



ZERO WASTE BEAUTY REPORT

2022 – 2023

ZERO WASTE BEAUTY

ABOUT THE REPORT



FOREWORD



It's no secret that the overconsumption of the earth's resources coupled with the amount of waste produced is having a detrimental effect on our planet.

The zero waste movement seeks to redesign resource life cycles. Now, more than ever, it's gaining momentum, as companies of all shapes and sizes strategize to eliminate waste across their supply chains in a bid to reduce environmental impact.

While there's still so much to be done, there are some inspiring zero waste initiatives in the beauty and personal care space right now.

This report aims to uncover the most inspirational examples of creative reuse and

wider sustainability efforts in the beauty industry as well as explore the home cleaning and food sectors.

It focuses on reducing the consumption of new resources, identifying waste as a valuable resource, and supporting the transition from a linear take-make-dispose system to a circular one.

By homing in on ingredients and formulas, as well as packaging materials and supply chain traceability, the report provides an insight into the future of zero waste beauty.

**LET'S
DIVE IN >**

01

INGREDIENTS & FORMULATIONS

In this section, we take a look at the latest sustainable developments in the world of cosmetic ingredients. Whether that's innovative ingredients made from by-products or the future of formulation.

5-6 Reduce & Reuse

7-11 Upcycling in Action

12-14 The Future of Formulation



02

PACKAGING & MATERIALS

Discover the packaging and materials that are helping to clean up the planet. In this section, we explore market-ready materials and exciting new creative concepts that are shaping the future of packaging.

16-17 The Refill Revolution

18-19 Creative Concepts

20-22 The Future of Packaging

03

GREENER MANUFACTURING

Get inspired by the changing landscape of manufacturing. In this section, we dive deep into the way in which beauty brands can go greener and cut emissions during the manufacturing process.

24-25 Carbon Considerations

26 Going Green

27-28 Sustainable Manufacturing

29 Green Beauty

Section 1

**INGREDIENTS
& FORMULATIONS****97%**

97% of consumers want beauty brands to be more transparent about the ingredients in their products.¹

1 in 3

Nearly 1 in 3 consumers claimed to have stopped purchasing products from certain brands due to ethical or sustainability-related concerns.³

1/3

Over 1/3 of consumers chose beauty & personal care brands that have environmentally sustainable practices & values.²

86%

86% of consumers want more transparent information about ingredient supply chains.

REDUCE & REUSE

From waterless formulations to customisable cosmetic solutions, here are 3 ways to reduce and reuse waste in the beauty industry...

01 CUSTOM BEAUTY

When we think of waste in the beauty industry, packaging tends to come to mind and while this is a huge problem, there are other avenues we explore that can help tackle the **waste crisis**. Unused products sitting at home, unsold or returned products, and items that expire in warehouses are all contributing to beauty in landfill.

Custom beauty presents an opportunity to create products that are tailored to consumers'

needs on a case-by-case basis, reducing the chances of products being thrown away. Moreover, made-to-order solutions eliminate the need for retail forecasting which can lead to unsold inventory being wasted.

Originating from couture fashion, 'made-to-order' is synonymous with luxury but it is now making its way through to other industries - and it might just be tackling the waste crisis in the process! This personalised approach to consuming is starting to be viewed less as a luxury and more as an affordable solution.

For example, Function of Beauty, is a made-to-order brand that sells popular customisable hair, skin,

and body products. Seeing as each item is tailored to each consumer, Function of Beauty ultimately reduces the number of products required in a beauty routine.

Skincare brand Curology is also tapping into the made-to-order model by providing customers with personalised skincare routines that follow a digital analysis of the skin and a short quiz - each at a **fraction of the cost** of a dermatologist.

Another approach worth mentioning is grown-to-order beauty which ensures products aren't expiring on shelves and going to waste. The eco-advocating personal care brand, Haeckels, launched zero waste eye masks made from locally

grown marine materials. To create the product, Haeckels cultivates agar in-house, extracting this from the cell walls of seaweed to make the membrane's material. Once ordered, the agar is grown over three weeks and infused with aloe vera, hyaluronic acid, witch hazel and cucumber - a process that customers can track via weekly email updates from the team.

Once grown and cut to shape, customers then add water to the eye masks to activate the ingredients, placing them under each eye for a 10-minute treatment. The results? An entirely compostable and naturally biodegradable product that creates zero waste.

02 BRING YOUR OWN WATER

More often than not, water is considered a limitless resource but unfortunately, demand is beginning to outweigh supply, with Global Market Researcher Mintel crowning it “the new luxury” ingredient.

“Water is set to be a precious commodity as consumption outstrips supply,” the brand’s Global Beauty and Personal Care Analyst explained.⁴

As consumers become more and more aware of the detrimental effect of excessive water usage, more beauty brands are embracing waterless formulations. **Waterless skincare** and haircare focuses on activating solid or powdered formulas with water at home, helping

to limit the overuse (and unnecessary shipping) of water within cosmetic formulations. In addition to reducing water wastage, powder or solid formats can be packed more sustainably, utilising compostable materials or go one step further by embracing a packaging-free, ‘naked’ format similar to eco-brand, Lush.

The result? More concentrated formulas and fewer carbon emissions.

03 FINDING VALUE IN FOOD WASTE

Did you know that one third of all food produced globally goes to waste? That amounts to approximately 1.3 billion tonnes per year. While this may seem like an issue we can help solve at home, an

estimated 40% of fruits and vegetables are discarded simply because of their appearance, not even making it to supermarket shelves.⁵ In addition to wasting perfectly good produce, the other looming issue is methane. When food is sent to landfill, it rots and becomes a significant source of methane – a potent greenhouse gas with 21 times the global warming potential of carbon dioxide.⁶

Upcycling by-products and ‘imperfect’ produce presents an opportunity to create new products using minimal energy.

For example, Otherworld is an eco-brand that has developed a pancake mix made with upcycled ‘wonky’ fruits and vegetables. From bruised beetroots to deliciously odd carrots, Otherworld embraces

food of all shapes and sizes that would have otherwise gone to waste.

Not only are these pancake mixes created with existing materials, but they are nutrient-dense due to the high vegetable content, making them a healthier choice for both people and the planet.

The beauty and personal care industry is finding value in plant-based leftovers with many brands creating effective yet sustainable products. By harnessing the power of micro-nutrients and vitamins already present within food waste, these brands are revealing that upcycled ingredients are not just effective, but in some cases, proven to outperform their non-upcycled counterparts. ■



UPCYCLING IN ACTION

BY-PRODUCT INGREDIENTS

We view our competitors as allies; a collective of like-minded companies working towards the same vision of circularity in the beauty industry.

To truly change the way cosmetics are formulated, we need to work together. To give you a head-start, we've curated the latest list of upcycled cosmetic ingredients that are proving just how valuable waste can be.

FOUNDATION

HYDRA-LEEN®

Minasolve debuted Hydra-Leen® in 2021 - a range of fragrant, skin-friendly hydrolats that are COSMOS approved, organic and free of listed preservatives. The upcycled ingredient is made

from a by-product of steam distillation. All hydrolat raw materials for Hydra-Leen® are produced by a Moroccan supplier of local natural products, maintaining a close relationship with farmers and guaranteeing full traceability of ingredients.

CHARCOAL CRUSH SMALL OR MICRO

Known for its oil-absorbent and cleansing properties as well as its intense black pigment, Full Circle sources only the most sustainable upcycled charcoal powder.

Made from small pieces of leftover charcoal that is derived from oak fencing offcuts, Full Circle's Charcoal CRUSH collection comprises 3 unique grades including skincare scrubs and an active powder.

ACTIVES

BARLEY TONIQ®

Launched in 2022, Full Circle's Barley TONIQ® is an ultra-soothing active made from a by-product of beer production. It is their second addition to the newly created TONIQ® range which houses a collection of water-soluble ingredients.

The upcycled barley leftovers are combined with a microbiome-friendly and upcycled grade of propanediol, eliminating the need for any traditional preservative. It's ideal for sensitive and reactive skin types, in fact in-vivo studies reveal that Barley TONIQ® soothes redness by 23% in just two hours.

AC POLYJACKHARIDES

Did you know that 80% of jackfruits are considered non-edible waste? Active Concepts are upcycling these valuable leftovers into a powerful ingredient for both the skin and hair.

Jackfruit polysaccharides offer impressive hair anti-frizz results whilst enhancing dry and wet compatibility,

as well as overall feel, shine and hydration. In addition, AC PolyJackharides can be used for skin moisturisation.

BLUEBERRY NECTA®

Eco meets luxury with this naturally potent upcycled active oil from Full Circle. Blueberry NECTA® packs a punch against blue light, supports barrier function and contains a natural source of pro-retinol. Not only that but the upcycled active is high in both linoleic acid and oleic acid. Linoleic-rich oils help to nourish and hydrate the skin without being too heavy, while oleic acid is known to permeate skin layers without disordering other fatty acids in the skin.

ALGAKTIV® UPLIFT

ALGAKTIV® UpLift harnesses the power of upcycled Icelandic freshwater microalgae polysaccharides to help firm and tighten skin by restructuring from within. Made from a by-product of nutraceutical industry and astaxanthin, this upcycled ingredient is said to restore skin firmness, boost elasticity and offer moisturisation.

FUNCTIONAL

SAPONIN +

Saponin+ is a 100% natural and **plant-based alternative** to traditional surfactants. This by-product of tea seeds is a 60% grade saponin that is extracted from camelia oleifera oil.

The upcycled, natural non-ionic surfactant boasts foaming, cleansing and antimicrobial properties; it's deemed to be a great replacement for SLA or SLS surfactants.

NATPURE SOL

Derived from sugarcane by-products, Sensient's Natpure SOL is an amazing upcycled

alternative to traditional emulsifiers. It's comprised of a mixture of sucrose laurate components that work in synergy to improve the solubilizing power of each.

Natpure SOL presents a solubilizing efficacy that covers a wide range of lipophilic ingredients. In addition, its liquid form at low temperatures allow for easy handling and reduced production down time.

Natpure SOL performs extremely well in both aqueous and hydroalcoholic systems while improving the final transparency of the products.

TILAMAR® PDO

This natural ingredient from DSM is designed to reduce formulation complexity by acting as a preservative booster, skin humectant, sensory enhancer, solvent, and actives carrier—all in one. The multifunctional ingredient is **100% bio-sourced** from non-GMO feedstocks. Not only that but the eco-designed facility where it is manufactured helps to contribute back to local industrial redevelopment and diversification.

In addition, TILAMAR® PDO is microbiome friendly, compatible with most cosmetic ingredients and has wide regulatory approval.

COSMEGREEN

The CosmeGreen range by SurfactGreen is comprised of an award-winning line-up of high-performance plant-derived surfactants which presents new and exciting formulation opportunities for naturals and cationics.

While CosmeGreen ES1822+ is a plant-derived cationic surfactant system with superior smoothing, strengthening, colour retention and detangling benefits, CosmeGreen MS1822 is a 99% bio-sourced multifunctional cationic surfactant that provides barrier protection and soothing properties for the skin and hair. ■

FUSSY

Fussy is a natural deodorant brand that's partnered with a UK-based tree wholesaler and oil distiller to create a fresh and festive scent that helps to **combat waste** at Christmas time. Their limited edition refill scent was developed by distilling unwanted 'wonky' Christmas trees. The result? Upcycled, fresh pine fragrance perfect for their sustainable deodorants. "We didn't want to release just another novelty scent this Christmas but to make an actual difference," said Matt Kennedy, CEO and Co-Founder of Fussy.

FARMACY

Farmacy is a UK-based brand that's championing sustainability. By taking advantage of by-products in the food industry, they've created a high-performance range of skincare that looks good enough to eat. For example, Honey Potion Plus contains upcycled apple extract that delivers essential moisture, smooth skin, and improved radiance. "Instead of one leftover ingredient per formula, we want to potentially make a whole formula from waste," said Kseniya Popova, the Director of Research and Development at Farmacy.

PLANET REVOLUTION

Committed to providing beauty enthusiasts with the access to affordable, greener formulations and eco-conscious packaging, Planet Revolution uses sustainable and upcycled ingredients wherever possible.

Launched in late 2021, Hemp Nourishing Serum Drops & Raspberry Nourishing Serum Drops are enriched with upcycled hemp and raspberry seed oil. While the hemp seed oil helps to nourish dry, irritated skin, the ultra-hydrating raspberry seed oil works to enrich skin with a burst of hydration.

TRULY BEAUTY

Truly Beauty is not your average clean beauty brand. They created a range of skin, body and hair care that's just as much sustainable as it is Instagrammable. Their bright and bold products are vegan, **cruelty-free** and utilise 'clean', organic and upcycled ingredients. Truly Beauty's Blueberry Kush range is infused with upcycled blueberry oil, a by-product of the juicing industry that helps to detoxify and illuminate skin. ■

FORMULATIONS



“Instead of one leftover ingredient per formula, we want to potentially make a whole formula from waste”

Kseniya Popova, Director of Research & Development at Farmacy

UPCYCLING IN ACTION

BRANDS &
PRODUCTS

Can you imagine a world where beauty products produce zero waste? These forward-thinking brands are transforming plant-based leftovers into the latest beauty products, with zero compromises on performance or efficacy. Here are just a few of the brands that are pushing the boundaries in the beauty industry with their no waste formulas...

THREE SHIPS

Three Ships is a sustainable skincare brand that is “on a mission to be the most transparent beauty brand in the world.” Using interactive maps on each product page on their website, Three

Ships give customers the opportunity to see exactly where their ingredients have come from.

What’s more, Dew Drops Mushroom Hyaluronic Acid + Vitamin C Serum is formulated with upcycled tree bark, a by-product of the Canadian lumber industry. This sustainable product is said to have anti-inflammatory properties and protection from excessive exposure to UV light rays.

UPCIRCLE

Founded with the idea of giving coffee grounds a new lease of life, UpCircle transformed an

estimated 350 tonnes of coffee waste into sustainable skincare.

The brand has since diversified into other waste streams including olive stones and date seeds. Now, they have an extensive range of skincare centred around upcycled ingredients.

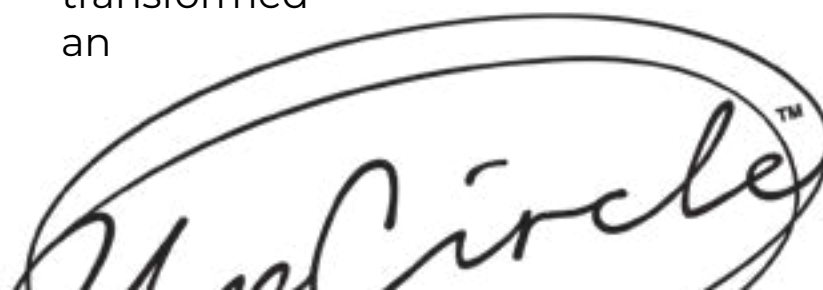
Launched in 2021, their Night Cream with Hyaluronic Acid and Niacinamide is made with antioxidant-rich upcycled blueberry extract; a by-product of the juicing industry that works to replenish tired skin overnight.

CIRCUMFERENCE

Circumference is a skincare brand that was founded on a

360-degree approach to sustainable beauty, with a **‘waste-not’ ingredient** sourcing initiative. The brand has partnered with independent agricultural producers to upcycle their by-products into luxury, highly bioactive skincare botanicals. This, in turn, helps to close the loop by taking what would usually be tossed out and ensuring it’s called back in.

Upcycled olive leaf extract is a key ingredient in their Daily Regenerative Gel Cleanser; the olive oil by-product is infused into the formula, helping to hydrate the skin. Any leftovers from this process are reintegrated into the residual farming soil as compost, fortifying the soil once more.



SPOTLIGHT ON

BYBI

GLOWCURRENT BOOSTER

“Glowcurrent Booster’s carbon footprint is negative because it is made using low-carbon ingredients and sequesters carbon throughout its supply chain from cradle to gate. It does not rely on or involve any carbon offsetting.”

BYBI

FORMULATIONS

UK based beauty brand BYBI recently launched Glowcurrent Booster; a powerful facial oil said to brighten, nourish and moisturise complexions.

The eco-focused brand are no strangers to upcycling, and feature upcycled ingredients in over 50% of their range. Many of their products are, again, sourced from by-products in the food industry. Examples include the Glowcurrent Booster derived from upcycled blackcurrant seed oil, Blueberry Booster derived from upcycled blueberry seed oil and Strawberry Booster derived from upcycled strawberry seed oil.

Claiming to be the ‘**world’s first carbon-negative skincare,**’ it’s no surprise that the Glowcurrent Booster has impressive sustainability credentials.

“Glowcurrent Booster’s carbon footprint is negative because it is made using low-carbon ingredients and sequesters carbon throughout its supply

chain from cradle to gate. It does not rely on or involve any carbon offsetting,” explained BYBI.

The booster is manufactured using 100% green energy with the negative carbon emissions relating to the whole supply chain, including its packaging.

Its new-to-market ‘Vivomer’ cap and nozzle are both **biodegradable** and compostable. It’s said to not emit greenhouse gases or leave behind any micro-plastics after the product’s end-of-life. In home compost, the cap breaks down within 52 weeks, being eliminated within three years.

Additionally, the bottle and carton are made from sugarcane; a carbon-negative material that is 100% recyclable and a great alternative to felling trees for traditional paper. ■

THE FUTURE OF FORMULATION

RISING DEMAND FOR BY-PRODUCT BEAUTY

Since our last report, upcycled ingredients have gained a lot of traction, with more beauty brands harnessing the power of plant-based by-products in their formulations, and upcycled ingredients being dubbed a key trend to watch out for in 2022.

With demand for upcycled beauty on the rise, ingredient manufacturers are continuing to innovate and expand their portfolios. The launch of upcycled functionals like Saponins+ are helping to bring the reality of entirely zero waste beauty products closer than ever.

In terms of demand, consumers are looking to do their bit when it comes to repurposing food waste. 95%

of consumers said that it was important to reduce food waste in their own lives, while 43% aimed to buy food and beverage products that use upcycled ingredients. Since consumers are already increasingly receptive to **diverting waste**, educating them about the powerful benefits of upcycling is the first step to raising awareness.

In order to educate people further, the Upcycled Food Association launched a certification in 2019 to help brands and consumers identify the upcycling credentials of a product and, in 2021, the certification programme was diversified to include cosmetic ingredients.

This has presented manufacturers and brands with the opportunity to verify their upcycled status by

adding an on-package mark to products, similar to other sustainability marks like the FSC forests symbol.

“Cutting food waste is the single most effective thing people can do to address climate change,” Turner Wyatt, CEO and Co-Founder of the Upcycled Food Association said. “Thanks to the roll-out of this set of clear, uniform standards and protocols, reducing food waste becomes much easier,” Wyatt said, adding: **“It’s an innovative approach because it’s the first consumer product-based solution, making it highly scalable and economically sustainable.”**

Currently, the vast majority of innovations in the upcycled beauty space are happening within indie brands. In line

with their mission to be a planet-first skincare brand, BYBI puts responsible ingredient sourcing at the forefront of business and creates products using over 70% upcycled ingredients.

But in order for change to be achieved on a mass scale, larger brands must step up and play their part by opting for more sustainable ingredients in their formulations. And there’s no time like the present.

Gen Z are adopting more sustainable behaviours than any other groups with 50% reducing how much they buy and 45% stopping purchasing certain brands because of ethical or sustainability concerns.⁷

BECOMING THE STANDARD

As demonstrated, upcycled ingredients have proven that they can outperform their counterparts. Raw materials should not only be consistent with the specification but be **standardised** with the same safety and efficacy levels as non-upcycled ingredients.

For example, Full Circle's Hemp NECTA® is a standardised upcycled active oil that is made from UK-sourced hemp seeds leftover from the food industry. The oil has 52% higher antioxidant capacity than conventional hemp seed oil and is a rich source of linoleic acid and vegan omega-3.

The upcycled ingredient manufacturer ensures consistency with their batches. They research their source and regularly test batches to offer customers peace of mind when formulating with their ingredients.

This is evidence that transitioning to upcycled ingredients needn't be risky. Brands have an immediate opportunity to champion sustainable ingredient

alternatives in their existing and future product lines without questioning consistency.

In order for a circular model to be effective, it requires cross-industry collaboration, creativity, and innovation. By embracing collaborative partnerships and employing smarter resource management, we can collectively reduce our footprint on the planet whilst inspiring others to follow suit.

COLLABORATING TO CLOSE THE LOOP

Food manufacturers are working with ingredient manufacturers to help tackle the waste crisis and transform by-products into high-performance cosmetic ingredients.

In 2021, Full Circle launched Gin TONIQ® – an ultra-hydrating water-soluble active born out of a partnership with Adnams. Over a century in the business, Adnams is a UK-based brewer dedicated to being 'zero to landfill'.

Full Circle transforms surplus locally grown grain ferment

– a by-product of Adnams' famous Copper House Gin – into a sustainable skincare ingredient for long-lasting hydration and moisturisation. The partnership means that for every bottle of gin produced, Full Circle can upcycle 4 litres of gin distillery leftovers – helping to close the loop and divert waste from landfill.

Pomarage™ is an anti-ageing active that is the result of another cross-industry collaboration between Provitol, cosmetic ingredient manufacturer and Mooma, a family-run, artisan supplier of cider. The ingredient is derived from a by-product of cider production called apple pomace – a mixture of apple flesh, seeds, and skin that is generally thrown away.

Another ingredient manufacturer diverting waste from landfill is Givaudan. Working in **collaboration** with Danish start-up company, Kaffee Beuno, Givaudan develops Koffee'Up™ – a coffee oil created by upcycling spent coffee grounds which is said to boost hydration to protect the skin barrier.

FORMULATIONS

TRANSPARENCY IS KEY

Consumers are becoming more interested in how ethical a company is and seek transparency in every aspect of the supply chain. In fact, Label Insight conducted a study and revealed that 73% of millennial responders were willing to pay more for a transparent product, while 97% want beauty brands to be more transparent about the ingredients in their products. Nielsen believes sourcing ingredients is the key to a transparent and traceable brand.

As the global climate crisis continues to escalate, consumers are looking to buy from brands that align with their ethical considerations.

94% of consumers said that they are more likely to be loyal to a brand that offers complete supply-chain transparency, while 39% say they're willing to switch to a more transparent brand.

In 2019, e-tailer Cult Beauty partnered with transparency software company Provenance to launch 'Cult Conscious'. This is a function that reassures customers by offering 'proof points' that verify product sustainability and ethical claims such as 'Cruelty-Free', **'100% Recycled'** and 'Supports Charity'.

Since it launched, Cult Beauty has added over 1,500 proof points across more than 70 different brands, including

REN Skincare, Paula's Choice and Glow Recipe. "This use of block-chain technology swings the status quo from over-sell and under-inform to educated and empowered," said Alexia Inge, the Founder of Cult Beauty.

Moreover, EM Cosmetics, founded by beauty guru turned entrepreneur, Michelle Phan, has partnered with Lolli, a Bitcoin rewards programme that allows customers to earn parts of Bitcoins called 'Satoshis' when they place an order. "The younger generation are hyper-conscious about what they want to buy, and they will boycott with their wallet if they don't agree with what a brand is doing," Phan said. ■

IT'S TIME TO LIFT THE LID ON INGREDIENTS

Recent developments in technology have presented the opportunity to offer transparency throughout the supply chain, with companies like SourceMap helping brands map out where their ingredients are sourced from and create transparency for the end buyer.

"It's not enough to claim that products are safe and sustainable: brands and manufacturers need to prove it. That means going beyond business-as-usual and engaging with suppliers to ensure responsible sourcing standards are being met," SourceMap said.

BYBI have developed their own internal auditing system called 'The Susty Score'. This grades the harvesting process, ingredients sourcing and transportation. The system also looks at upcycled ingredients from another supply chain, helping calculate an ingredient's carbon footprint and decipher what environmental impact it would have in a BYBI product.

From manufacturing to packaging, the scoring system factors in various data points to calculate the total carbon footprint of each product.

Section 2

PACKAGING & MATERIALS

91%

91% of consumers would prefer less packaging and 88% want to be able to refill their cosmetics.¹⁰

1/2

Over 50% of consumers are less likely to buy products in packaging that is harmful to the environment.

92%

92% of UK consumers now say minimalist, eco-friendly, or biodegradable packaging is important to them.¹¹

74%

74% of global consumers say they would pay more for sustainable packaging.¹²

THE REFILL REVOLUTION

To tackle packaging landfill, brands are reducing waste and reshaping the way they package and refill everyday personal items. But refill schemes come with their challenges and a shift in consumer behaviour is required to make them work. Here are some innovative ways brands are breaking down accessibility barriers and creating a refill experience that has minimal interruption to daily life.

RETURN & REUSE

Tesco launched its refill partnership with Loop in select UK stores in 2021, allowing customers to buy a wide range of food, drink, household, and

beauty items packaged in a refillable container, straight off the shelf. Once empty, the packaging can then be returned to the Loop Station, before being professionally cleaned and refilled at a facility, ready to be sold once again. Beauty brands currently taking part in the scheme include Molton Brown, Love Beauty and Planet, Nivea, Bulldog Skincare, REN, Simple, Radox, Carex, and Alberto Balsam.

For decades, The Body Shop has been looking for ways to empower customers to opt out of unnecessary packaging via refill schemes. Long before **refillable products** became popular, The Body Shop founder Anita Roddick encouraged customers to return their bottles to be reused, and in 1993 the company launched an official

in-store recycling program called 'Bring Back Our Bottle.'

"We actually had refills in our stores around 20 years ago, but at that time, the customer retail environment was changing towards people not wanting refills at all," Linda Campbell, The Body Shop Managing Director said.

"Everyone, at that time, was moving to plastics. Now, that conversation has evolved to the point that customer demands have come full circle. We're responding to demand not just from shoppers but from our own store teams and from the wider policy and culture piece too," she adds.

Hoping a new generation of consumers will adopt

the refill practice, the brand announced that they would be relaunching their refill stations across four hundred stores globally in 2021 - with plans to expand the program further in 2022.

Rose Pirate is a French start-up that is tapping into the sentimental side of beauty by giving a new lease of life to lipstick components that consumers are not ready to throw away.

The brand collects old lipstick cases and refills them with a 100% natural lip balm formula, then returns them to the consumer to be enjoyed once more. This refilling process can be repeated numerous times, helping to repurpose beauty packaging into something new.



PACKAGING

INFINITE LIFE CYCLES & LOWER EMISSIONS

Guided by the principles of a circular economy, KanKan is a personal care brand that has created daily essentials that can be recycled time and time again. Their 'Forever' bottle, designed to be refilled, is produced from sustainably sourced recyclable glass. Meanwhile, their soap refills are packaged in an aluminium can.

This presents customers with a refill system that is readily recyclable at home and has an almost infinite life cycle. In fact, 75% of all aluminium produced is still in productive use today. To take their sustainability initiative one step further, KanKan plants a tree for every refill sold.

Forgo is shaking up the refill concept (quite literally) with their **mix-it-yourself** hand wash. The Swedish brand offers a starter pack equipped with a glass bottle and pump, marked with a fill line. Making hand wash at home easy, consumers simply need to add the powder, dilute with water and shake.

To further reduce emissions, the refills are packaged in recyclable, compostable paper and shipped in an envelope that weighs next to nothing. This makes transport considerably more eco-friendly than a traditional hand wash due to the sizable weight reduction.

Haeckels is a Margate-based brand that combines design and sustainability. Their refillable aluminium deodorant case has a never-ending, **infinitely recyclable** life. Instead of buying the case to keep, customers rent it for as long as they need by placing a cash 'deposit'. The case can be refilled as many times as needed and once it's finished with, the customer simply returns the case to get their deposit back.

"The purpose of the deposit is to offer full responsibility for the product – closing the loop," Haeckels said.

In addition to eco-packaging, the natural deodorant utilises sustainably sourced mushroom and kelp extracts that work in tandem to fight the bacteria that is often associated with body odour. ■

“If refill designs were to be applied to all bottles in beauty and personal care (as well as home cleaning), packaging and transport savings alone would represent an 80–85% reduction in greenhouse gas emissions.”

The Ellen Macarthur Foundation



CREATIVE CONCEPTS

79% of the plastic waste from beauty packaging ends up in landfills, dumps, or the natural environment. If current levels of consumption continue, our oceans could contain more plastic than fish by 2050, warns the UN Environment Programme. While these statistics are sombre, to say the least, there are plenty of brands and creatives working towards a more sustainable future for packaging. Here are some innovative concepts and materials that are helping to divert waste from landfill.

UNIQUE MATERIALS & CONCEPTS

From bio-based polymers to popcorn polystyrene alternatives, these unique

materials and packaging concepts provide insight into what's possible when it comes to designing high-impact packaging solutions with minimal impact on the earth.

BIO-BASED

Globally recognised cosmetic packaging manufacturer, Baralan, has introduced a range of plastic alternatives in their Bio-based Packaging Series. This biopolymer is an **eco-friendly alternative** to synthetic polymers, helping to reduce the need for plastic production and ensuring full recyclability of the packaging.

"Our ability to design beautiful, functional packaging for our customers that is also renewably sourced represents a major step in reducing our environmental impact and creating positive

societal outcomes," Baralan said.

SUPER SEEDS

UK-based LoopEco is a botanical skincare brand which launched on Earth Day 2021. Their products are housed in sustainable plastic-free bottles and shipped in compostable boxes that are embedded with chrysanthemum seeds.

Once the box has served its purpose, consumers can plant and cover with soil, water often and watch the flowers bloom, creating new life out of what would typically be considered waste.

DISSOLVABLE PACKAGING

PLUS Body Wash sachets boast all the cleansing power of a traditional body wash

but with **zero plastic** and zero waste. The brand has the vision to create zero-trace products, and has even omitted water from their range, claiming that "every year in the U.S., 42.1 billion bottles are used to ship products that contain over 70% water".

The single-serve body cleansers lather up into a rich foam, while the outer packaging completely dissolves when exposed to water, resulting in a 100% biodegradable body cleanser.

In addition, the brand utilised their innovative dissolvable packaging to minimise waste at Christmas by creating a limited-edition gift-wrap that dissolves in contact with water.

POPCORN BY-PRODUCTS

From snacking to packing, popcorn has been given a new purpose. Researchers at the University of Gottingen have reimagined the snack to create an environmentally friendly alternative to polystyrene and plastic packaging. This upcycled plastic alternative is made from the inedible by-product of cornflakes and can be composted after use, leaving behind zero waste. The University has now signed a license with Nordgetreide, a German cereal manufacturer that specialise in premium milled products, for the commercial use of the process and products for the packaging sector.

UPCYCLED APPLE LEATHER

Beyond Leather are finding value in what others would consider waste through their creation of Leap™. They transform low-value apple pulp - a by-product of the cider industry - into a high-value luxury plant-based leather alternative. Made from 80% bio-based ingredients, Leap™ provides a sustainable, **more efficient**, upcycled and biodegradable replacement for traditional animal leather. "Thanks to our energy-efficient production, it takes us only 1 day to create Leap™ using 99% less water and ~85% less CO2* than traditional leather production while completely avoiding harmful substances," Beyond Leather said.

FOAM-BASED PLASTIC ALTERNATIVES

Zotefoams, a UK-based food packaging company, created ReZorce, a circular beverage packaging alternative to replace traditional plastic. ReZorce uses a multi-layer structure made of High-Density Polyethylene (HDPE), creating a foam layer to ensure the preservation of the beverage within. The company has stated that ReZorce foam could be used in other applications besides drink cartons, including pouches, tubes, and other structures, thus expanding the potential of ReZorce. Currently, the largest issue faced by ReZorce is the texture of the outer layer which is caused by the foam. Zotefoam is actively seeking a solution that would eliminate this minor issue.

PLANTABLE EYELINER

Sprout World is an eco-pencil brand that recently launched a **'world-first'** plantable eyeliner, developed without microplastics that are typically found in cosmetic pencils. Designed to be planted after use, the eyeliner contains a cellulose seed capsule at the end that can be placed in soil, watered frequently, and eventually transformed into bee-friendly wildflowers. While the eyeliner is housed in certified sustainably sourced wood, the cap is made from fully recyclable bioplastic to create an eco-friendlier alternative to a traditional eyeliner.

PACKAGING

CREATIVE COLLABORATIONS

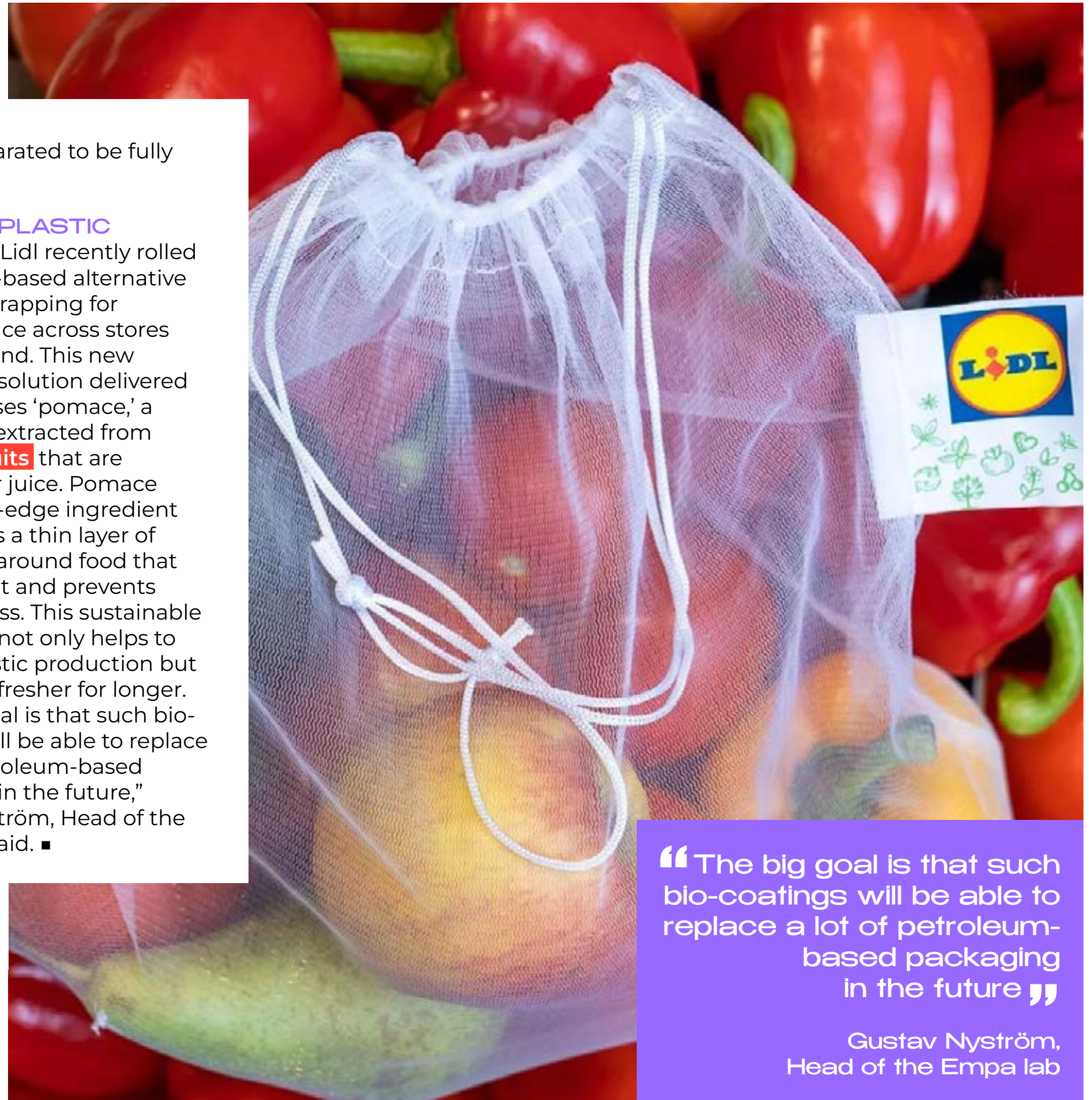
Eviosys, Grown.Bio and Verescence are three packaging manufacturers that have joined forces to collaborate on an environmentally-friendly gift pack, setting the tone for the future of packaging. While the outer metal tin, supplied by Eviosys, can be infinitely recycled, the packaging, manufactured by Grown.Bio, has been customised to accommodate a home-compostable insert derived from mycelium. The bottles are supplied by Verescence as part of CARA, the French glassmaker's new range of luxury glass for cosmetics. The glass bottles boast an innovative screw neck (GCM1 15 415) design that allows the top to unscrew and be easily refilled at home or in-store. What's more, the packaging



can be separated to be fully recycled.

POMACE PLASTIC

Food giant Lidl recently rolled out a plant-based alternative to plastic wrapping for fresh produce across stores in Switzerland. This new packaging solution delivered by Empa uses 'pomace,' a substance extracted from **leftover fruits** that are blended for juice. Pomace is a cutting-edge ingredient that creates a thin layer of protection around food that is safe to eat and prevents moisture loss. This sustainable alternative not only helps to reduce plastic production but keeps fruit fresher for longer. "The big goal is that such bio-coatings will be able to replace a lot of petroleum-based packaging in the future," Gustav Nyström, Head of the Empa lab said. ■



“The big goal is that such bio-coatings will be able to replace a lot of petroleum-based packaging in the future”

Gustav Nyström,
Head of the Empa lab

THE FUTURE OF PACKAGING

From biocontributing mycelium to 3D printing, here are some cutting-edge ideas to watch out for.

BEYOND BIODEGRADABLE

Instead of polluting the earth, 'biocontributing' packaging boosts biodiversity by adding nutrients to the soil as it breaks down. The eco-brand Haeckels' mycelium and seed paper packaging is a shining example of what **the future** of packaging could look like. After use, the mycelium box and the seed paper can be planted together, with the mycelium encouraging the seeds' growth, making the packaging, what Haeckels founder Dom Bridges describes as a "seed bomb."

West~Bourne, a New York-based food manufacturer,

has created compostable seed packaging for its line of foods. These packages - made of seed paper and soy-based ink - offer the same level of protection, insulation and texture as plastic while being entirely biodegradable. This means that instead of recycling or adding traditional plastics to landfill, the consumer can simply throw the seed package into a compost bin after use.

SUSTAINABLE BY DESIGN

In an effort to become more sustainable, brands are optimising their designs by giving a new lease of life to single-use packaging and cutting back on material wastage. For example, designer Javyn Solomon created a concept design for H&M's shopping bags that also doubles as a hanger. By

strategically folding up the bag, it transforms into a paper alternative to plastic hangers. This upcycling concept presents an opportunity to divert what is generally considered a single-use item from landfill and providing it with a new purpose.

Simply using **less material**, regardless of what that material is, can work wonders, too. London-based smartphone supplier, Raylo, re-engineered their packaging to reduce waste and ultimately, save money in the process (bonus!). Their boxes are optimised to house their products throughout the shipping process, creating a snug environment for the phones and eliminating the need for unnecessary additional materials.

The redesign resulted in a 21%

overall weight reduction as well as a 21% reduction in glue. The result? A more sustainable and cost-effective packaging solution.

TECH-LED SOLUTIONS

Forust is a wood-tech company that is helping to build a greener future through 3D printed wood. This technique can mimic the grain of almost any natural wood source. Created by upcycling sawdust, this sustainable way of woodworking allows designers to create complex features which would be difficult (if not impossible) to achieve with traditional woodworking methods. From everyday home goods to high-end architectural detailing, Forust caters to a wide variety of industries, offering a more sustainable and **cost-effective** solution to felling trees for wood-based products.



SUSTAINABILITY GOES BOLD

Sulapac is challenging the status-quo by creating bold, eco-friendly packaging. Their colourful, bio-based containers are capable of housing both oil-based and water-based cosmetics. In 2021, Sulapac partnered with Chanel on their N°1 de CHANEL line. Focused on sustainability, the caps made for the line's bottles are bio-based materials.

Many of Sulapac's packaging components are available in brightly coloured formats - a far cry from the muted earth tones and recyclable materials like cardboard that are often associated with sustainability.

Eco-packaging has come a long way, and the introduction of bolder, **more vibrant** sustainable options will help eco-minded brands stand out from the competition on retail shelves. Developments like this showcase that, in the future, we could potentially see environmentally friendly (and even upcycled) packaging created from materials that look and feel indistinguishable from their non-sustainable alternatives.

GOING NAKED

Solid formulations present an opportunity to go naked and ditch packaging altogether. Lush is an example of a **sustainability-driven** cosmetic brand that is truly championing naked products.

"My first invention was the shampoo bar in the late eighties. Since then we've taken the concept much further," Mo Constantine Product Inventor and Co-Founder said. Now, their all-year-round range boasts as much as 60% of naked products.

Another brand in the naked packaging space is SBTRCT, boasting a range of high-performance skincare that's completely plastic free. In 2022, SBTRCT launched the Vitamin C Booster Bar. Dubbed the 'world's first' solid vitamin C serum, the booster bar provides customers with the opportunity to switch from traditional plastic-housed serums to a naked alternative (without compromise on efficacy). SBTRCT also offers the option to purchase a bamboo pot perfectly sized to store the product. ■



**LOOKING FOR MORE
PACKAGING-FREE
INSPIRATION?**

Check out our kind2 brand spotlight

SPOTLIGHT ON

SAMPLES

It's clear that beauty samples are integral for sales and marketing, but their production comes at a cost to the environment. Sample packs are often made of plastic or mixed materials that are difficult to recycle and ultimately end up in landfill. With a few conscious changes, the future of beauty sampling could look like this...

COMPOSTABLE BEAUTY POUCHES

Proverb is a UK-born beauty brand that is committed to transitioning its entire range to sustainable packaging by 2023. Already, they have created a compostable beauty pouch that is capable of holding liquid formulas.

Currently being trialled to house skincare emulsions for

sampling, the compostable paper-based packaging is said to be the first of its kind; made from layers of paper and biofilm from wood pulp cellulose. These sachets are designed to be compostable at home, and with ambient temperatures, they turn back into water, CO₂, and biomass without ecotoxicity for the soil.

SMARTER SAMPLING SOLUTIONS

REN Clean Skincare and partner Tubex have created an eco-smart sampling pack that allows consumers to trial a product from a tube that is 100% recyclable. The innovative design eliminates the need for tamper seals or plastic caps, with every part of it made from recyclable aluminium - including the nozzle. In addition to offering full recyclability, the sample

pack increases the shelf life of the product due to its efficacy at blocking light. Meanwhile, the malleability of the soft metal material allows consumers to get every drop out of the product with ease – leading to less product wastage.

VIRTUAL TESTING

The ultimate zero waste way to try a product is by not physically trying it at all.

Augmented Reality (AR) is slowly but surely making its way into our everyday lives and now, beauty routines too! Sephora's virtual try-on experience allows shoppers to try out entire combinations of products without leaving their homes. What's more, skincare brands Olay and Clinique offer personalised recommendations following a facial scan that identifies

problem areas.

Another brand that has recently adopted the AR try-on experience is Sally Hansen, offering consumers the option to trial nail colours on a live, moving image of their own hand, creating a mess-free, convenient alternative to sampling the product.

Srijan, leaders in the AR scene, said: "All of this is made possible by several significant developments around facial recognition, feature tracking and computer vision. These combine to create the advanced AR applications that almost all global beauty brands are currently investing in." ■

Section 3

GREENER MANUFACTURING

70%

70% of carbon emissions attributable to the beauty industry could be eliminated if people used refillable containers.¹⁴

1/3

Over 1/3 of consumers rank skincare, haircare and makeup manufacturers 'most responsible' for protecting the environment.

1/3

Manufacturing processes currently use over 1/3 of the world's energy.¹⁵

£200bn

The UK's low carbon economy is now worth more than a staggering £200bn.¹⁶

CARBON CONSIDERATIONS

To meet the 1.5°C global warming target as set out in the Paris Agreement, we must become net-zero by 2050, emitting no more greenhouse gases than our ecosystems can safely absorb. What does achieving net-zero look like? Simply put, **net-zero** means cutting greenhouse gas emissions to as close to zero as possible, with any remaining emissions re-absorbed from the atmosphere, by oceans and forests for instance.

Many companies opt to offset these remaining emissions by planting trees to convert carbon dioxide into oxygen. Planting carbon-absorbing organic matter presents companies with the opportunity to become net-zero, or commonly known as carbon-neutral.

In order to meet these targets the beauty industry must join the fight against carbon.

To accomplish carbon neutrality, companies will need to consider all aspects of the supply chain – from manufacturing to transportation and everything in between. As it stands, there are many indie beauty brands that have already attained carbon-neutral status.

For example, Davines is a haircare brand that is on a mission to develop high-performance products without compromising the planet. The cult 'A Single Shampoo' is Davines first 100 per cent carbon neutral product. "All the CO2 emissions generated during the life cycle of A Single Shampoo - excluding the

use phase at home or in the salon - are offset," the brand claimed.

In addition, the electricity used in the offices and even the staffs' commute to work is offset to help further reduce Davines carbon footprint.

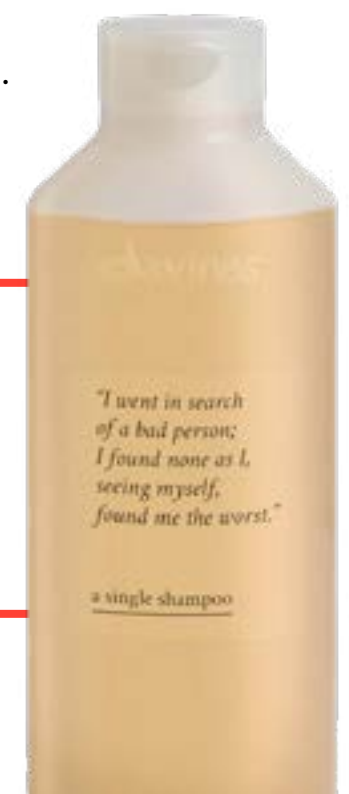
Other brands like BYBI are **going one step further** by working to achieve carbon negativity. BYBI offers complete transparency when it comes to their sustainability goals and practices on their website and social media channels.

They take a proactive approach to challenging carbon emissions by shedding light on their journey to carbon negativity with the public. In these communications, the brand

covers everything from where the ingredients are harvested right down to the energy source that the factories use to manufacture the packaging.

To verify this supply chain, the brand uses its very own internal auditing system called 'The Susty Score.' This is used to determine an ingredient's carbon footprint and decipher what impact using it in a BYBI product would have on the environment.

**100%
CARBON
NEUTRAL**





Climate Neutral is a non-profit organisation that is dedicated to eliminating carbon emissions; they give brands access to invaluable tools and networks that support them during their **decarbonisation** journey. In 2021, the non-profit partnered with beauty brands to measure, offset and cut emissions. Since the partnership, 28 health and beauty brands have been certified as Climate Neutral including Versed, The Moringa Project and Saie - to name a few!

“When a brand gets certified, it achieves zero net carbon emissions for all of the carbon it creates while making and delivering its products or services for a year. The Climate Neutral Certified label makes it easy for consumers to find certified brands,” Climate Neutral said, adding: “We

envision a world where all consumers have the ability to choose brands that take responsibility for their carbon emissions, and all brands have the tools to do so.”

B Corp is another organisation that is working to eliminate carbon emissions across businesses. The climate-focused corporation offers certifications that verify how “eco” a company truly is. Companies that have achieved **B Corp status** undergo rigorous scrutiny of their behaviour, products, and practises every three years. B Corp certified companies must prove their ethical commitments, not just to their customers but also to their employees and the community at large.

To date, there are around 3,000 companies spanning 150

industries and 70 countries that have achieved this highly regarded certification. In the beauty world, a few names who have made the grade include The Body Shop, Aesop, Ethique, Beauty Kitchen, and Sunday Riley.

To raise awareness of their mission while showcasing a few of their certified brands, B Corp launched a London-based pop-up shop in March 2022. The store features products from the likes of The Body Shop, Beauty Kitchen, and Little Soap Company. Despite the pop-up looking like an operational shop, no product was sold to maintain B Corp’s focus on purpose over profit. To take their sustainability efforts one step further, the shop was built using upcycled materials and all products were donated to The Felix Project. ■

CARBON NEUTRAL

This means that any CO² released into the atmosphere from a company’s activities is balanced by an equivalent amount being removed.

CLIMATE POSITIVE & CARBON NEGATIVE

These terms can be used interchangeably and are described as activity that goes beyond achieving net-zero carbon emissions to create an environmental benefit by removing additional CO² from the atmosphere.

CARBON POSITIVE

This is how organisations describe climate positive.

CLIMATE NEUTRAL

This refers to reducing all GHG beyond carbon to the point of zero while eliminating all other negative environmental impacts that an organisation may cause.

NET-ZERO CARBON EMISSIONS

This means that an activity releases net-zero carbon emissions into the atmosphere.

NET-ZERO EMISSIONS

This balances the whole amount of greenhouse gas (GHG) released and the amount removed from the atmosphere.

GOING GREEN

Factories are responsible for an estimated two-thirds of greenhouse gas emissions, with much of the emissions contributed to material choices, non-renewable energy, and excessive water usage.¹⁷

The manufacturing sector bears a particular responsibility, emitting an annual total of 880 million tons of carbon dioxide equivalents - making it one of the largest single emitters of greenhouse gases in Europe.¹⁸

From air pollution to water contamination, many industries release inorganic wastes into our ecosystems. In order to meet the net-zero target by 2050, companies must make greener choices.

Conscious consumers are paying closer attention to the working conditions, material inputs and waste disposal methods employed by

manufacturers, shifting their purchasing habits to align with their values and putting the onus on brands to do better.

WHAT IS GREENER MANUFACTURING?

In general, definitions of green manufacturing describe the environmentally responsible production of manufactured goods. Though, the definition of 'green' is continually being redefined as we navigate the current climate crisis. A concise way to describe green manufacturing was suggested at an expo in New York as "the creation of manufactured products that use processes that are non-polluting, **conserve energy** and natural resources, are economically sound, and safe for employees, communities and consumers."

Greener manufacturing and sustainable manufacturing are terms that are typically used interchangeably by the media. Other related terms to look out for include green technologies, green chemistry, zero waste and energy-efficient manufacturing. ■



GREEN MANUFACTURING IS...

“The creation of manufactured products that use processes that are non-polluting, conserve energy and natural resources, are economically sound, and safe for employees, communities and consumers.”

International Trade Administration (ITA)

SUSTAINABLE MANUFACTURING

According to the US Environmental Protection Agency, sustainable manufacturing can be defined as “the creation of manufactured products through economically-sound processes that minimise negative environmental impacts while conserving energy and natural resources.” In this section, we explore the benefits of greener manufacturing.

INPUTS

Inputs refers to the main input indicators (materials) that typically become part of a product. These include the quantity of non-renewable

materials used, restricted substances, and recycled or reused content.

NON-RENEWABLE MATERIALS

As we know, the supply of non-renewable materials is limited and, in some cases, it includes rare earth minerals. Using these materials in one product means there are fewer supplies available for other products. The production and delivery of such materials could also have an impact on the environment. Switching to **renewable alternatives** or tapping into waste streams are just a few ways in which we can omit these materials from the manufacturing process.

RESTRICTED SUBSTANCES

Other areas to consider is the use of restricted substances. These are described as materials that are known to be harmful to both people and the environment. Examples of this include harmful chemicals from plastic that can be ingested (primarily food and drink containers), as well as substances that can taint the environment when the product is discarded, like heavy metals in obsolete electronic devices. As ingredients are already regulated, these restrictions usually apply to packaging in the cosmetics industry.

RECYCLE & REUSE

When a product utilises more recycled or reused content, the need for non-renewable or **damaging materials** in the manufacturing process is reduced. This, in turn, mitigates the amount of material sent to landfills and the creation of new materials to be used specifically in the production process of products.

OPERATIONS

Energy, water, and waste are three key elements to take into account when it comes to greener manufacturing. Here are a few ways to help reduce carbon emissions in operations.

ENERGY

When it comes to manufacturing, energy-intensive processes such as directly using fossil fuels like coal in a blast furnace, or indirectly, by using electricity produced by fossil fuels can have great negative impacts on the environment.

According to Client Earth, 89% of global CO2 emissions come from fossil fuels and industry.¹⁹ Making the switch to renewable forms of energy such as solar or wind and implementing energy conservation measures can help reduce the

environmental impact caused by manufacturing.

WATER

Water is a **finite resource**, and this is especially true for certain parts of the world that have less access to treated water. For factories, if the local water supply is insecure, the amount used for manufacturing could threaten the local population's well-being. In addition, untreated water that is returned to the natural environment can contaminate water sources, including groundwater and surface sources like lakes and rivers. Waterless beauty presents an opportunity to create products that offer the same performance as water-based cosmetics without the addition of this scarce resource.

WASTE OUTPUT

Another factor to consider in

manufacturing operations is waste output. Waste can apply to many areas such as greenhouse gases, runoff water, material sent to landfill or to be recycled, and sewage waste - to name a few! Reducing waste output, where possible, is a way in which manufacturing can **go greener**. As mentioned earlier in the report, there is often value to be found in by-products and reusing waste materials in another supply chain. These methods can also help to increase a company's bottom line.

GOING GREENER, LITERALLY

Adding greenery to a manufacturing site can help to offset carbon emissions produced by the factory. When building new facilities, companies can work to preserve as much as the natural environment as

possible and add plant cover to create an 'artificial lung,' as the plants work to convert carbon dioxide into oxygen.

PRODUCTS

While the manufacturing process stops once the product has been created, the product life cycle continues and can go on to affect the environment for decades.

Considering how products will live on post-production helps towards reducing a company's overall carbon footprint. The disposal of the product can be as important as the use of recycled or upcycled materials used in manufacturing.

There are many sustainable packaging options on the market today that have very little environmental impact (and in some cases, a positive impact!) ■

GREEN BEAUTY

Today, many beauty brands are making moves towards a greener future. For example, Tropic is an eco-friendly skincare brand that runs their offices entirely using renewable energy. The company has not only offset carbon emissions but sent zero per cent of its waste to landfill in 2019 and 2020.

Founded in 2020, HIGHR Collective is an LA-born lipstick brand that chose to be carbon neutral from launch. “By tracking everything from the start, we were able to tell people how much one exact lipstick saves in terms of CO²,” explained Molly Hart, the Founder of HIGHR.

The lipsticks are created in a factory that runs entirely on renewable solar energy. The brand proudly offset all of their carbon emissions using a company called Native Energy.

Ethique is another example

of a beauty brand that is challenging emissions and working towards a greener future. The UK-based solid skincare brand achieved carbon negative status in 2021, offsetting 120% of their emissions.

Since the brand only sells **solid formulations**, their products are sustainable by their very nature. In fact, one of their shampoo bars is said to have just 8% of the carbon footprint when compared to liquid products in a plastic bottle. And, the brand doesn't stop there! Ethique's office is powered by 100% renewable energy and all staff travel is offset, with any staff air travel being offset twice.

THE FUTURE IS GREEN

To reap the benefits of greener manufacturing, sustainable material selection and ethical ingredient sourcing are all great places to start. As highlighted in our previous

sections, there are strong existing innovations that can be adopted by beauty brands looking to make greener choices and reduce emissions. From ingredients created with existing waste materials to packaging that gives back more to the environment than it takes – there are plenty of sustainable alternatives on the market today that will help reduce the production of carbon and get us one step closer to building a circular economy.

The Greener Manufacturing Show Europe presents **the latest innovations** for boosting your brands' sustainability efforts - whether that's inventive packaging solutions or the latest factory equipment. Dubbed a must-attend event for sustainable companies, events like this represent a shift in mentality, with more and more beauty brands looking to reduce their impact on climate change. ■

MANUFACTURING



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