resume with him, a one-pager, and he pulls it out and gives it to them.

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And then, within a week, he gets a call back, and that began his career in the chemicals industry in the United States. And eventually, after working at multiple big chemical companies, he started his own chemical company. In fact, it was a very big chemical that he started and sold. And I was there along the way. He would bring me in, every weekend, to the lab, to formulate chemicals for customers.

And that's where I learned about the intersection of technical knowledge and really understanding what customers care about. And so, that's really what got me my first bite of the apple, so to speak, into the chemicals space. And after that, I swore to him that I'd never be in the chemicals industry, yet here I am.

TC: So, I think, for many of our listeners, they will be thinking, chemicals, this is a non-sexy industry, not that relevant to me, but it's incredible when you highlight just how embedded chemicals are in our everyday lives. So, can you set the scene for the chemicals industry? How does it work today? How do our listeners interface with it?

GC: Yes, so at the highest level, you can think of every single object that you interact with, this glass that I'm looking at right now, the water that's in this glass, all of it, is here because of the chemicals industry.

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The glass, because it's been produced by a chemical process, the water because it's been treated by a chemical process. This table, every little nuance that we interact with is because of the chemicals industry. I actually think of the chemicals industry as the molecule industry. It's the fundamental underpinning of everything in society. You talk about energy, you talk about plastics, anything is a molecule, at the end of the day, and it is made by a chemical process.

Today, we're relegated to, what I would say, a pretty inefficient chemical process. The best-in-class chemical processes, they can take a feedstock, i.e., like a petroleum or a natural gas, and go to a product with a yield of, at best, 60%. That means there's 40% of your starting material, the carbon that was in your starting material, that either ends up in the environment or has to be reworked in your process to actually make your end product.

That costs money, costs energy, and that's why the chemicals industry, given its scale, is also one of the most emissive industries in the world. And so, if you look at how the actual industry works, it is 100-, maybe 150-year-old companies that have been around since the discovery of really fundamental chemical reactions.

In fact, a really interesting thing was, in the 1930s and 40s, when petrochemistry and synthesis chemistry was starting to come of age, that was like the tech industry.

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That used to be like a Google or a FANG. It was like, wow, I'm going to go, work at DowDuPont because that was the hot, cool company at the time. Now, when you look at the chemical industry, it's a completely different world. It feels stagnant. It feels like we've hit this plateau of, we've perfected everything we can. But I think that's not true. I think there's a second wave coming, and I hope Solugen is part of that second wave, where we can make chemicals one of the high-growth industries again.

TC: And why have we got to this point where it is ripe for disruption?

GC: We've gotten comfortable with the inefficiencies, I would say. You make enough money at these inefficient processes, meaning, a 1% increase in yield at a refinery translates to billions of dollars of bottom-line profit. So, here, there's just no way for us to go from that 60% yield to that 90% yield unless we completely change the way we look at that process technology. And right now, the capex is already installed.

We've already paid for massive refineries, massive chemical plants, so every incremental improvement is just a bottom-line view. So, that complacency is that, well, we've already got this asset base. We don't need to create a new asset base. Let's just eke out every dollar of profit that we can.

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I think that's the wrong way to look at it. I think, fundamentally, we have to reinvent the way that we produce the chemical and not just eke out another percentage of margin.

TC: So, your mission is to decarbonise the chemical industry. It's no mean feat, so just explain, in very high-level terms, the science behind how you plan to do this.

GC: Where's the whiteboard? No, it's really, we've invented this new technology. It's called the chemoenzymatic process. Rolls right off the tongue, but it's quite simple. We take the catalysts found in nature, enzymes, they're called, we produce them at scale, and we marry them with catalysts found in industry that are called heterogeneous metal catalysts, which sounds really fancy, but it's just metal. That's all it is.

And the technology is marrying these two, marrying the catalysts that are naturally found in nature, with the catalysts that we've deployed for years at

industrial scale. And by doing so, our yield percentage is no longer 60%. We have proven, at commercial scale, that our yield is north of 90%.

In fact, one of our facilities in Houston is at a 96% yield from feedstock to product. Never been done before. And so, that's really how the technology works, is a more efficient way of converting a feedstock into your end product.

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TC: And just to clarify, an enzyme is a part of that reaction from feedstock to end product that is not consumed in that reaction. It facilitates the reaction, helps it go faster?

GC: Exactly.

TC: So, you do that better than other people?

GC: We do that significantly better than other people, at least 30% better from a summation perspective. But I would say, the way that I look at it is, our goal is to reuse our catalysts, i.e., our enzyme, in a metal as much as possible. That's what gives you the scale and gives you the throughput that makes this a profitable endeavour.

TC: And you, sort of, hinted at this before with what you were saying about the billions that have already been spent on our industrial chemical industry, but what is the competitive advantage? Why aren't others, why aren't the big chemical companies, trying to do this?

GC: Yes, the big insight for us, there's three big insights. One was, we can actually use computation technologies to engineer these enzymes.

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So, what we can do is actually model and predict how to design an enzyme using computers, using AI, using ML. That is not a skillset that's commonly used in the chemicals industry. We just talked about how it's stagnated. It's stagnated because there's no need to invest in this piece of the puzzle. That's number one.

Number two is the process piece of it. We had to completely change the way that these processes are done. If you look at a chemical process today, it's, maybe, 12, 15 single-unit operations. We had to say, well, why do you need these? Why do you need every single one of these operations? And the answer is, you don't, so we, basically, deleted as much of it as we could, and now we're down to three unit operations.

That simplicity is actually the beauty of this technology. You take away as much of it as you can. And the third piece of it is, figuring out, how do you locate these? Today, when you go to a chemical plant, it's just a massive... I grew up in Houston.

My backyard was just a giant chemical plant. It's the size of an island. And so, obviously, you have to transport that product somehow. So, for us, that whole, entire infrastructure that exists today is based on a logistics chain that presupposes that you have to produce centrally.

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What we believed was, by having a more efficient process, by having only three unit operations versus 12, or maybe even 20 unit operations, we can actually make smaller chemical plants. Now, mind you, this is all relative. Smaller, in the chemicals industry, still looks big to a layperson, but relatively speaking, what we have uncovered is that you can make smaller versions of chemical plants that allow you to have a distributed network of these things. So, all of a sudden, the logistics hurdle that you traditionally see in chemicals is largely gone.

TC: So, you just don't have to transport these things long distance anymore?

GC: It's local.

TC: You can produce them at the point that you would want to use them?

GC: Precisely. I'll give you an example. This is funny. Our biggest customer from our Houston facility is a mile and a half away from our production site. And literally, I joke that I'm going to get my Toyota and give them the product themselves, but that's really what it is. You're shipping this product down the street. And that, to me, is the key unlock in this space. No one cares about the technology. Fundamentally, you just want a product, and you want the product at a good price point, and it performs, and you want it on time.

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All of a sudden, if we're successful, if we're successful in having multiple versions of these Bioforges, the logistics chain becomes so much simpler. And when you look at the pricing of chemicals, 50% of the pricing is tied into the logistics chain. Safety, handling, actually getting the product to your end user, containerising it. If you can remove a lot of those barriers, you've now taken away 50% of the headache associated with just getting your product.

TC: So, does that mean that you are a competitor to the established chemicals industry, or do you see yourselves more as a partner?

GC: I would be foolish to say that we're not competitive. Of course, at the end of the day, there's a finite number of customers that we're going after, that we are competing against. I think we can be partners. I think the future of this industry is going to be predicated on these bigger companies that have massive

customer footprints, teaming with production centres like ours, to give them the opportunity to have more localised delivery of product.

That said, I think this is going to be an evolving piece of the puzzle. I think, really, what we're competing against isn't these companies, it's a philosophy. It's this philosophy that the chemicals industry doesn't have to be as massive and capex-heavy. And we're fighting that by creating smaller, more efficient processes.

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TC: Now, you used the term, when we were talking there, about a Bioforge for one of your production facilities. Could you just help our listeners visualise that? What does a Bioforge look like?

GC: Absolutely. I love that because we've got Lego versions of the Bioforge, but basically, what it is, it's a 10,000^2 ft space. It looks like a warehouse space. And it's just three big tubes, that's it. It looks like a mini SpaceX Falcon rocket. But it's a cylinder, and there's three cylinders across this whole, entire facility, and you've got these big tanks that hold product. That is it. It's very, very simple.

TC: So, completely different from this idea of what a chemical plant would be.

GC: Completely, yes. I'll paint a picture of what a chemical plant looks like in Houston. It looks like a city. You've got piping interconnections everywhere, lights, flare gases. It looks like an organism, like a city that's actually living, because of the complexity of it. When you come to our Bioforge, what you'll see is what's not there, which is the empty space.

TC: I think, in the early days of Solugen, you started out by focusing on hydrogen peroxide.

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GC: Yes.

TC: And can you explain how selling hydrogen peroxide into the niche market of float spas was the strategy that you adopted? How did that come about?

GC: Yes, so it was not very glamorous. We had a small reactor. It was a PVC reactor. It was a 6 ft pipe, couldn't make much product. But what we knew was that there was a market that would take this product, and that market happened to be in our backyard. And so, what we did is, we looked at all of the different markets where peroxide is used, and overlayed where we had access to the customers for where our PVC reactor, at the time, was.

And that was float spas, which are isolation chambers. They use really high salt concentration to keep you afloat, but then they use peroxide to clean up that water. And so, we went and talked to every single float spa customer that we

could, and we said, hey, would you use this peroxide that is cleaner, made in a cleaner way, but we can deliver it to you when you need it at the right time?

And then, all of a sudden, they said, yes, that's the biggest problem we have, because they had to order it through a distributor who's buying it from another distributor, who's getting it from a service company, who then gets it from the manufacturer.

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So, there was three or four different exchanging of hands for the product. But all of a sudden, what we said was, hey, we have the ability to give you this product when you need it, at the price you want it. That was exciting to them, and so, that's where we said, while this is not the most glamorous market, maybe not even the biggest market, we captured 80% of that market in the span of 12 months.

And there are a lot of float spas that we were able to capture because of it. So, that's where we started, but the concept there was what mattered the most, was, this model could work. The end user could get their product when they wanted it, instead of being at the behest of a big chemical company. If you look at trying to order peroxide, or really any chemical, today, what will happen is this. The producer will say, you will get your product in the month of October, potentially, on the second or third week.

So, all of a sudden, your customer experience is terrible. So, the net promoter score in the chemicals industry is negative. It's precisely because of this problem. There's no predictability on your supply chain, and so, what ends up happening is, you're, effectively, left to the devices of the manufacturer and the distributor. What we said was, if there is a way for us to focus on the customer experience in the chemicals industry, then the technology is worth it.

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It wasn't, let's build the technology, and then it will matter to the customer. It was, what does the customer need, to feel that they will give a good net promoter score? Then that technology will support it. And that's exactly this, what we call, last-mile-type support on the product side.

TC: So, talk us, then, through the journey from those early days of the float spas, those customers, to where you are today and products you're producing, who the customers are.

GC: Yes, so we started with peroxide in the float spa market, then we went through Y Combinator, raised a little bit of money, scaled up again.

TC: So, and Y Combinator is a provider of capital to early-stage companies, right?

GC: Yes, Dropbox, Airbnb, really good companies have come out through it, but it's called seed investing. A small amount of money was put in. So, we had a little bit of money to go and scale up from our PVC pipe to something that was a little bit more professional-looking. So, what we did then was, we did the same exact exercise. We said, now that we're at this scale, what market will be best suited for this product, knowing that we have a limited capacity to produce and that the price point should be higher than traditional industrial grade?

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So, we did what anyone would do, and we went into wipes. We sold our product to wipes manufacturers because they were paying a good dollar per gallon for the peroxide, and it was a small enough volume that our pilot plant could capture a good percentage of the market. So, we worked with a wipes manufacturer to launch wipes products using our peroxide, and what ended up happening was, they ended up acquiring our wipes private-label business.

And that was how we hacked our way from a five-year sales cycle to a two-year sales cycle, because we got a contract with that supplier. So, then we were able to say, okay, now we've got to offtake contract for this peroxide. There's something here. There's something bigger happening here. That's when we graduated to the industrial-grade markets. So, if you look at our history, it's really a history of scale.

Starting from PVC, float spa, pilot plant. A pilot plant is really a plant that's subscale, kind of small, very small footprint. But that pilot plant was supporting the wipes industry. Now we graduated from that into what we call a proper Bioforge. So, this is a very well-scaled, 10,000^2 ft production facility. That's where we really are today, the industrial market. So, the customers that we have today are not float spas.

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The customers that we have today are water treatment. So, think municipalities, think industrial water treatment. That's the biggest chunk of our market. The other sector of customers that we go after are in the construction industry. So, obviously, we've graduated from peroxide now, to organic acids, which is really a much bigger market, but that organic acid is used in multiple end industries.

And what we've done is, we've focused that organic acid product in areas where location matters a lot. Construction location matters a whole lot because these organic acids are used on site at the construction sites. So, where we are in Houston today, a lot of our customers are in the construction industry. The biggest, I guess, chunk of customers for us are in the water treatment space.

And again, it's more localised. So, we're trying to bring this idea that localised production is actually what you need to succeed in this market.

TC: And in the summer of 2024, you hit quite a big milestone, securing this condition loan from the US Department of Energy for over $200 million to build a new Bioforge in Minnesota. For context, Tesla also received a similar loan from the Department of Energy back in 2009, to help build Fremont, now the largest production facility for autos in the US. Many said that loan was an inflection point for Tesla.

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Is this loan, for you, more about the dollars, or is it what it signifies, the endorsement from the Government commitment to this type of technology?

GC: Yes, I'm not going to lie, dollars definitely help. But what I would say here, the process that we had to go through, we spun out of MIT in 2016 and really got going in 2017. So, for us, in a span of seven years, to take a technology that didn't exist, to a technology that could be underwritten by the US Government, that was a very significant milestone.

That was the fastest from zero, no technology, to a technology that had a readiness level that the Government was willing to back it. The process that we had to go through for that, maybe I'm a glutton for pain, but I loved it because it was the most diligence that we've ever had to do as a company. We literally had people staying in our production facility 24/7 for two weeks, to see every single production number that we were making.

It was 18 months of diligence, where they had to look at every piece of our business, from technology to commercial, to how we operate as an organisation. And once they felt comfortable with that, they would give us the stamp of approval for this loan. So, the money, yes, great, but what's more important is, it's almost like, okay, this technology has made it. It's here now. It's here today.

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TC: So, pivoting slightly, I want to talk about culture at Solugen. It's something we focus on a lot in our research process. I looked back at the first research note we wrote on you in 2021. It said, part of what we think makes Solugen special is that they've approached this problem from a fundamentally different point of view.

So, that was our take on what makes you special, but can you talk about how you think about culture, what enables you and your team to have this relentless pursuit in achieving your goal? And how do you ensure that everyone is aligned and focused on that mission?

GC: Yes, we've learned a lot, I would say, in the last seven years. I think that it's really three buckets of how I look at it. The first bucket is, you start with the engineering culture. Traditionally, when you look at a chemical company that is bringing a new technology or new process to market, one, it takes 15 years to do that. We did it in 11 months with our site in Houston.

The way we did that was this philosophy called, follow the project, which means, we have engineers that we actually put into the lab, meaning, these are chemical engineers that knew nothing about biology or anything. And we said, hey, you're going to go into the lab, and you're going to learn how to do the biology.

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Once that biology is at a point where we can scale it up, you're going to follow that biology, and you're going to go, build it in the pilot plant, the demonstration unit. Then, when you do that, you're going to follow it to the bigger scale. So, basically, we have this idea that you follow the project through, or traditionally, you have handoffs, and handoffs, to me, are the death of innovation because now you have no context of what idea maze you had to go through to actually learn along the process. So, that's number one.

Number two is, we call this idea of mission to metrics, which I think we talked about a little bit earlier. But the idea is that, when you vertically integrate like we do, you're going to the end customer with a product from a new technology, by necessity, you have a very diverse working population, meaning, you've got scientists, engineers and operators. And they all have different educational levels. They all have different life experiences.

And all of them are trying to figure out how they fit into the bigger puzzle of what we're trying to do. So, what we've done is, we've formalised this idea of mission to metric, which is, hey, here's the mission for the company in the next 12 months. Not the vision. The visions is, we have to decarbonise this, but the mission is, what is the tangible thing that we have to solve in the next 12 months for us to be successful?

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Fantastic. Now, break that down into roles and responsibilities across this project stream. That's why I started with the engineering example. Walk me through how every single one of these is coming down into a role, a responsibility and finally a metric. So, if you talk to, I don't know, a receptionist at Solugen, and you say, how is what you're doing helping the mission this year, and they'll be able to tell you.

Oh, if I'm able to answer this many calls and screen this many phone calls and have this many folks that don't actually come into the office, but we actually are

able to triage, then I'm helping the engineering staff not be bogged down in sales calls or things of that nature, which means that I can actually help them accelerate their progress to hitting their metric.

So, we break everything down to the most minute part, and that makes everyone's life easier because you're not guessing about how you're contributing to the overall success of the organisation. That's the second piece. And the third piece, and this is a bit controversial, but we call it the morphing org chart. It goes back to the project.

So, our org chart will change every 12 months, depending on the highest-priority project at the company.

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So, what we have is, you've got an engineering manager who's leading a team of salespeople, which sounds bizarre, but for that project, it makes the most sense because they have to understand the technical nature of the product before they can go, sell it.

Now, in another 12 months, that project may have hit a steady state. Now we transition to the next project, and the org chart is going to reflect what that project is. So, it's very project-driven. The project pulls the company, not the organisation pushing the project, yes.

TC: I guess, if you think about how we came to meet, the backstory to that was actually via the founder and CEO of Zipline, Keller Rinaudo. He was, coincidentally, the first ever guest on Invest in Progress, Series 1, Episode 1. Could you just tell us about your relationship with other founders, such as Keller, who are tackling equally challenging projects? Do you share stories and war wounds? Is there a support network amongst entrepreneurs as you go on the journey from a startup to the various stages of maturity?

GC: Yes, oh, absolutely. Keller, we have a standing call, where we, basically, share war stories, I guess, you could say. They started in 2012, so I would say, he's got a few more reps under his belt than I do, and I just look up to him, as an entrepreneur.

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But we're solving different challenges, but again, when you reduce a problem down to the fundamental, what are the three things that make this problem challenging, it's always the same thing. It's people, it's, at least in a technical role, engineering, and it's capital. That's it. For us, that's what it always comes down to, and every single one of those, when you can reduce the problem to that, every founder who is successful can talk that language in the technical context.

So, yes, I think, with Keller, he's helped me a lot with people design, particularly around performance management. He's got a really good philosophy at the company, at Zipline, where performance management, it should not be a surprise. No one should be surprised by if they're doing well or not doing well, hence the mission to metrics. That's the North Star for us. On the actual engineering side, Keller actually taught me about this whole idea of handoffs. Handoffs are what kills companies.

When you start trying to put departments in a company that's sub-1,000 people, it doesn't make any sense. You're not going to execute at a fast pace then. You've just created silos for no reason. And on the capital side, I'm using Keller as an example because I talk to him the most, but he's given me a lot of advice on thinking through how to talk about the company, because not everyone's going to want to talk about the chemoenzymatic process and yield that we get.

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At the end of the day, let's just simplify it down to what are the most fundamental things that people care about. Why is this technology important? And put numbers on it, so that people can relate to it in a much easier way.

TC: So, what are the biggest challenges that you face today? You started in 2016. Do you think the Gaurab of 2016, when the company was founded, is different to the Gaurab of 2024? How have you evolved as a leader?

GC: He's got a lot more scars, I'd say. He's got more [unclear] states. No, I think the one thing, there's a really interesting insight I've been thinking a lot about, which was, in the last few years, the company grew a lot, and there was almost this unspoken rule that you have to corporatise, that you have to become a segmented org chart-driven-type company.

And we did that for two years, and it's just not consistent with how fast we want to achieve our goals. In fact, what's most consistent is maintaining that ethos of 2016, being like, I don't care what my title is. I'm going to go, turn this wrench because that needs to happen. We let ourselves stray away from that, I guess, during the COVID years, just because it was easier when you're at home and in your own head.

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But now we're coming back to this culture of, everyone can do anything at this company, doesn't matter what your title is. That's one thing. The second thing is, on the commercial side, as technologists, Sean and I are just hardcore nerds. You probably got that by now, but we're hardcore technologists, and we always just think about the world as, well, this technology should exist.

But at the end of the day, when you're talking to a customer, and this is where I learned from my father, no one cares. No one, fundamentally, cares how good your technology is. So, what I've learned now is, go for the customer pull. Go where the pull is the strongest, because the technology will follow, once you understand what the customer pull is. And the third piece of it is, it sounds silly to say it, but assume that you're the dumbest person in the room, always.

The second we started thinking that, oh, we know the science better, that's when things start to fall apart. And so, what we've done is surround ourselves with people that are not afraid to be brutally honest to me and Sean. That's helped a lot as well, yes.

TC: Oh, interesting. We always finish with the same question, What does the world look like if Solugen succeeds?

GC: Yes, I think, if Solugen succeeds, I see three big buckets, one is, we can actually have decarbonised or carbon-negative cities.

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And what I mean by that is, if you walk around a city, I'm in Edinburgh, clearly, and just walking around, it's beautiful, the concrete, the insulation, the roofs, all of that should be made from carbon pulled out of the atmosphere. That's what I fundamentally believe. And if we're successful in doing that, you could truly have a city that is carbon-negative, or at least carbon-neutral.

The second is, thinking about, really, going back to my origin as a physician, what if the materials and chemicals that exist in our society don't get into our waterways, like PFAS, or don't get into our bloodstream like microplastics do, but in fact, degrade before they can even do any of those things? You actually have a safer environment around you.

And the third piece is, really, I think about it as equality of opportunity. If you have the ability to have regional production at the city level, potentially even smaller than that, of Bioforges everywhere, all of a sudden, you create labour pools that didn't exist before. These labour pools could be done in, like, for instance, that we're doing in Marshall, Minnesota.

It is an economically depressed area because manufacturing left from that region. Farming and manufacturing are leaving. But now, we have this opportunity to democratise access to chemicals production.

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So, every single pocket in society can have access to the same exact chemistry that anyone else does. And from that point of view, I view, if we're successful, chemicals become cool. Going back to the old 1930s and 1940s chemicals,

chemicals are something people want to be around because it's going to be something that they know is safe, and it's going to be something that they know that they can help innovate and build a better future for everyone. So, that's really what I think the future looks like if we're successful, yes.

TC: A really dramatic impact across so many different parts of society.

GC: It's massive, yes. It starts small, right, but the impact, it compounds itself throughout the value chain in a way that is really hard to predict.

TC: Well, Gaurab, thank you so much for joining us today.

GC: Yes, oh, thanks for having me, Tom.

CS: So, Tom, what a great kick-off to Season 3, and I think that conversation with Gaurab really epitomises what this podcast is all about. And so, we finish off each episode by trying to give the listeners an insight into what the Scottish Mortgage perspective is on these businesses. And we always ask the managers the same five questions about the investment case for the starring company.

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So, Tom, as Gaurab alluded to, it was Keller at Zipline that introduced us to the company. And so, thinking about idea generation, is this example indicative of how we find ideas in the private markets more broadly?

TC: It is, partly. I think what's most important is how you behave as an investor. You can talk about being long term, you can talk about being supportive, but what do you actually do? Because founders talk to one another. They get ideas from one another about who to go speak to, where to think about getting money from. And so, I think, living up to the promise of what you do is the most important thing.

And then beyond that, it is about those relationships. It's about both those ad hoc introductions, but also, if you're thinking about a particular area, understanding more about it, from one investment, can take you to ideas of companies you want to approach. So, I think it's broad, but I think being there, being involved in the market and actually living up to the promise of what you say you'll do are the most important things.

CS: And I think we got a really great flavour of Gaurab's background, his vision and how he runs the business, from that kind of operational perspective. But from your perspective, what does Gaurab and his cofounder, Sean, bring to the company that increases its chances of success?

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TC: Well, go back to the founding moment, if you like. There's not many people that will be sat, on an evening out with friends, and then decide to start a company, so these are, by definition, unusual people. But I think the framing of the question was right. It's what do the two of them bring? And I think the crucial ingredient here is, totally different perspectives about the same problem, that you have somebody who's coming from understanding the chemicals industry, has that background, understands catalysts.

And then you have somebody coming from a biological background and understands what biological processes can bring to making chemicals. And you combine those two things, and you have a totally different approach. Now, that's really important at the start, but I think it remains really important because what you're trying to do in the culture of the business is, you're trying to bring together people from a totally different disciplines and have them work effectively together. And so, I think, don't underestimate the challenges that are involved in doing that.

CS: Yes, absolutely, and then you touched on this in your discussion, but Solugen's positioning in this industry as a competitor or a potential partner to the big existing players. And Gaurab said it's, potentially, a bit of both.

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But in your eyes, what is the company's competitive edge in an industry that Gaurab describes as quite stagnant.

TC: Yes, well, going back to the previous question, I think there's a really important part of it, which is to do with just the whole approach to the problem. These aren't people from the chemicals industry. They're coming at the task with a different approach. And what does that mean? Well, if you're trying to produce the chemicals that they are today with just using traditional catalysts, then you need a lot of energy. And if you're using a lot of energy, that means a lot of cost.

But likewise, if you're trying to do this just from a biological process standpoint, then there's a very high cost for the enzymes and so forth involved. So, it's actually the combination of the two and the intellectual property and the knowhow that goes with that. And then that allows them to be producing chemicals at low cost, and that's, I think, really, the heart of the competitive edge.

CS: And I guess, with any company that is trying to do something different and disrupt an industry, there is always going to be challenges. So, in your opinion, Tom, what are the threats to this business? What is the most significant, and why do you think the company is well placed to overcome those challenges?

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TC: Well, I think the biggest threat is their ability to execute. They've shown, in the early stages of the business, that they were scrappy, they were competitive and going out and finding end markets for their initial products. But I think the skillset that you need, as a business, changes over time, as you scale. And I think, being disciplined about where you focus your time and energy. But the opportunity is a big one, and their approach is very different.

So, I don't think it's about, is somebody else going to do this better than they are. I think they have a very different approach. It's can they execute on that approach? Can they actually deal with the harsh realities of the chemical industry? Because one of the things we like about the business is that it's an approach, which actually consumes carbon. It doesn't emit carbon, and I think that'll be a really important contribution to the chemicals industry.

But the customers don't care about that. They're not going to pay extra because there's a green process here. There's no green premium. It's can they deliver a better or equivalent product at a better or equivalent price, and that's where they've got to aim for.

CS: And then, finally, Gaurab said the mission was to make chemicals cool, which I loved as a phrase. And we've talked a lot about the size of the industry and what Solugen are doing to disrupt it.

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But from your perspective, how would you describe the scale of the opportunity ahead for Solugen from here?

TC: Well, I'd say, the scale of the opportunity is vast. It's almost so big, it's a non-issue. Chemicals go into everything, and I think the challenge for the company is, when you have such a broad waterfront, what do you go after? And I think they've got to be really efficient in how they do that, think through what are their highest-value opportunities.

Where is the traditional industry least efficient? Where can they have a real cost advantage with the approach that they have? And then you attack those niches, and you build scale. And as you build scale, you get more efficient, and then that allows you to broaden. So, it's don't be distracted by the breadth of the opportunity.

Have focus, get scale, and then you can go after the blockbuster chemicals, the really huge-volume opportunities where the industry is probably quite efficient. But you can only do that if you've cracked the first several opportunities.

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CS: Perfect. Well, Tom, thank you for your insights and giving us the Scottish Mortgage perspective on Solugen. A big thanks to our guest today, Gaurab Chakrabarti of Solugen, and to our investment manager, Tom Slater, for kicking off Season 3. Over the next five episodes, we'll be welcoming more visionary leaders from companies within the Scottish Mortgage portfolio.

From AI-enabled drug discovery to the world's most trusted crypto platform, this season promises to bring to life our mantra of investing in progress. You can subscribe, so you're first to hear when new episodes are released, and you can learn more about Scottish Mortgage by visiting our website, scottishmortgage.com. You've been listening to Invest in Progress. Thank you for joining us.

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