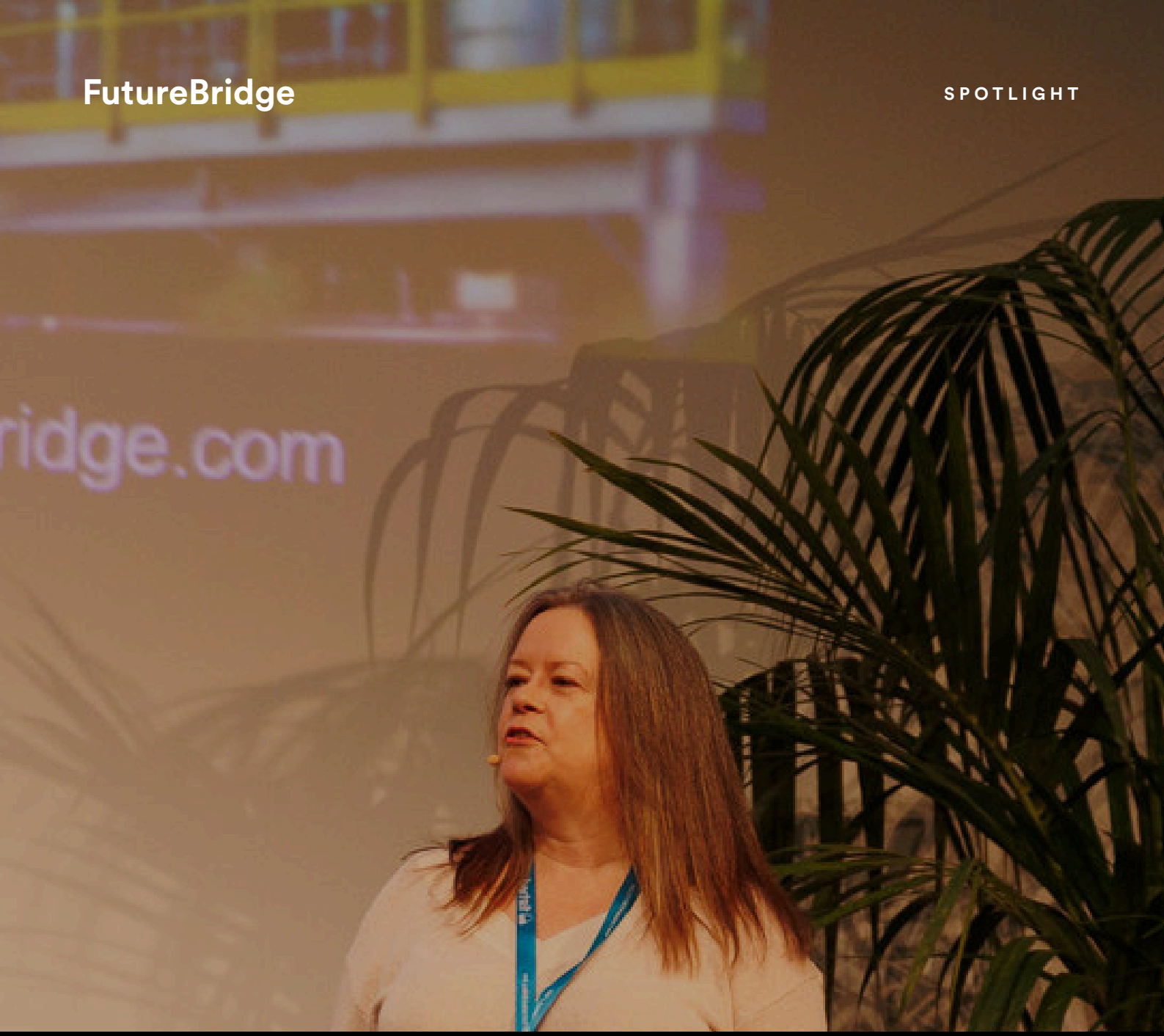


INTERVIEW · SARAH HICKINGBOTTOM

It’s not the core technology that will kill it!

Sarah Hickingbottom, Global Head of Chemicals, Materials & Natural Resources at FutureBridge, on why bio-based plants sometimes fail and what the ReSolute project taught her.

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INTERVIEW: KATHARINA SCHWAIGER

It’s not the core technology that will kill it!

Many bio-based processes work: in the lab, at pilot scale, sometimes in a demonstration plant. Far fewer make it to a commercial plant, and fewer still are built a second time. Sarah Hickingbottom looks at exactly this gap. She advises companies on which bio-based technologies are worth backing. She also knows it from the inside: at the start-up Circa, she worked on a first-of-its-kind plant in France that came within reach of construction but was never built. In this interview, she explains why the technology itself is rarely what fails, and what founders, investors and funders can overlook until it is too late.

ABOUT SARAH HICKINGBOTTOM

- **GLOBAL HEAD OF CHEMICALS, MATERIALS & NATURAL RESOURCES, FUTUREBRIDGE**
- Previously at Circa Group, where she worked on the flagship CBE JU project ReSolute, and CEO of the UK innovation cluster BioVale.
- Frequent speaker on the future of the bioeconomy.
- Advises senior leaders on strategy, innovation, sustainability and long-term growth; expertise in bio-based chemicals, feedstocks, circularity and the commercial realities of scaling new technologies.
- Studied at Imperial College London; PhD in Chemistry from UCLA in the group of Sir Fraser Stoddart (Nobel Prize in Chemistry 2016).

FUTUREBRIDGE AT A GLANCE

WHAT IT DOES:

Techno-commercial consulting and advisory: tracks and advises on the future of industries from a 1-to-25-year perspective, helping clients track technologies, identify new markets and business models, and find partners.

INDUSTRIES:

Six, among them chemicals and materials, energy, food and nutrition, and mobility.

SIZE:

Founded in 2000; more than 500 people working across three continents, with clients in over 70 countries.

When a company shows you a new bio-based process, what is the first thing you want to know?

What the feedstock is. I assume the core chemistry or biology, the step that turns the feedstock into the molecule, works. My job is to check the physical economy around it. At first, it's only about orders of magnitude: not just what the feedstock is, but how much of it is genuinely accessible, rather than theoretically available. That has to match the volume you want to sell, and that volume has to match the market. A complicated perfume molecule sold by the kilo is a very different case from a commodity at a hundred thousand tonnes. When I was CEO of BioVale, I often broke young entrepreneurs' hearts with this check. Six or seven times out of ten, it killed the business plan. One team wanted to make tens of thousands of tonnes of chemicals from coffee grounds. There might be millions of tonnes of coffee grounds in the world. But once you factor in yield and where a plant would be, the amount that is financially feasible and available is nowhere near enough.

Suppose the numbers add up. What comes next?

Even before capital, the next question should be: why would anyone buy this product? And if it's a drop-in, a bio-based version of a molecule that already exists, why would a customer switch? An existing market is not the same thing as a market that's wanting your product. So before being seduced by technology, you want to look at the physical and the commercial ecosystem around the process.

Many plants have been announced in Europe over the past ten years. How many of them are actually running?

I don't have a defensible percentage, partly because it depends on what you call "running". Take Avantium's 5,000-tonne FDCA plant. It was officially opened in 2024, commissioning ran through 2025 and 2026, and the first commercial sales are expected towards the end of 2026. So when do you declare it running? I would distinguish between a plant being announced, financed, built and commissioned, the first product, and commercial sales. The real test is sustained operation at meaningful yields and utilisation.

Then what is the better measure of success?

The second plant. A first-of-a-kind plant is one particular set of circumstances that came together once. Only the second or third plant tells you whether you have a repeatable industrial business or a one-off.

LanzaTech built four plants in China before its first one in Europe. Is that kind of path typical?

It depends on markets, and on the economics of production and funding. LanzaTech has a fascinating replication story, and it achieved that by licensing its technology rather than building and financing every plant itself: six commercial plants around the world, all of them making ethanol today, which can be used as a fuel or turned into products such as polyethylene. The process is offered as a platform, so in theory it can make other molecules, and they are now looking at other gases too. Neste is another good example. At the time, they had a novel process for a different type of biodiesel. They started in Finland, then built a huge plant in Singapore and another in Rotterdam. And it goes back to the feedstock question I started with. Neste wanted to use used cooking oil, a waste feedstock rather than a commodity like virgin vegetable oil, and no supply chain for it existed. At the beginning, I worked with them on building one from scratch. The question of feedstocks can expand into a project of its own.

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SARAH HICKINGBOTTOM ON THE FIRST QUESTIONS TO ASK ABOUT A BIO-BASED PROCESS



But replication doesn't always work, even for the biggest companies. Around twelve years ago, large joint ventures between multinationals went into bio-based succinic acid, including BASF, DSM and Purac, which is now Corbion. I was involved in some of that as well. Eventually, they all closed. Every company and every molecule has its own reasons for succeeding or failing.

You say every case is different. But do you still see a pattern in what kills a project?

There's never just one thing. If you can only name one, most people would say capital. But in a lot of cases, that's not the disease. It's the consequence, or the death certificate.

It's easier to say what doesn't kill a project. Once you're seriously building a commercial plant, it's not the core technology that will kill it, meaning the step that turns the feedstock into the molecule. The problems happen at the interfaces around it: feedstock handling, pretreatment, separation, purification, utilities, sometimes skills, logistics, commissioning, ramp-up. And location. Everybody talks about economies of scale. We talk far less about the economics of location.

Why does location matter so much?

Because for a first plant, the economics of location don't win out. What wins is where you can beg, borrow and steal support. At Circa, we had a fantastic feedstock partner. But you also look at which governments will give you capital, which regions want you there, and what obligations come with grants and investors. Your decisions focus on what is possible, not on what is ideal. You might end up too far from your feedstock, and you live with it, because you need that first plant. Then the feedstock costs more than it should, and that follows you into the economics of the second plant. Investors accept that it costs more to build small than large. We need the same understanding for location and plant ecosystems.

What else can go wrong on the way to scale?

A lot: the cost of building the plant in the first place, customers delaying decisions, partners who commit but won't go public, energy and feedstock shocks, permits, and regulation such as REACH. It also depends on who owns the plant. A large company can put a project on hold for a year. A start-up cannot survive that pause.

BEYOND THE KEYNOTE

Asked what would not fit into her esib talk, Hickingbottom chose a problem she sees coming downstream:

"Over the last 20 years, the field asked: can we make the molecule? Can we secure the feedstock? Can we scale it up? Can we finance it? Now the question is whether customers can absorb the complexity we are creating. Take adipic acid, a commodity sold in millions of tonnes. Today there is bio-based adipic acid, fossil adipic acid made with renewable energy, adipic acid from recycled plastic, mass-balanced and segregated versions. The customers are the same. How do they price these when it's all the same molecule? What if one supply dries up? What do they report? If we ignore this, it could become a barrier to adoption."

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If you can only name one thing, most people would say capital. In a lot of cases, that's not the disease. It's the consequence, or the death certificate.

SARAH HICKINGBOTTOM ON WHY BIO-BASED PROJECTS FAIL



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Whilst you can't let perfection kill the first plant, you can't let its imperfections carry over into the second.

SARAH HICKINGBOTTOM ON WHAT A FIRST PLANT SHOULD NOT PASS ON

You experienced many of these risks at Circa. When you joined in 2021, ReSolute was already underway. What did you see as the biggest risk?

I knew the project well. Circa had been one of our start-ups at BioVale, and I was there the day the grant was announced. When I left BioVale, Circa asked me to join. The company was fully capitalised, and I fully believed the plant would be built. But projects like ReSolute can de-risk the demonstration of a first-of-its-kind technology. They can't necessarily de-risk the business around it. When Russia invaded Ukraine, gas prices shot up like a hockey stick, and our plant had been designed to run on natural gas. The plan had been to turn our co-product, biochar, into high-value activated carbon, a key revenue stream. Suddenly, the most valuable use of the biochar was to consume it ourselves, so we had to redesign the plant to run on a biomass boiler. Things like this happen all the time when you build something new. But the grant budget had been fixed in 2019, when the proposal was written, and within a grant structure that kind of change is very difficult. That is one of the challenges of grants: a forecast can be completely invalid six months later, not because you did anything wrong, but because the world has changed.

How close did the plant come to being built?

Very close. We had the permits, REACH registration was coming through, we had the engineering, the staff and the contractors, and the equipment was in a warehouse on site. Other things went wrong too, so the crises weren't the only reason. But this decade has brought one shock after another: the pandemic, steel prices, the Suez Canal, inflation, interest rates, the war in Ukraine. Each one added cost, while the grant stayed exactly the same, with no allowance for inflation. If the conditions of 2019 had stayed the same, I think the plant probably would have been built. I don't want to sound ungrateful. The French government, the region, the BBI JU and the CBE JU, universities and investors all put a great deal into it. The support was astronomical. A bigger company could have ridden out some of the bumps; a start-up can't. Public money has to be protected, and administrative certainty and innovation agility create tension. The public-private partnerships do brilliant work, and we need them. We just need them in a slightly more agile manner.

What did you take from Circa into your work at FutureBridge?

Above all, the customer side. At Circa, I worked on commercialisation: with customers, their R&D trials and their procurement teams. That taught me how risky switching is for a customer. One risk that isn't talked about enough is what happens downstream. If a company switches to a new bio-based ingredient, it isn't only about whether the product works. It's also the paperwork around it. And many companies don't want to talk about it. I was surprised how many were unwilling to go public, even with a memorandum of understanding. For a start-up, that hurts, because investors want to see that customers are using the product. Some multinationals have even told me they already have bio-based content in their consumer products but don't mention it, because they are worried about greenwashing. I was on the advisory board of the BBI JU project BioSwitch, which was about persuading brands to switch. I think we should persuade them to switch, and then persuade them to talk about it.

RESOLUTE AT A GLANCE

GOAL

The first commercial-scale plant for Cyrene, a bio-based solvent made from wood residues such as sawdust, intended to replace toxic solvents such as NMP. Planned capacity: about 1,000 tonnes a year.

SITE

The Carling Saint-Avold industrial platform in north-eastern France.

FUNDING

Horizon 2020, Bio-based Industries Joint Undertaking (today the Circular Bio-based Europe Joint Undertaking, CBE JU). Total cost €23.9 million, EU contribution €11.6 million.

OUTCOME

Project start October 2020, closed early in 2025. The plant was not built, and Circa Group is now bankrupt.

THE TRAIN AND THE CAR

How Hickingbottom describes the tension between grants and emerging technologies:

"I think of it as the difference between a train and a car. A train is absolutely superb if the route is correct. But a brand-new technology sometimes needs to reverse, take stock, go in a different direction, or even change the destination when circumstances change. A train cannot do that, and grants are designed to be trains rather than cars."

At FutureBridge, we use this when we work with lighthouse customers, the first customers for a new product. We look at why they would buy, how their procurement works, what would make them switch and what would stop them. In the past, consultants called that customer needs analysis. Today we know it's much more about behaviour and risk. Having sat in so many different shoes, I can understand why a multinational behaves the way it does. I would recommend it to any consultant: spend three years in a start-up.

Many of the risks you describe depend on each other: feedstock, location, customers, regulation. Could AI help to make better forecasts here? And what would you like it to predict in five years that we cannot predict today?

I would like AI to tell me where the industrial ecosystem is fragile. You could give it the technology, the feedstock, yields, plant scale, location, utilities, purification, customer qualification times and policies, and ask: which assumption is most likely to break the investment case? What happens if energy costs double? Using AI to design processes is the obvious answer. The more interesting use is not to predict which technology will win, but where we shouldn't put our money: dynamic industrial twins that test thousands of combinations of risks instead of treating each one on its own.

You started out in the most fundamental chemistry imaginable, with Nobel laureate Sir Fraser Stoddart. When did the molecule stop being the most interesting part?

During my PhD, our group moved to UCLA, where research and industry worked together much more closely at the time. We were funded by DARPA, one of the funders behind GPS, and we worked with Hewlett-Packard. We were making molecules called rotaxanes. Imagine a dumbbell, like the weights in a gym, with a ring around the bar. The ring can sit in one of two positions, and you can push it from one to the other with a stimulus from outside. So the molecule works like a tiny switch: one position is a zero, the other a one. That is the binary code computers use. We were working on arranging these molecular switches into arrays… We were even talking about atomic computers.

I had chosen Fraser's group for the beautiful bluesky chemistry. But being there as it turned into innovation, something that might one day reach a market and change the world, was exhilarating. So when I decided to leave academia, I wanted to chase the molecule: where does it go once it leaves the lab? I started out as a generalist and ended up in oleochemicals, chemicals made from plant oils and fats, because I was fascinated by the bio-based world. And the moment that world turned to new technologies, I was smitten. I've never looked back.

> **I would like AI to tell me where the industrial ecosystem is fragile.**
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> SARAH HICKINGBOTTOM ON WHAT AI SHOULD PREDICT IN FIVE YEARS



GLOSSARY

FIRST-OF-A-KIND PLANT

The first commercial-scale plant for a new process; the second and third show whether the business can be repeated.

COMMISSIONING AND RAMP-UP

Starting up a newly built plant and bringing it step by step to full capacity.

DROP-IN VS NOVEL MOLECULE

A drop-in is a bio-based or recycled version of a chemical the market already buys. A novel molecule, such as the solvent Cyrene or FDCA, a building block for the bio-based polyester PEF made by Avantium, has to build its own market.

ADIPIC ACID

A commodity chemical made in millions of tonnes a year, mainly used to make nylon.

MASS BALANCE VS SEGREGATED

In mass balance, renewable and fossil feedstocks are mixed and the renewable share is allocated on paper; in a segregated chain, the renewable product is kept physically separate.

REACH

The EU chemicals regulation, run by the European Chemicals Agency (ECHA). A new molecule must be registered before it can be sold in volume.

OLEOCHEMICALS

Chemicals made from plant oils and animal fats, for example for detergents, cosmetics and lubricants.

FutureBridge Spotlight

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