

Sifted \ Reports

Packaging unwrapped

Sustainable food and
drink packaging



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In *Packaging unwrapped: Sustainable food and drink packaging*, we highlight the European startups striving to replace everyday food and drink packaging with natural or reusable materials that don't pollute the Earth. We share engaging stories about innovators' journeys; about the gains they've made in this small — but suddenly vibrant — sector and the transition pain still to overcome. We discuss the changing outlook of corporate customers and brands, as they wait with open wallets and bated breath, for tech to come up with guilt free packaging that won't clog our oceans. None of this, it transpires, is easy: some solutions feel temporary or barely better than the status quo; others feel like they'll never scale or be cheap enough. Yet amid all the hurdles, there's great excitement too, and a sense of momentum building for some genuine "made in Europe" world beaters.

Who are the ones to watch? Read on to find out.

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We're on a mission

Daniel Grubbs, Global Chief Venturing & Investment Officer, PepsiCo

PepsiCo has significant interest in the future of packaging. Over 500 of our food & beverage brands are consumed more than one billion times a day in more than 200 countries and territories around the world, and packaging plays an essential role in their safe delivery and consumption.



We also recognise and share the concern that packaging, when disposed of incorrectly after use, may end up as waste in the marine environment or on land. This urgent global issue requires a systemic shift. We need more circular solutions for consumer packaging through multi-stakeholder collaboration and active partnerships across the entire packaging value chain.

As part of the PepsiCo Positive (pep+) initiative, we are striving to lead that change. By leveraging the power of our brands, we have exciting and powerful initiatives in place to create a more circular, inclusive and sustainable supply chain through innovative packaging technologies and business models.

PepsiCo Ventures Group is the corporate venture capital arm of PepsiCo. We are at the forefront of emerging consumer needs and solutions, including a sustainable approach to packaging. We are working to establish partnerships across the organisation, including the PepsiCo Sustainability organisation, in order to accelerate PepsiCo's portfolio transformation and simultaneously advance PepsiCo's front-end innovation learning agenda.

We invite you to read this report and join the conversation, to build together a world where packaging never becomes waste.

It's an exciting time for packaging

Mark Allen, Senior Director for Sustainability, PepsiCo Europe

As a passionate engineer and sustainability professional I have spent my career exploring new and innovative packaging solutions that improve the current plastic systems.

Packaging counts for approximately 20% of our GHG emissions, with PET being the biggest contributor. Yet PepsiCo is fully committed to creating a world where packaging never becomes waste.

We have ambitious targets to design 100% of packaging to be recyclable, compostable, biodegradable or reusable by 2025, and to cut virgin plastic per serving by 50% across our global food & beverage portfolio by 2030. We are also driving forward business models that require little or no single-use packaging, including SodaStream, which is expected to eliminate the need for nearly 200m virgin plastic bottles globally by 2025.

To achieve our net zero emission goals, we know that implementing circular, non-fossil based packaging will play a vital role.

We feel this is an extremely exciting time to be involved in the packaging revolution as we are now beginning to unlock the potential for natural and reusable materials. And, as a large global brand, we have the unique opportunity — and responsibility — to catalyse and drive change within the industry and use our reach and consumer trust to deliver rapid improvements without requiring significant behavioural change.

This report highlights the innovators that are creating new and revolutionary packaging solutions that could upend the status quo. Finding efficient ways to change how we make and consume will be the key to their — and our — success, as well as collaborating with governments, suppliers and retailers.



Packaging unwrapped

Can the world innovate its way out of a plastic bag?

What would it be like to buy a sandwich and toss away the packaging without guilt? What if — instead of going in the bin — the packaging was put back into use? What if there was no packaging at all? These ideas are the motivation behind a parade of emerging innovations in Europe



Far too much packaging is made to last for ages. Plastic used for minutes often ends up clogging the ocean for hundreds of years. The Ellen MacArthur Foundation, which backs sustainable projects, estimated there will be more plastic than fish in the oceans by 2050 if companies and consumers continue as normal. The material breaks into ever smaller particles that can spread far and wide while carrying toxic substances. These microplastics are now frequently found in drinking water, food, and in our bodies.

Little wonder that food companies and retailers, increasingly criticised for contributing to landfills and causing other forms of pollution throughout their operations, are wrapped up in the quest to wean themselves off plastic and leave a lighter environmental footprint.

Scientists and startups are scouring the fields and oceans for viable replacements. So-called bioplastics — made from mushrooms, cereals, tomato skins, seaweed, milk protein or other organic materials — have emerged as potentially winning alternatives, though they currently make up less than 1% of the global plastics market.

PLASTIC'S WINNING EDGE

Why have bioplastics made so little ground? Turns out it's really hard to replace everyday packaging without something synthetic involved. Can anyone create the perfect bottle that's cost-competitive with plastic, won't leak and won't stick around for centuries?

Chip bags, as an example, have a special layer of plastic that keeps moisture out and prevents chips from going soggy, but it makes the bags impossible to recycle. Could a natural alternative serve the same purpose? This particular challenge has prompted hundreds of experiments by one group of scientists in Austria, who have come to the conclusion that it's fiendishly difficult to develop an organic water barrier for chips (more on this in chapter 3).

Arriving at a biodegradable material good enough to replace plastic is fickle work, because it's undeniable that plastic — cheap to produce and incredibly durable — is a miracle material, and has helped make daily life more convenient, affordable and, in some cases, safer.



FAKE PLASTIC LOVE (AND HATE)

Still, startups claim to have ready substitutes. London-based Shellworks says its nifty bottles — made from microbes — will disintegrate like a twig or a branch if left outside. Another UK company, Notpla, has created dissolvable seaweed capsules people can drink from as well as containers that have the decency to go away when no longer wanted. Mushroom-based moulds from Dutch company Grown.bio and sheep wool from Estonia's Woola are sold today as drinks packaging.

Will biomaterials save the world? Not everyone thinks so. "Recycle facilities hate them," says Victor Dewulf, CEO of Recycleye, developer of AI software that can sort waste materials. "Customers may love these things but it makes the whole system a lot more complicated." The typical recycle plant is filled with multiple whizzing conveyor belts, with technology or people to separate aluminium, paper, plastic, glass and other materials. Few waste centres have sensors to discover biomaterials among the rubbish, meaning they're likely heading for landfill. That would be fine if these materials were sophisticated enough to dissolve harmlessly into the ground — but many aren't.

Biobased materials, in any case, aren't the only sustainability game in town. Other startups are inching forward with pitches for reusable packaging and refillable solutions.

WHEN IS “BETTER” GOOD ENOUGH?

Key questions for all these efforts: are they practical and do they provide quality? If it's a startup working with biobased material, can it be produced at scale? (You need a lot of mushrooms to outcompete a paper mill.) Is it financially sound? (If it's an organic material, is it anywhere near as cheap as plastic?) If the business model is centred around reusable containers, how can startups be sure customers won't get lazy and drift back to packaging that doesn't require drop off at a cleaning depot? Also, is the alternative not just ethical but desirable too? (We are all suckers for an attractive design.)

“If you don't have a means of making it all circular, then it's not really sustainable.”

Sarah Greenwood, packaging technology expert at the University of Sheffield

And few alternatives to plastic are completely without controversy. “It's very difficult to say whether a material is truly sustainable or not — it's more to do with the system in which it sits,” says Sarah Greenwood, packaging technology expert at the University of Sheffield. “You have to look at the lifecycle of the packaging and the product together. If you don't have a means of making it all circular, then it's not really sustainable.”

Environmentally friendly substitutes could also have unintended consequences — for example by increasing the weight of a product, which would have a negative impact on carbon emissions. The experience of producing plastic equivalents like cotton bags, aluminium cans or paper boxes tells us that some efforts can require more energy and water to make and transport.

Moreover, some bioplastic attempts appear uneconomical, while some people worry that biodegradable plastics could encourage littering. Others say there's too much focus on creating the perfect recycling material and instead call for more love for reusable systems.

THE PRESSURE IS ON

Going green is not simply a desire by companies to do good: often there's a compelling economic case for minimising synthetic packaging. In any decision to adopt new packaging, if a lighter material can simultaneously reduce your carbon footprint and shipping costs, it's a winning combination.

There's also a generational play. Millennials and Gen Z shoppers rank sustainability as a key factor in their shopping decisions. The work companies are doing now is part of planning for the future of packaging as the influence and spending clout of younger generations grows.

Policymakers are slowly marching companies in this direction too. Stricter laws on single-use packaging — including bans on straws and other items — across Europe and beyond are driving the growth in alternative packaging and biobased materials innovation. “The single-use ban is a complete tailwind for us,” says Safia Qureshi, founder and CEO of ClubZerø, a London-based company making reusable packaging for food and drink. Greenwood calls it “great news for the environment but potentially another burden for struggling businesses [that] needs to be implemented with care.”





STEP BY STEP

Sustainability attempts at companies today are tentative, but will speed up in the coming years, explains Herwig Kirchberger, managing director of Delsci, an Austrian organisation making eco-friendly paper. “Most brands will do this switch in a step-by-step way. No one would touch their major products first — they’ll go for a smaller test market in a smaller range. That’ll take a couple of years, and then this bigger transition will happen, sometime in the 2025-2030 timeframe,” he says.

2023 could be an important year, too, for the effort to cool our unstoppable love affair with polymers, as talks to shape a global treaty are expected to reach a critical point. Fifty nations have joined the High Ambition Coalition to End Plastic Pollution, which is pushing for a treaty that will limit production of plastic, with binding targets for every nation that signs the pact. If approved, it could mean additional regulatory risk and scrutiny for businesses.

THE TRASH MOUNTAIN TO CLIMB

Companies can expect more curbs on packaging; a trend that will force them to reshape. In Germany, for example, restaurants, bistros and cafes that sell takeaways are required to offer their products in reusable packaging from January 2023. The reusable option must not be more expensive than the food and drinks in disposable packaging.

And a widening of Extended Producer Responsibility (EPR) regulations now transfers the financial burden of waste collection and treatment of packaging from local authorities to the manufacturer itself. This is putting pressure on brands to make rapid changes. France and Belgium lead the way on this, with fines for introducing non-recyclable packaging; the UK and other member states are expected to follow suit.

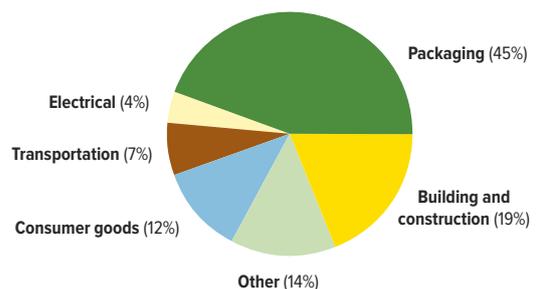
But while governments talk about tackling trash piles, we still can’t get enough of plastic. More than a third of the food sold in the EU now comes wrapped in plastic, and each of the continent’s 510m residents produces about 31kg of plastic packaging waste per year. Only about 9% of plastics ever manufactured have been recycled.

And things are forecasted to get dramatically worse: the amount of plastic waste produced globally is expected to triple by 2060, with around half ending up in landfill and less than a fifth recycled, according to the Organisation for Economic Co-operation and Development (OECD).

“So banning straws doesn’t touch the sides of the problem,” says Niall Dunne, CEO of Polymateria, a UK company that has created a formula to transform plastic items such as bottles, cups and film into harmless sludge. “This is a runaway train, it isn’t stopping. But you can’t afford to be pessimistic. You need to boil it down into a material sciences challenge and an infrastructure challenge.” Considering that packaging is responsible for nearly half of our plastic waste, there’s a big prize for anyone who can curb its explosive production.

Packaging accounts for nearly half of global plastic use

Plastics by end use



Source: Bloomberg

Chapter I

A slow start to a sustainable packaging revolution

More sustainable and minimal packaging has long been a dream, but alternatives remain a novelty



WHY IS IT SO HARD TO SWITCH TO SUSTAINABLE PACKAGING?

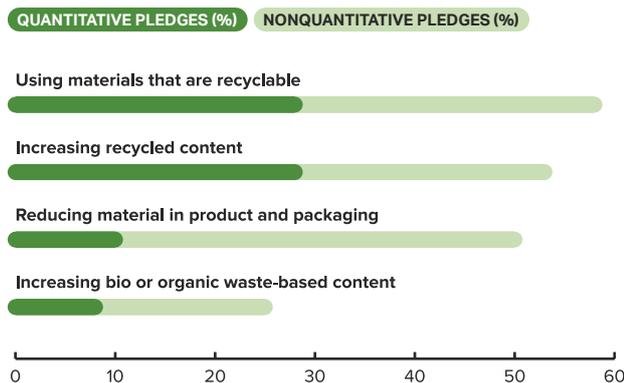
At the start of 2023, the Ellen MacArthur Foundation published a progress report on its New Plastic Economy Global Commitment. In the past five years, more than 500 organisations, representing 20% of all plastic packaging produced globally, committed to achieving 100% reusable, recyclable or compostable packaging by 2025. But with just two years to go, the news isn't good. The report found an overall increase in virgin plastic across all industries. This year, the charity acknowledged that the 2025 targets "are expected to be missed".

Few are surprised. This isn't an easy problem to solve, particularly for the food and drinks sector. Plastic packaging — the number one enemy — ensures freshness. It's cheap, lightweight and can be moulded into any shape. It's durable and long-lasting. Equal value alternatives are hard to come by.

Adding to the sustainability challenge is that there is no universally agreed definition of sustainability. And there are many views as to how sustainability goals should be measured. For example, glass is recyclable, but producing it and melting it for recycling takes an enormous amount of heat, creating a hefty carbon

The majority of brand owners have plans to increase plastics recycling, but vague pledges far outnumber concrete ones

Survey of 252 companies on their plastics recycling pledges



Source: McKinsey

footprint. Plastic, in comparison, has a lower carbon footprint but is difficult-to-impossible to recycle. So can a lower-emission alternative to glass be called "sustainable" if it has a plastic element?

It's a conundrum that Rob Malin, cofounder of the wine company When in Rome, says many companies regularly grapple with. In 2021, When in Rome became the first wine brand in the UK to go public with its climate footprint after working with CarbonCloud. A year later, it launched the world's first paper wine bottle, the climate impact of which is six times smaller than a single-use glass bottle. The move secured the company deals with Ocado and Sainsbury's, as well as interest from Canada, Norway and Japan. But some retailers were unconvinced because there's a plastic liner within the paper, Malin says. "It can be recycled but some people just said no. Around 40% of the wine industry's global emissions are caused by the production and transportation of single-use glass bottles. This is a much more sustainable alternative. But I remember one representative saying: 'My job isn't to save the planet. My job is to reduce the amount of plastic bought by the supermarket.'"



If it's biobased or biodegradable, it's all good, right? Right??

Trying to anticipate what will happen to packaging after we're done with it is like trying to follow the plot of Mulholland Drive.

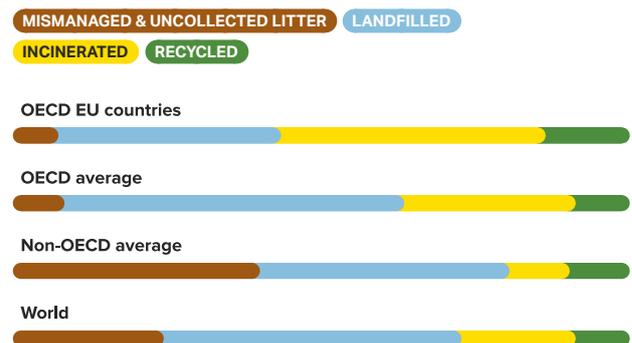
If something is described as "biodegradable", it means it's designed to break down at the end of life into oxygen, water, biomass and salts. "Compostable" materials are a subgroup of biodegradable goods that break down under specific conditions, such as when they go through industrial composting facilities. But when plastic is buried in a landfill, where there isn't much oxygen, neither type of material breaks down particularly well.

Bioplastics, meanwhile, are materials made from organic materials. Not all biodegradable plastic is biobased, and not all biobased plastic is inherently biodegradable. Nor are all bioplastics made entirely without fossil fuels; some products are only partly made from bioplastics.

Policymakers in Brussels want to clear away some of this fog. Only materials that have been confirmed as industrially compostable should be labelled "compostable", according to draft plans. Also on the legislative wishlist are rules to make producers state the environment in which the plastic is designed to break down and how long this is supposed to take.

Only 9% of global plastic waste is recycled

Share of global plastics by waste management category



Source: OECD

THE INFRASTRUCTURE GAP

"Plastic is not an inherently bad material solution," says Sally Beken, founder of the UK Circular Plastics Network and organiser of the Global Research & Innovation in Plastics Sustainability conference. "The issue is its single-use nature and the fact that we do not have the infrastructure to properly make these materials circular."

Recycling methods and rates vary wildly across Europe — between countries and also between regions — which makes it difficult to achieve a widespread, harmonised waste solution. Just because a plastic alternative could be recyclable does not mean the local facilities have the capacity to do so. "The designers of all plastic alternatives must have good intentions. But I doubt many have stepped foot in a waste plant," says Victor Dewulf, CEO of Recycleye, a company using advanced technology to improve waste sorting. "I've yet to find any waste facility that likes bioplastics. They're very hard to detect, forcing plants to build new streams. Most biomaterials, it seems, won't be recoverable — they'll go straight to landfill. The packaging industry should really think seriously about standardisation."

Experts say efforts to change industry practices, including collecting more waste and increasing recycling, are hampered by a lack of data and oversight around the commitments of global stakeholders. The Netherlands, for example, is the third largest exporter of plastic waste in the world, after the US and Japan. One study

estimates up to 31% of plastic exported from Europe for recycling doesn't end up being recycled at all. An episode of the Netflix documentary series *Broken* highlighted the illegal recycling plants popping up across Malaysia to cash in on the mountains of plastic waste imported into the country every year. Many dump or burn the waste, rather than processing it properly.

While recycling infrastructure is ripe for disruption, others have focused on introducing infrastructure for reuse. Among those fighting this fight is Matt Kennedy, founder of London-based Again. The company recently raised £2.55m to build the supply chain infrastructure to allow food and drink packaging to be refilled and reused. It's a model that's already well established in countries like Germany, where bottles returned through the deposit scheme are either reused or recycled. But in the UK, the capital investment to create such circular infrastructure from scratch is prohibitive for brands.

Again has two cleaning cells in London which are operational for brands like Tom Parker Creamery, Belu and Milk & More, and are running pilots with big names such as Budweiser Brewing Group, Diageo and Biffa. "We provide a shared supply chain that all brands can use. They access it like a service and pay us per unit of packaging," Kennedy says. Every piece of packaging is tracked through the network using a tag, and consumers are incentivised to return their packaging with rewards such as free delivery or discounts.

The startup focuses on glass bottles, although it is expanding the range of plastics it can deal with. There are logistical challenges with plastics, as well as economic ones — at present, Again can compete much better with the cost of single-use in the glass industry.

CONSUMERS NEED EASY SOLUTIONS

With so many recycling codes, variable capacity at regional waste centres to sort and process them, and a variety of recyclable/compostable/biodegradable alternatives hitting the market, consumers can be excused for not always recycling correctly.

Unfortunately, nearly a fifth of items households place in their recycling bin could end up in landfill because people are "wish-cycling" or hoping items are recyclable. Contamination with items such as toothpaste tubes, polystyrene or some takeaway boxes means valuable recyclable resources are lost.

“Human behaviour has so much to play in this. We have to teach people to do the right thing.”

Sally Beken, founder of the UK Circular Plastics Network

Sally Beken from the UK Circular Plastics Network is positive about the development of alternatives to plastic, provided the infrastructure is there to process them at end of life. "We should be using alternatives, as long as they generate a lower carbon footprint and are less polluting to the environment than what we have currently. But human behaviour has so much to play in this. We have to teach people to do the right thing."

Reuse is gaining traction as a viable alternative to recycling but encouraging consumer behaviour change is imperative for reuse models to work, Kennedy says. "One thing we've learned is that if you plug into places and behaviours that already exist, like customers placing packaging in a bin on the kerbside, then it works fantastically well," he adds.



“Where we don’t see it working effectively is asking customers to return packaging to a foreign destination. The incentives we can put in place are not big enough to ensure that sort of behaviour.”

Consumer education is also key. UK supermarket Tesco recently ran a year-long pilot with the American reuse giant, Loop. It was already present in around 40 Carrefour stores in France, with plans to extend this to 500 by 2025. With Tesco, the pilot covered more than 200 products online and in-store, it was one of the biggest reusable package schemes trialled in the UK. The pilot results were promising — shoppers wanted to buy products in reusable packaging — but Tesco found public awareness about the benefits of reuse over recycling is lacking. This was mirrored by a recent poll from environmental charity Hubbub that found 38% of people are concerned reusable packaging may not be clean or hygienic. Another study by packaging manufacturer Tetra Pak into deposit return schemes found 56% of consumers would not travel more than a mile to return packaging.

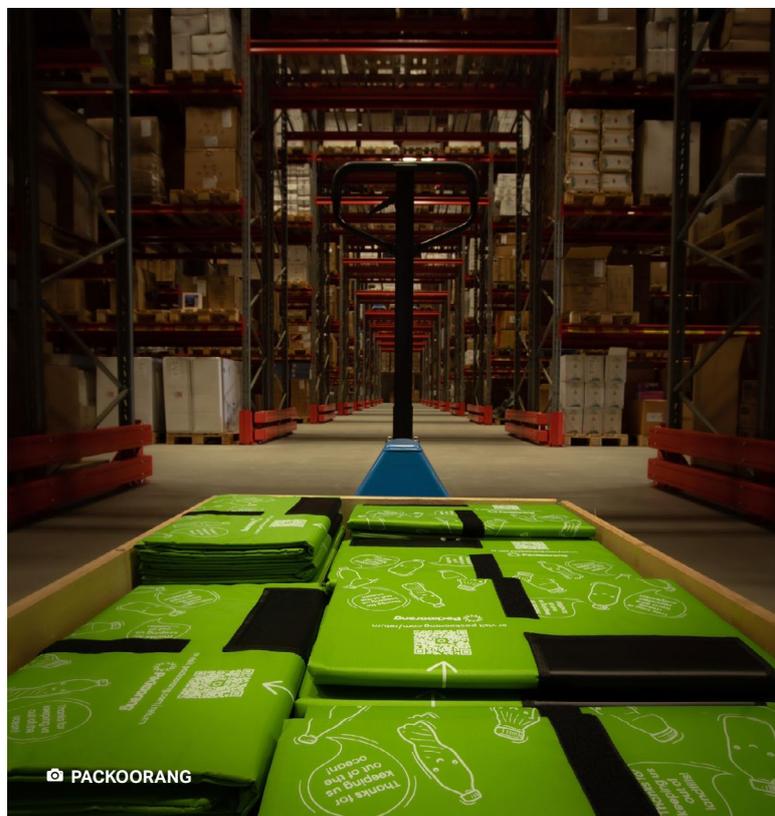
SWITCHING TO ALTERNATIVES CAN BE A HEADACHE

For Karolina Ling-Vannerus in Stockholm, one of the biggest challenges for companies looking to make the switch is the very process of switching itself. This frustration inspired her to set up Circulate, which helps organisations define their packaging needs and find sustainable suppliers.

“For an inexperienced buyer, sourcing packaging is really complex.”

Karolina Ling-Vannerus, founder of Circulate

“The world has known about the massive problem of packaging waste in nature for far longer than we’ve been talking about climate change,” she says. “But sourcing packaging is super analogue, very inefficient and very opaque as a market. For an inexperienced buyer, it’s really complex.”



She says the task usually lands on the desk of the product developer, designer, marketing manager, logistics manager or CEO of a company — it’s rarely someone’s whole job. “Plus the lead times are long. Companies don’t tend to switch packaging suppliers, or if they do it’s once every five to 15 years.”

BIGGER BRANDS = BIGGER PROBLEMS

Alternative packaging suppliers also face a slew of problems meeting demand. In Oslo, Packoorang has its eyes on circular packaging as a service. The Norwegian startup provides mailer bags, which are made from recycled bottles that can be recirculated up to 500 times. Since launching in 2019, the team has seen a surge in demand and has partnerships with PostNL, Austrian Post, and Postnord among others. There’s a long wait list and the company’s in promising talks with retailers such as Waitrose and Marks & Spencer in the UK. Working with bigger brands is good in terms of having an impact, but Packoorang cofounder Alvin Leer admits it can be a slow process.

“Working with billion euro companies takes more time,” he says. “Everyone seems to want this to work and are willing to take risks to make it work but there are tenders, procurement and lengthy bureaucratic processes. Secondly, circular systems are so much more complex than linear products and services. You cannot simply develop a reusable product, you must also be able to provide software and technology to facilitate the return and circulation of the products. You’re basically building an infrastructure, a product line and an IT company all at once, which is both time- and capital-consuming work.”

“Many of our partners make it the default packaging option at the checkout.”

Alvin Leer, cofounder of Packoorang

On the other hand, the benefit of working with large brands is that consumer awareness grows naturally. “Our marketing is the ecommerce stores that onboard us,” he adds. “Many of our partners make it the default packaging option at the checkout. So in terms of awareness we haven’t had too many roadblocks.” Packoorang has gone to great lengths to ensure the return label can be digitally printed, and to use existing drop-off infrastructure so that returning the pouches is easy. To encourage repeat business it offers rewards and shows the consumer the positive impact choosing Packoorang has on the environment.

SCALING TO SATISFACTION

Another big issue for embracing alternatives: new packaging has a long lead time to test, develop and scale.

“Testing takes a lot of time, especially for food and drink. You need at least 18 months to get that to market,” David MacDonald, owner and CEO of Cullen Eco-Friendly Packaging says. “Then if you go to the largest supermarkets and say you’ve got this fantastic alternative but you can only provide 7,000 units, you’ve completely wasted their time. You need to come to them with mass volume, at a competitive price point so they can run a massive conglomerate business.”

Cullen is one of the few established manufacturers to crack the scaling challenge. Originally a corrugated-box business, it started moulding the waste from cuttings into new products. It now produces 1.2bn products each year, including coffee shop cup carriers, protective packaging for fine wine, and fruit and vegetable trays for supermarkets, which are distributed to 34 countries. In 2022, it also launched a moulded fibre bottle for dried goods such as herbs and spices, and recently announced plans to invest £15m in a new factory in Glasgow.

MacDonald says it shows it can be done. “No plastic is made on our site. We’re passionate about that. That’s the drive to make change and to support people that want to make that change. But there’s a lot more progress to be made.”



Let's unpack this

Europe's green F&B packaging startups

Bio/alternative materials

AGREE NET	BIO2 COAT	B'ZEOS	CELUGY	Cullen	FlexSea	Glenntex	GROWN bio	kelpi	Lactips
MAGICAL MUSHROOM COMPANY	NOTPLA	one•five	PABOCO	Papkot	PAPTIC	Poly materia	PROSERVATION	PulPac	Searo
SHELLWORKS	SULAPAC	traceless	VEnvirotech	<i>Woola</i>	WOWPAK.	Xampla			

Reuse/refill

&REPEAT	andless	BIBAK	Bower Collective	cauli BOX	CLUBZERØ	Green Goblet	PIZZycle	POY	reath
REUSABOL	SwapBox	UNPACKAGED	unda	UZAJE	Vytal				

Recycling/upcycling

CIRCLE BACK	cirplus	CURE	CYCLED	FunCell	GREENBIG	greyparrot	impact recycling	MACREBUR	NORD SENSE
Ogoori	PENTATONIC	RECYCLEYE	recyda	Resourcify	SCINDO	ScrapAd	Scrapp	terradona	

Greener supply chain

again	circulate	empower	Giunko	Packhelp	PONERA	RECUP	send me pack	sourceful	VOIDLESS
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Greener delivery

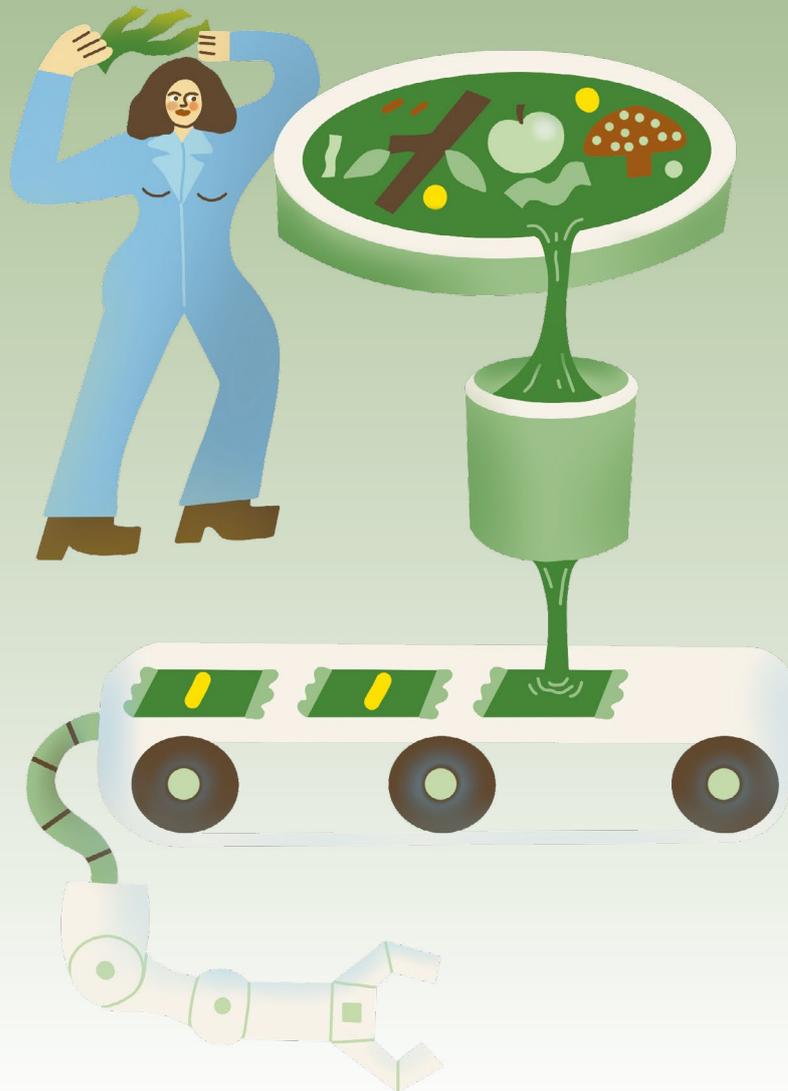
alpakas	GERNE OHNE	modern milkman	Packoorang	PANDOBAC
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Note: startups were chosen on the basis of money raised to date and/or recommended to us by experts and investors

Chapter II

Supporting the next generation of innovators

These emerging business models and investment trends are helping companies to shape and scale their solutions



SHIFTING SOLUTIONS OUT OF THE LAB

In the drive to find alternatives to plastic, startups are thinking creatively about what solutions could look like. Innovators are experimenting with materials from seaweed, algae and mushrooms, to potato starch and milk (more on this in chapter 3). The results have been astounding — but a good idea is only half the battle, and few clever solutions will ever see the light of day.

“Scientists can be working on their life’s work for years and years just to end up with a lab-proven result that never makes it to the market,” says Martin Weber who, along with Claire Gusto — both former employees at vertical farm startup Infarm — founded one • five (pronounced one point five), a “Disneyland of material science” in Hamburg. Since launching in 2020, the company has gathered a network of more than 2,500 universities and research institutes, which are all developing promising biomaterial solutions for commercial scale. The aim, Weber explains, is to minimise the time it takes for biotech to breakthrough.

“Usually, innovations are not ready for the market, they still need to go through various scaleup steps. But that’s what we’re really good at. We’re finding this stuff, facilitating the scaleup and handing it over as a technology transfer package to the existing manufacturers.” It has to be a drop-and-play solution, he says, adding that they can take lab-scale materials to pre-industrial trials in just 12 months.



MATERIAL MATCH MADE IN HEAVEN

Startups are also looking to make sustainable packaging selection easier for brands aspiring to make change. The one • five platform has a solution. It uses natural language processing and artificial intelligence to take the product requirements from a brand like Unilever, and search existing patents or research papers to suggest plausible sustainable solutions. This can often mean layering multiple technologies on top of each other to create something unique.

“Customer behaviour and the appetite for sustainable packaging is undisputed. We want the brands we consume to take more responsibility.”

Martin Weber, founder of one • five

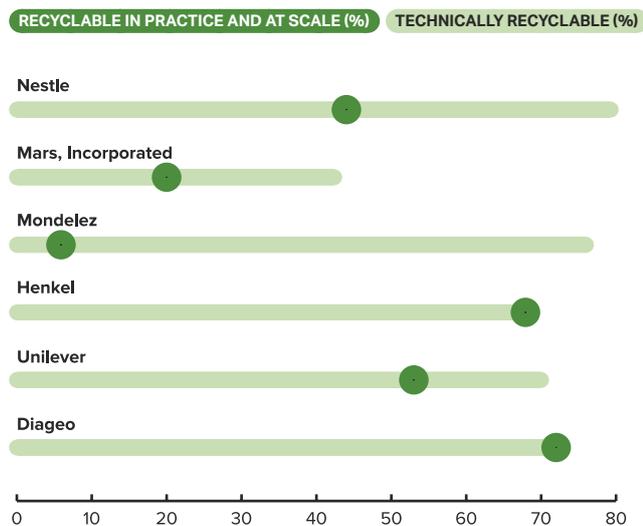
“We are building up a portfolio of different types of IP packaging solutions and material inventions that we have identified, optimised, refined and can now push into the market,” Weber says. “The cool thing about the modularity of this is when a brand owner comes to us, we can reverse-engineer the functionalities of a product to tailor a solution.”

The momentum is there from brands, Weber adds. But the main challenge — as always with B2B — is finding where the budget lies. “Brands are willing to talk and explore. But there’s often a complex and delicate handoff between various teams involved in transitioning to more sustainable products,” says Weber. “Marketing owns the product vision, R&D is responsible for solutions and procurement does the purchasing. The major FMCGs such as Mars, Unilever, Nestlé, Procter & Gamble etc. pull budgets together from these various groups in different ways and it’s not always clear cut.”

Still, he says the strongest driver right now is the reputational risk companies are running should they fail to make any change. “Customer behaviour and the appetite for sustainable packaging is undisputed. We want the brands we consume to take more responsibility.”

In moving to fully recyclable packaging, many food brands are facing technical limitations

Share of select brands' packaging weight that is recyclable in practice and at scale vs. technically recyclable



Source: Ellen MacArthur Foundation

FINDING CAPITAL TO SCALE

Once a viable solution is found, the race is on to achieve scale — and investment to fund that scale.

Some come by it easily enough: when one • five started looking for pre-seed funding, it had interest from more than 60 angels, high-net-worth individuals and micro VCs, as well as the larger predominantly impact-focused funds, such as Speedinvest, Planet A, Green Generation Fund, Revent and Climentum Capital. But it doesn't always happen that way.

Woola, an Estonian company that uses waste wool for packaging had little trouble raising €450k in 2020 from angel investors after winning a slew of tech competitions. Still, subsequent fundraising was “hell from the start,” said CEO and cofounder Anna-Liisa Palatu. “79 VCs turned us down in 2021, when money was flying to software and food delivery apps.” Finally, the VC firm Future Ventures stepped in with €2.5m. “The day we signed the papers, we had €2.46 left in the bank.”

“But we never felt demotivated. We're very focused on our mission, which is to push fossil fuels out of business.”

Tobias Seikel is partner and cofounder at Planet A, an impact-focused fund where investors back startups working in climate mitigation, resource saving, biodiversity protection and waste reduction. He says scientists on the team run lifecycle analysis on startups the fund is interested in investing in.

“That methodology helps us to quantify the positive difference the company could make, compared to the status quo. It helps us to have good investment decisions based on data rather than gut feeling. We believe the companies that are going to create the biggest environmental impact in the future, are also going to be the commercial winners of tomorrow.”

Some of those will be capital intensive, he adds. “If you're operating in the hardware space, you'll usually come from the lab, you'll have a pilot plant, then the demo plant, then the first commercial plant, and the funding needs to increase with each stage. But we believe you have to invest in hardware as well as technology to create the new industry of tomorrow — one that takes its ecological footprint into account. You cannot save the world with just a software update.”

“We believe you have to invest in hardware as well as technology to create the new industry of tomorrow.”

Tobias Seikel, partner and cofounder at Planet A

Climate funds aren't the only game in town. When the founder of Again, Matt Kennedy, raised his pre-seed round of £2.5m to launch the startup's first cleaning facility in London, he was encouraged by the types of funds willing to talk. “A lot of fintech and SaaS investors are interested in funding climate-focused startups, despite the fact that the solutions to the problems we're talking about are logistically complex and capital intensive. These sorts of businesses have not historically been backed by the venture capital community.”

Corporate VC is moving into this space as well, he adds. Global shipping company Maersk is one of Again's investors, and now has a representative on its board. This addresses another investment challenge, which is finding people who understand the proposed solution.

"This is a very early space. It can be difficult to find investors who believe in what we're doing and are able to do due diligence. There are only so many retailers and brands investors can go to and sense-check what we're saying." Finding Maersk was serendipitous. "It knows all about supply chain and all its customers are potential future clients. It makes a lot of sense."

When all else fails, turn to the people. Sustainable packaging startup Notpla won the Earthshot prize in 2022, which comes with bragging rights as well as a £1m cheque. But in the early days, investment for its seaweed packaging wasn't easy to come by. After months of pitching without finding any lead investors, cofounders Rodrigo Garcia Gonzalez and Pierre Paslier decided to try equity crowdfunding on Crowdcube. After a slow first day, social media platform Now This found their campaign video and shared it. £850k of contributions poured in from all over the world in three days. That money helped the team move into a permanent space with a lab, and allowed them to hire their first chemists and engineers to scaleup and mechanise manufacturing.

The startup would later raise £10m in a Series A round and has since worked with Unilever and Just Eat.

VC funding into waste solutions topped \$1bn for the first time last year

VC funding into European waste solution startups, 2015-2022 (\$m)



Source: Dealroom



IMPROVING TRANSPARENCY, EDUCATING CONSUMERS

We all need a better idea of where our packaging is going and how (and if) it's being recycled. That knowledge impacts future purchase and recycling decisions. Unfortunately, insight into the waste system is difficult to secure.

One company looking to turn the tide is London-based Sourceful, a packaging platform aiming to improve transparency for brands through the entire supply chain, from design through to end of life. As well as helping businesses source sustainable packaging, the platform provides live data on carbon footprint, price and delivery as the packaging is created. It's also working on a project with the University of Manchester to pilot ways to track the entire recycling journey of a piece of packaging.

Cofounder Sharon Chan says life-cycle transparency needs to increase across the board. "End of life traceability is very interesting. Where did this packaging actually go — did it go to landfill, was it recycled? But we also need much more transparency into how something is made, the process of each step, how much carbon is produced across the whole supply chain. And an understanding of what real sustainability actually means."

She also wants to stress that responsibility cannot just lie with the public: “Europe in general has good consumer awareness about this issue. But the pressure can’t just be on the customer. There is only so much they can do.”

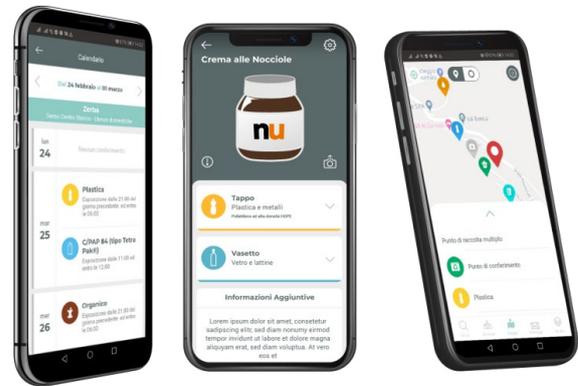
“The pressure can’t just be on the customer. There is only so much they can do.”

Sharon Chan, cofounder of Sourceful

In Italy, the Junker app launched in 2015 to help educate citizens about waste sorting and recycling. The country has one of the highest recycling rates in the EU — 79% of collected waste was recycled in 2021. That’s partly because the municipalities make money from second-life materials, says Noemi De Santis, founder of Giunco, which developed Junker. “The idea was that each municipality would be a circular economy. Of course there are still years before we can do that.”

Like other countries in Europe, the materials that can be recycled vary wildly depending on the region, and some municipalities fine citizens who fail to sort their rubbish correctly. Junker recognises a product’s materials by the barcode and uses GPS technology to tell users what to do with it, according to local rules. Junker now has 2.6m users and 1,800 municipalities on board. Municipalities pay a subscription depending on the number of citizens in the city. As well as at-home recycling, it also has advice about local drop-off points for clothes, batteries, etc.

The main challenge for Junker, De Santis adds, has been building a database of product packaging. “We had this idea that if you could recognise a product from the barcode, you could access an open database containing the information of consumer product materials. There is no such database.” So the Guinko team built its own, with the help of users. So far the team has classified 1.8m products — a third of which came from public suggestions — and still adds more than 2,000 products a month. “Italians are easy to activate, easy to fascinate,” De Santis says. “They want to participate and to contribute. We call ourselves a collaborative platform.”



© JUNKER

In 2021, Giunco started offering its services to a new client base — companies that needed to provide more information about product packaging and how it should be treated at end of use in various locations. Environmental labelling became mandatory in Italy from 1 January 2023, and the startup is working closely with importers bringing products into the country. In December 2023, the European Commission is expected to provide the standards required for the future digital passports of products across other countries too. “It will need to include tracking information, life-cycle assessment, the origin of the product and instructions on how to reuse or recycle the material,” De Santis says. “We will be ready.”

“Governments, brands and consumers are rooting for innovators to succeed.”

ROOTING FOR EUROPEAN INNOVATION

One positive factor driving momentum for sustainable packaging is that governments, brands and consumers are rooting for innovators to succeed. So are investors, with a number of funds looking specifically at this problem. In 2022, Emerald Technology Ventures, which has its headquarters in Zurich, announced a venture-backed investment fund for startups focused on the sustainability of packaging.

Neil Cameron, a partner at Emerald Technology Ventures, has been working in this space since 2006 and says the past five years have been significant in terms of progress. "When I first joined, we talked about biodegradable and recyclable packaging with global corporate FMCG companies. And the general consensus at the time was 'the last thing we want is our brand sitting on a piece of packaging that is decomposing'. By 2018, the conversation was completely different. I think most global corporate groups would be delighted to see pictures like that now."

The new fund is worldwide and will consider several hundred startups a year, Cameron says. "We're looking for big problems that have big solutions that deliver big rewards." And while European startups aren't the only ones focusing on this problem, they are often setting an example for others to follow.

"Europe leads the way with plastic bag bans, single-use plastic regulations. They lead the way with aggressive regulations around recyclability and compostability. Europeans have always been the ones most sensitive to the sustainability of the packaging they consume; they put a large amount of pressure on brands to do the right thing." Cameron adds that this puts pressure on converters to make sure packaging is sustainable, which, in turn, puts pressure on the raw material supply. "There's a trickle-up effect, catalysed by consumer behaviour."

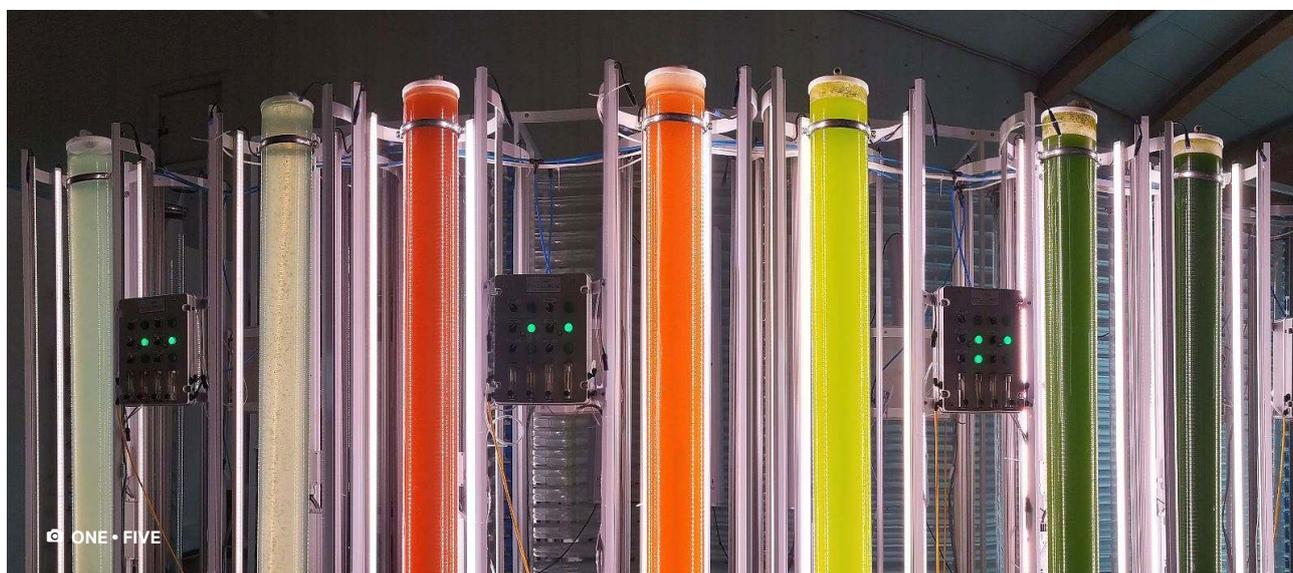
URGENT NEED FOR COLLABORATION

Planet A's Tobias Seikel doesn't think there can ever be enough people working on this issue, but we need more collaboration between the various stakeholders in the value chain. "There are so many approaches right now that we cannot even track them all. But that's good. Change is somewhere out there in the process."

“We’re using resources that we don’t have to produce packaging that we don’t need that end up in waste management systems that can’t handle it.”

Karolina Ling-Vannerus, founder and CEO of Circulate

Karolina Ling-Vannerus, of Circulate, agrees but wants to see more urgency: "Right now we're using resources that we don't have to produce packaging that we don't need that end up in waste management systems that can't handle it. We need to get innovations out of pilots and lab environments and get climate implementation at scale. When it comes to packaging, the volumes are absolutely huge. And all of these empty promises companies make about 2030 won't happen unless they start working on them now."



Packaging unwrapped

Chapter III

Coming soon to a shelf — or doorstep — near you

Seaweed, edible sprays, mushrooms, wool: packaging is about to get very different. But is all this for real — or faddish?



It's conceivable that soon the takeout order delivered to your front door will be served in the same container you used a few months earlier. You'll walk from aisle to aisle in your local supermarket without spotting a shred of plastic. The football stadium will serve beer in self-destructing cups. In the recycling centre, artificial intelligence-powered robots will make sense of the various forms of waste.

WOOL: AN IDEA THAT WON'T BE FENCED IN

Another scenario that feels a safe bet: overlooked materials will gain in popularity. Someone with an unorthodox idea is Estonian Anna-Liisa Palatu, who wants to prove there's a market for an abundant material: coarse sheep wool (the kind that's too tough for knitting). Her startup Woola, founded in 2020, is assigning value to this agricultural byproduct, in the expectation that customers will pay a premium for it.

“90% of wool goes to waste in Estonia because the quality is not high enough. So why not use it in packaging?”

Anna-Liisa Palatu, cofounder and CEO of Woola

Wool, in her hands, is becoming a bubblewrap replacement to protect wine bottles, jewellery and electronics. “My cofounder and I got the idea when we were running a small ecommerce store and we saw just how much bubblewrap was used, with no replacement on the market,” says Palatu.

“We got in contact with the national post office and they confirmed it's a big problem — so much so that they had a task force to find bubblewrap replacements. Around this time, I read an article that said 90% of wool goes to waste in Estonia because the quality is not high enough. So why not use it in packaging?” Sheep farmers were keen from the beginning, as they had no idea what to do with their leftover wool (200k tons of wool is burnt or buried in Europe every year, Woola estimates).



This was the beginning of 2020 and things moved quickly from there. The company opened a small production facility one hour outside Tallinn and by the end of 2020, Woola was selling woolly bottle sleeves in four different sizes (alongside little notes to guide customers on reuse, return and recycle options).

Palatu and colleagues decided they'd only work with ethically minded suppliers. Similar to the Know Your Customer due diligence process, Woola has developed “Know Your Wool”, which includes farm visits and third-party auditing.

While Woola has found customers, Palatu doesn't hide the fact that the product is unlikely to ever be as cheap to produce as plastic bubblewrap. “We're already at a comparable rate, but we'll never be on par; it's not part of our strategy,” she says.

And what if, after everything, the wool ends up discarded in the bin, like most plastic bubblewrap? “What we recommend is for customers to repurpose the wool,” says Palatu. “You can use [the wool] as a plant fertiliser, or as a teapot warmer, or as extra bedding for a pet. The best option is to return it — we're doing some pilots, though the logistics will be difficult.”

And in the worst case scenario, “If you compare incinerating plastic bubblewrap versus wool, the latter is still preferable,” Palatu argues. The argument is faithful to her company motto: “not perfect, but better”.

SPRAY IT WITH ME

Wool and other lower-impact materials have investors' attention — but they still need to prove they can do the same good things as plastic.

One highly desirable feature of plastic is how it enables longer supply chains. Plastic wrapping around cucumbers, for example, prolongs their life, allowing them to be delivered anywhere in Europe year-round. Without a good replacement, people would have to go back to eating seasonal fruit and veg.

Supermarkets put huge amounts of plastic packaging onto the market. According to a 2020 survey from Greenpeace, UK supermarkets alone generate around 114bn pieces of single-use plastic every year, including 17.7bn wrappers for fresh fruit and veg.

“We can tackle two things at once: eliminating plastic and food waste.”

Solon Cunha, chief technical officer of Bio2Coat

But what if a company promises it can do much better than plastic? Bio2Coat, a startup just north of Barcelona, has developed a method for creating imperceptible edible barriers that the company says can greatly extend the life of perishables. “We can tackle two things at once: eliminating plastic and food waste,” says Solon Cunha, the company's chief technical officer.

Bio2Coat's tasteless spray can stretch the shelf life of an unwrapped strawberry by two weeks, says Cunha. And it doesn't require chemicals; instead, it's a blend of natural raw materials, including the babassu nut that grows in Brazil.

The company, having trialled its product with retailers, aims to raise investment. Edible coatings — like those introduced by American companies Apeel and Akorn Tech — have already raised large sums.

Bio2Coat has some distance to go in Europe, facing several potential hurdles: the product is still largely

untested at a commercial scale, and growers may decide it adds too much cost. Still, says Cunha, “Spain is the top producer of fruit and vegetables in Europe — so we're in the best market.”

A LITTLE HELP FROM OUR FRIENDS

One material with big potential to take us to a biobased future is the abundant seaweed.

UK startup Notpla, which we talked about in chapter 2, has developed a product called Ooho: an edible seaweed-based bubble that encapsulates liquid. It's been used to replace thousands of sauce sachets, dispense Lucozade at the London Marathon and served as edible shots at a Pernod Ricard cocktail event. An ongoing partnership with Just Eat, the food delivery site, led to the development of a biodegradable seaweed-based coating that can be used on takeaway boxes instead of plastic. The team is now working on seven products, including a film to package dry goods.



“We’ve delivered more than 1m boxes to Just Eat alone,” Notpla product manager, Ella O’Toole, says. “One thing we did with Ooho is we manufactured all of that in house. I think that’s been a challenge for us in terms of scalability.” They’re now working on fitting other innovations into existing manufacturing capabilities. “Our coating, for example, is designed to work with traditional equipment so it can be adopted by the market.”

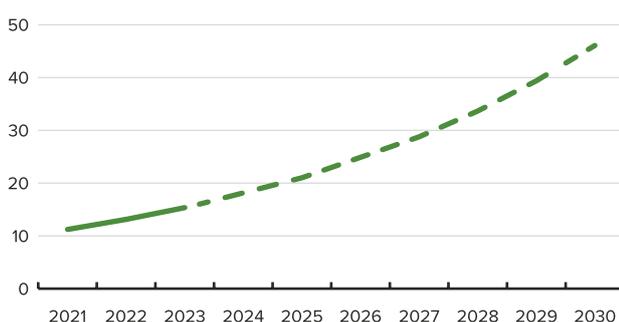
Just Eat’s collaboration with Notpla has been popular with customers, Ella O’Toole says. The company reported that 92% of customers wanted to see more seaweed-based sachets. But the development of the takeaway boxes has given the team something to think about when it comes to educating the wider waste supply chain. “Our takeaway boxes are not only home and industrially compostable, they’re also recyclable. That’s a challenge for the waste streams and existing infrastructure because there’s typically an understanding that you can’t recycle those boxes. We have to re-educate them to say the Notpla logo means that it can be recycled and it can be trusted.”

SHROOM BOOM?

If invisible coatings don’t do it for you, what about packaging food with other food?

The global bioplastics market is projected to grow by more than 4x within the next decade

Projected global bioplastics market size (\$bn)



Source: Precedence Research



Put simply, the starting point for creating mushroom packaging is to place its thread-like roots, known as mycelium, in a bag with some wood chips. “It grows on the wood chips extremely quickly; in four or five days it will colonise the waste,” says Jan Berbee, CEO of Grown.bio, a Netherlands-based startup. After the mycelium roots bind the chips together, the new material is placed in a custom-shaped mould and dehydrated in an oven.

It’s unconventional, for sure, but mushrooms have already been successfully repurposed as packaging for wine bottles, furniture and art. So could we soon be taking a sip of water out of a mycelium-made bottle? “Yes, if you don’t mind the bottle being around 15mm thick,” says Berbee. “Go any thinner, and the material’s too fragile.

“That’s now, but I’m confident the science will develop. It’s a young field. We’re where the car was in the 1900s — still giving out lots of smoke, still a bit creaky, but improving all the time.”

Berbee’s technology is licensed from Ecovative, the global mushroom leader based in (aptly named) Green Island, New York, that has raised over \$100m. Alongside its mushroom packaging — which, in true full-circle form, can also be used as a fertiliser — Ecovative also sells mycelium-based “bacon”.

Berbee believes mycelium, while still niche in Europe, will eventually grow to compete with conventional plastics. “We have halved the cost of package production in the last three years. That’s because we’re working smarter and learning more about how this stuff behaves. We started out 10x more expensive than Styrofoam; today, we’re 3-5x more expensive. Next year, it’ll be cheaper again.”

SUSTAINABLE ON PAPER

A number of startups, meanwhile, are looking at whether more paper can reduce some of the impact of packaging on the environment.

Paper of course comes from trees, which are, in theory, a renewable resource. Paper can also be more easily recycled or composted than plastic — but it takes more energy to manufacture a paper bag than it does to make a single-use plastic bag from oil. Paper-based packaging is also usually lined with a plastic coating to strengthen the material.

The founder of a Swiss company thinks he has something better to replace strips of plastic on paper: a coating made of silicon and cellulose. Despite no chemistry background, Manuel Milliery was growing gradually more alarmed about microplastics in the water, so he started a makeshift lab in his kitchen to see if he could make a greener paper package. “I dared to defy academics, the biggest chemical companies, investors, banks,” he says. “In recent years, we’ve been inundated with new plastic materials derived from seaweed, potatoes, lettuce, milk... [our coating] is made of ceramic, so there is no plastic in it: no plastic, no bullshit, no harm.”

Over in Austria, meanwhile, the €1bn+ paper-manufacturing group Delfort set up a sister company called Delsci to see if it could come up with greener paper packaging. What they discovered, however, is that plastic remains hard to beat for some applications.

“Just about every cigarette uses Delfort paper,” explains Herwig Kirchberger, Delsci’s managing director. “It makes us very profitable but a company with a slightly bad karma.” The quest for better karma sees the company spending €4m per year on R&D for lower-impact wrappers for fast-food items like burgers and chips.

The research effort has come up with a paper coating partially made from sustainable ingredients. Plastic’s role has been reduced, but not fully, because finding something organic that can imitate the water-resistant qualities of plastic is an ongoing scientific challenge, Kirchberger explains.

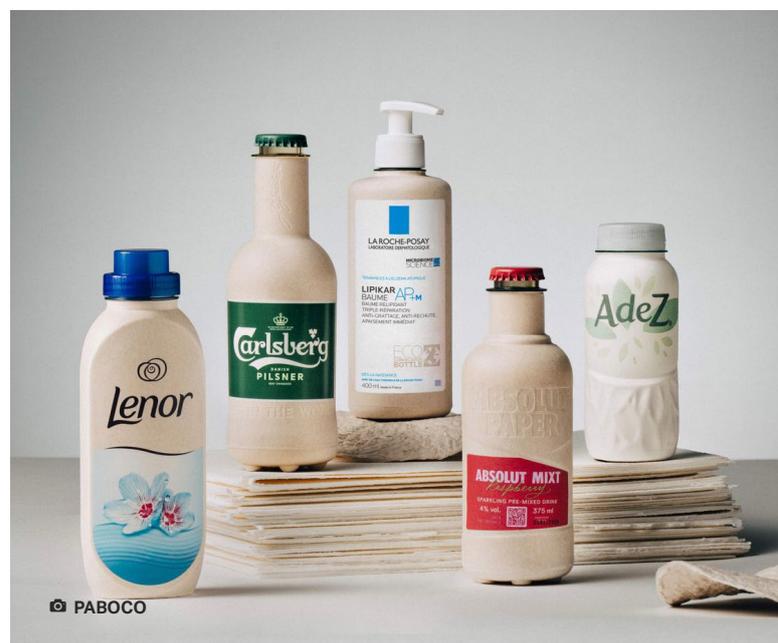
After many, many experiments, he’s come to the conclusion that “not every product can be replaced

with paper packaging. I think there is no paper supplier that can deliver a barrier paper that is 100% recyclable against water”. Chip bags, he says, will probably always need bits of synthetic coating: customers want nice crunchy chips, unaltered by exposure to water vapour, and that’s what plastic delivers.

Similar research efforts in Europe are searching for a natural — and economical — paper coating. Recyclable fibre beer bottles made by Copenhagen-based startup Paboco, and trialled by the brewer Carlsberg in 2022, contained some plastic to keep the product from leaking. But products like this — paper with a little synthetic coating — will be almost impossible to recycle, says Victor Dewulf, CEO of Recycleye, which creates waste-sorting technology for recycle centres. “Most likely it’s heading straight to landfill.”

Carlsberg says its ultimate goal is to bring the paper bottle to market, while it “works towards a solution without plastic”.

So some form of paper bottles may be coming to our shelves, but there’s still a practical hurdle to clear, says Sarah Greenwood, packaging technology expert at the University of Sheffield. “Will the consumer accept not being able to see the material inside? If I were spending £30 or £40 on a bottle of gin, I think I’d like to see inside.”



© PABOCO

SELF-DESTRUCTING CUPS

Another — and more ambitious — way to create sustainable bottles is to design them to disappear.

One German startup working on this, called *traceless*, was founded by Anne Lamp and Johanna Baare in 2020. The company creates natural biopolymers from farm waste, which are naturally compostable within two to nine weeks, free of toxins and climate friendly. *Traceless* produces the material in granulate form, which can then be transformed into a wide range of packaging and single-use products. The process, the company says, cuts carbon emissions by 95% compared to virgin plastics. Lamp says the startup has had good feedback so far, and has been able to develop and scale thanks to a seed fundraising round, and a €2.42m European Innovation Council grant in 2021.

“There’s an onus on material makers to make sustainable packaging straightforward — and if possible, fun — for customers.”

British startup *Polymateria*’s plan for plastic pollution is an additive, created in the Imperial College London lab, that decomposes plastic into a wax that’s then digested by nature. The company is going after a big market — the plastic cups used in the food industry and discarded immediately after use. In 2022, *Polymateria* trialled its “self-destructing” cups at rugby games in the UK and a big electric vehicle race event in Saudi Arabia.

Consumers will initially be encouraged to recycle the product, but should the packaging become litter, it will biodegrade anyway, explains Niall Dunne, *Polymateria* CEO. “Historically, people have thought you can’t have recyclability and biodegradability together. The factions have been at war with each other. We’re showing you can have both.”

Dunne says there’s an onus on material makers to make sustainable packaging straightforward — and if

possible, fun — for customers. “All the research says the consumer is very confused by sustainability,” he says. “Our messaging — the ‘self-destruct’ cup — sparks intrigue. It’s part-‘Mission Impossible’. It becomes an experience for the customer. You cut through better that way, we think, than if you had just stuck a green leaf on something.”

Another startup emerging from Imperial College London with a dissolvable bioplastic is *Shellworks*. CEO and cofounder Insiya Jafferjee says she wants to create beautiful products that people want to hold onto and reuse. “But we have a safeguard — i.e. the products will harmlessly degrade — if they escape into nature,” she says. The company’s material is formed from microbes found in the soil and marine environments and can be shaped into solid jars or containers, as well as more flexible products.

Based in east London, *Shellworks* has its eyes on the food and drink world — but first it’s making products to hold cosmetics. “It’s a process. Food has a lot more regulations around it, and rightly so, plus it’s harder to break into and capture a slice than the cosmetics world. Volumes in food are so large but once we’re at the scale, we’ll be more than a match for plastic,” Jafferjee says.





CAN REUSE IDEAS CATCH FIRE?

Away from the whizzy biomaterials, another bunch of innovators are trying to achieve change with a pitch that promotes reusable packaging and refill solutions.

In London, Safia Qureshi's company ClubZerø focuses on returnable packaging for takeaway and delivery in the city's finance and tech district. The founder and CEO estimates her company, which has partnered with the delivery service Just Eat, has displaced over 2m single-use packaging units. Customers have a choice to opt-in for reusable packaging when placing an order from a range of participating restaurants through the Just Eat for Business platform. After use, the fully recyclable packaging will be collected by ClubZerø bikes and taken to be cleaned and then redistributed.

66 56% of people would prefer a company that doesn't use single-use plastic."

Many people want more modest packaging for their takeaways. A 2022 global survey commissioned by Belgian foodtech startup Deliverect found that more than half (54%) of the people it polled preferred a restaurant that removes excess packaging from food delivery, and 56% said they would prefer a company that doesn't use single-use plastic.

Qureshi wants to reach these people even if, right now, her clients are mainly city-bound corporates — including the likes of Funding Circle, a business lender, and Truelayer, a fintech. "The inevitable goal is for everyone to have this service available to them," Qureshi says. "People outside cities too. But first, we have to build economies of scale, which is how we make it affordable for everyone."

The reuse business model is developing at different speeds across Europe. Germany is ahead of the UK, for example, says Qureshi, because of a new rule that states takeaways must provide a reusable packaging option to customers.

One German company, born as a university project during the pandemic, is hoping to capitalise. PIZZycle's founders wanted to do something about used cardboard boxes destined for the "everything else" bin for items that can't be recycled (this is because food residue is inseparable from the material and could damage the recycling machines). PIZZycle's answer is a reusable box, which is essentially two round plates, following the outline of a pizza, that can be cleaned in the dishwasher and "used several hundred times," according to the company.





Another young reuse player, Cologne-headquartered Vytal, is working with fried chicken restaurant KFC Germany to offer reusable packaging to customers. To avail of this service, customers need to download and register for the Vytal app. The customer then pays a small deposit, and as long as the packaging is returned to an outlet that is part of the scheme within 14 days, there is no charge. Otherwise, the deposit is forfeited.

Will this model catch on? Some people, of course, don't want the hassle of downloading a new app, or returning packaging themselves. Qureshi's ClubZero anticipates and gets around the second part of this problem by sending her people out to collect packaging — which works well, for now, because the company is covering a relatively small area filled with corporate offices.

"Retail is by far the hardest space to scale in," Qureshi acknowledges. "Everyone's put up their hands to say it's not working right now, there's not yet the economy of scale needed. It's a very long horizon."

Meanwhile, while big supermarket chains are exploring ways to cut down plastic waste, progress on rolling out package-free solutions has been slow. True, you'll discover a growing refill selection in supermarkets or so-called zero-waste stores, but they're logistically complicated — not only do groceries need to be delivered, but once empty, the packaging needs to be collected, cleaned and refilled — and in order to succeed, they need suppliers, retailers and customers willing to take a punt.

This system's not for all kinds of food. The reason packaging-free grocers are associated with bulk, room temperature goods such as lentils, nuts, rice and pasta is because the packaging requirements are simple. Dry products have a longer shelf life, don't require controlled temperature storage and are less likely to discolour the packaging they're kept in. But because these services are often operating at a small scale, it's difficult for them to achieve price parity with everyday packaging.

“Retail is by far the hardest space to scale in. Everyone's put up their hands to say it's not working right now.”

Safia Qureshi, founder and CEO of ClubZero

Regulatory winds, like those witnessed in Germany, could boost reuse ventures. In the US, for example, several states have passed producer-responsibility laws that require producers to make less plastic and ensure that all single-use products are recyclable or compostable by 2032. California wants a 25% reduction across all plastic packaging sold in the state, covering a wide range of packaging items. It's not hard to see how rules like these could provide an innovation spur for refill stations for products like detergents or drinks.

Packaging unwrapped

Conclusion

Shift happens?

So you've made a nice, useful, competitively priced packaging material: now you need to bring customers on board



Whether it's hidden in the product price or explicit at checkout, there's an extra cost of sustainable packaging. Who will pay for it?

This is one of the big questions hanging over the green packaging future. Depending on who you talk to, the expectation that consumers will reuse bottles or containers or become better recyclers is naive — but expecting people to pay more for sustainable goods sounds naive to plenty of people, too.

It's true that in some big recent customer surveys, people say they'd pay more for green. The 2022 Global Buying Green Report, based on a survey of more than 15k consumers across Europe, found that 86% of those aged 45 and under said they were willing to pay more for sustainable packaging. There were similar findings from the European Consumer Packaging Perceptions study: "77% of consumers in Europe are willing to pay extra for packaging that has less impact on the environment."

Conscious consumers with money to spare will buy expensive, sustainable items. But despite what survey data says, it's not clear how many, really, would pay more for sustainable packaging right now.

“So far we don't actually see packaging influencing buyer decisions as much as we would have wanted.”

Karolina Ling-Vannerus, founder of Circulate

"I'm very sceptical of consumer research. You're not going to tell a pollster you want unsustainable packaging — but when push comes to shove, we don't always make the greenest choices," says Patrick Poitevin, packaging expert and consultant with Advisory4Pack. Circulate's Karolina Ling-Vannerus also questions whether these good intentions recorded in surveys (such as one that suggests 70% of customers are willing to pay more for sustainable packaging, rising to 85% among younger consumers) play out in practice.

"So far we don't actually see packaging influencing buyer decisions as much as we would have wanted. And when you buy something online, you don't actually know what packaging the product is going to come in," she says.

Woola tested the willingness of customers to put their money where their mouths are in a 2021 experiment involving more than 7,000 people. The company provided its wool-stuffed envelopes to two ecommerce sites, and the shops both added an option to their checkouts where shoppers could choose to pay a small extra fee to receive their order in this sustainable packaging.



Out of the 7,753 purchases made during the experiment, only 458 people checked the box for sustainable packaging. “Despite what consumers express in surveys about the willingness to pay extra, when actually faced with the choice, most don’t follow through,” Woola wrote in its blog. “The conclusion is clear: online shoppers are not ready to bear the cost of sustainable packaging, which puts the responsibility on the retailers.”

This was only one experiment — but it’s true that packaging pollution will never be tackled without consumer buy-in. And what’s really difficult for customers to understand are the various green environmental logos you find on packaging, said Dewulf. “Some of these are completely meaningless,” he says. For instance, a logo can indicate that packaging is recyclable — or it may simply signify the packaging producer has made a contribution, of some kind, towards recycling. “Brands have the biggest responsibility to ensure they’re being straightforward with people,” Dewulf added. “Because people are too busy to follow what all these different logos mean.”

According to ClubZero’s Qureshi, there’s “no point complaining” if people don’t choose the greenest solutions. “The only question we all, as businesses, need to focus on is how do we make sure we’re making things that are 100% convenient for customers?”



What trends are the smart money keeping a close eye on? We asked the industry’s brightest packaging players — including founders, academics and investors — for their thoughts, hopes and predictions for the future of the European packaging-tech market.



Social trends and rising costs could save us all

“I don’t think we’ll see much single-use packaging in 10 years’ time. It’s not going to be acceptable anymore. It’s already not accepted by a lot of huge consumer groups, and the prices of the material and fines are only going to increase. That’s good for us reusable companies. You’re only paying for something once, rather than 100 times.”

Alvin Leer, cofounder, Packoorang



Get ready for a revolution

“This is one of the industries that’s expected to be the most disrupted in the coming decades, because it has to be. Raw materials are not going to be available at these prices anymore. We need to realise that everything has value and there’s no such thing as waste. It’s a resource that can always be used for something else. I hope we will have wired that into our behaviour.”

Karolina Ling-Vannerus, founder, Circulate



New laws will push plastics to the brink

"Similar to the ban on single-use plastics, authorities will [eventually] unilaterally ban all plastics-based products and non-recyclables. The food and drink industry will rapidly evolve its models and surf on the new wave of alternative materials to elevate their brand. Consumers will demand 100% transparency on the impact footprint of materials and the industry will adopt new labels to ensure transparency."

Yoann Berno, general partner, Climentum Capital



More government funding for infrastructure

"It's obvious that the future of packaging contains a high percentage of reuse. But like any logistical challenge, reusable packaging needs scale to be viable. I think there's a role for governments to help the industry get there. We need more catalytic funding to help bridge the gap in the same way as we've seen in the clean energy and electric vehicle industries."

Matt Kennedy, founder, Again



Nature has the answer

"There'll be more companies looking to nature for the answer. We believe nature knows best and it's done all this before. We found seaweed but I'm sure there are many other things that haven't been discovered yet."

Ella O'Toole, product manager, Notpla



Brands need to think about packaging before it's too late

"Suddenly a lot of brands are waking up and realising they've completely overslept this change. With regulatory changes coming into effect by 2028 or 2030, this shift needs to happen now. It takes years to scale new technologies and implement them with brands."

Martin Weber, founder, one • five



Recycling systems will advance

"I hope we'll simplify the polymers we're using and have recycling capabilities for almost all polymer packaging types. And chemical recycling is going to become something we need to do. Breaking plastic down is the only way to really clean the virgin material so you can use it for food contact purposes."

Sally Beken, founder, UK Circular Plastics Network



Memory of disposable cups will make us cringe

"In 10 years' time, using a single-use cup for a takeaway coffee will be as antisocial as lighting up a cigarette indoors. We will laugh at people with disposable cups in old TV programmes, thinking how foolish we used to be. People will understand that unnecessary consumption of any packaging material is bad for the environment and remember their own reusable cup or borrow one."

Sarah Greenwood, packaging technology expert, University of Sheffield



More packaging will be tech-enabled for sorting and reuse

"Packaging has to contain, protect and inform but if that's all it does, it's a wasted opportunity. It can do so much more. In the future, we expect packaging to be smart and connected, to be communicative and to deliver more value. And we expect a great deal more emphasis on design and closing the loop, so there will be more effort placed on smart collection, smart sorting, to make sure that all waste streams find their way into second life."

Neil Cameron, partner, Emerald Ventures Technology

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