MICROPLASTICS IN INDUSTRY

Identifying Risks & Opportunities for Action

PRESCOUTER

The issue of microplastics in the environment has sparked a discussion among stakeholders in various industries. It is clear that to promote both sustainable innovation and environmental safety, microplastic regulations must be refined and tailored to the unique needs of each sector.

Microplastics are non-biodegradable tiny plastic particles (<5 mm) that accumulate in the environment, harming living organisms (and potentially humans). Microplastics are divided into primary (intentionally manufactured) and secondary (resulting from larger plastic product breakdown) types. Industries such as packaging, cosmetics, textiles, and paints contribute to microplastic pollution, which accounted for 1.3 M metric tonnes (11% of total ocean plastic pollution) in 2016. It was estimated that, without intervention, the figure would more than double by 2040 to around 3 M metric tonnes.

Regulatory agencies are concerned about microplastic hazards, but their full impact on human health and the environment is not fully understood. Different actors prioritise different courses of action. In some cases, replacing microplastics can be technically straightforward and easily justifiable, yet substitutions could be more questionable, raise performance concerns, and cost more money.

The United States, Canada, Brazil, UK, Australia, and several European Union countries, have implemented strong mitigation measures for intentionally added microplastics in the **cosmetics industry**. However, industries such as **paint**, **tire**, **and textiles are still significant contributors to microplastic pollution**.

In this Intelligence Brief, we highlight the challenges plastic-intensive industries are facing and some strategies in place to tackle the microplastic crisis. We also provide a comprehensive overview of the regulatory landscape and touch on potential removal methods.

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Naveen Nair
Director of Engineering, Strategic Partnerships

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Vlad Zaitsev,
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The microplastic problem

Microplastics are a significant source of global plastic pollution. About 51 trillion particles of microplastics are floating on the surface of the ocean today.

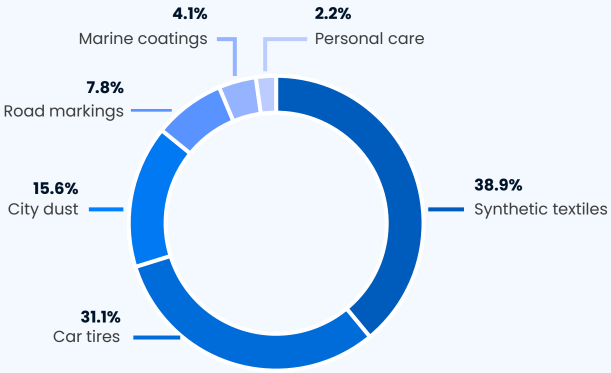
Microplastics are a category of plastic beads/fibers that can reach up to 5 millimeters (i.e., about the diameter of a standard pencil eraser) to 1 nanometer (i.e., only visible under a microscope).

Microplastics are considered an emerging persistent pollutant of diverse shapes, sizes, and chemical compositions and are found from Mount Everest to the deep sea and within wild animals and humans.

They are produced because of commercial product development as well as the breakdown of bigger plastics.

Microplastics, as a pollutant, can be hazardous to human and animal health. Microplastics have been found to accumulate in the bodies of organisms and can cause physical harm, as well as potentially release toxic chemicals into the environment.

THE SHARE OF ESTIMATED TOTAL MICROPLASTICS IN THE WORLD'S OCEANS AS OF 2022. Source: Statista.



Four sources of microplastics alone (synthetic textiles, car tires, personal care products, and plastic pellets) accounted for 1.3 M metric tonnes which represented 11% of total ocean plastic pollution. Without immediate changes, microplastic ocean pollution will reach 3M metric tonnes by 2040.

There are two classes of microplastics: Primary microplastics designed for commercial use, and secondary microplastics that result from the breakdown of larger plastic items.

PRIMARY MICROPLASTICS

Primary microplastics are manufactured as pellets, nurdles, industrial plastic powders, microfibers, and microbeads to be used in the production of cosmetics, toothpaste, pharmaceutical drugs, etc.

- Plastics pellets
- Plastic glitter
- Plastic Powder
- Microbeads
- Microfibers

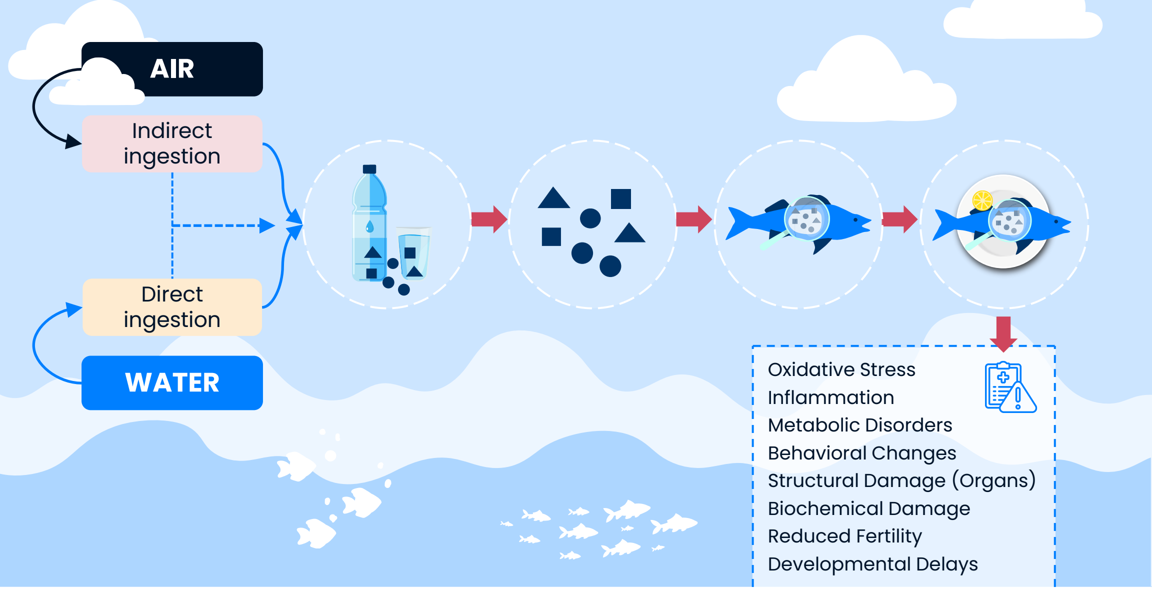
SECONDARY MICROPLASTICS

Secondary microplastics exist from the degradation of larger plastics (e.g., water and soda bottles, plastic bags, and other items) into smaller pieces under different chemical, physical, and biological conditions.

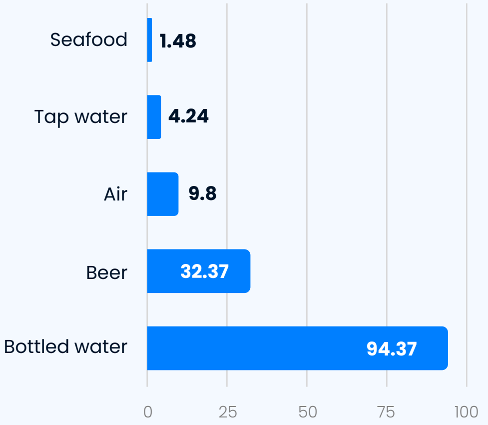
- Plastic Packaging
- Tire wear particles
- Synthetic textile
- Fishing gear - nets, lines, traps, etc.
- Tea bags

Both classes of microplastics can inadvertently be inhaled, drunk, and eaten causing physical harm to living organisms (including humans), and accumulate in the marine food web at all trophic levels.

SOURCES OF DIRECT AND INDIRECT INGESTION OF MICROPLASTICS AND POTENTIAL HEALTH EFFECTS ON LIVING ORGANISMS.
Source: modified from Australian Government and Wasser 3.0.



AVERAGE NUMBER OF MICROPLASTIC PARTICLES FOUND PER GRAM/LITER/M³ OF CONSUMABLES.
Source: University of Victoria, BC, Canada



And even worse, microplastics can act as carriers of persistent organic pollutants such as PFAS aka ‘forever chemicals’ and heavy metals, further exacerbating the forever chemical crisis.

Per- and polyfluoroalkyl substances (PFAS) are a group of artificial chemicals that were introduced in the 1940s and since then PFASs have been used in a broad range of consumer products and industrial applications. Their chemical and thermal resistant, hydrophobic, zwitterionic, and surface-active properties allow them to have a variety of applications.

Common PFAS are highly persistent in the environment, and at low concentrations (70 ng/L), PFAS cause development effects, cell cycle alteration, infertility, and cancer. PFAS can bioaccumulate in the body for up to 9 years!

PFAS can accumulate on the surface of microplastics, making them more persistent and potentially harmful to marine organisms that ingest them. Additionally, **microplastics can act as a vector for the transport of PFAS** across different environments, such as from water to sediment or from the ocean to the atmosphere.

RISKS FROM MICROPLASTICS AND PFAS TO HUMANS AND ECOSYSTEMS. Source: California Environmental Protection Agency

Features	Microplastics	PFAS
Persistence	Extreme	Extreme
Bioaccumulation	Low to unknown	Low to High
Toxicity	Moderate/Unknown	Extreme to Unknown
Mobility	Moderate	Extreme to Low
Diversity	>40,000 polymers	>6,300 compounds
Complexity	Extreme	High
Ubiquity	Extreme	Moderate
Data Gaps	High	Moderate

Here, we focus on 4 plastic-intensive industrial sectors.

Primary Microplastic Users:

Cosmetics

Up to **680 metric tons of microplastics from cosmetic products** are estimated to enter the marine environment annually.

Paint

Around **9.4M microplastic particles** per square kilometer are released into the air during ship painting activities.

Secondary Microplastic Users:

Packaging

Around **32% of the 78M metric tons of plastic packaging** produced annually ends up in the oceans.

Textiles

An estimated **16,000 metric tons of microplastic fibers** from synthetic textiles are released into European marine environments each year.

01

Microplastics in the cosmetics industry

The cosmetics industry has heavily relied on synthetic microplastic polymers or microbeads, which are added to cosmetics and personal care products.

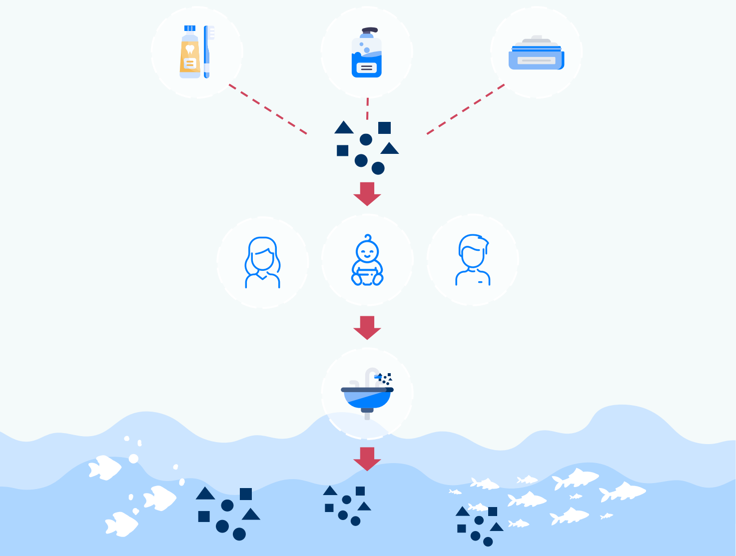
In Europe, about 3800 tonnes of microplastics are environmentally released due to the use of cosmetics and care products, only!

An assessment of 7,704 cosmetics and care products from 10 global popular brands indicated that 9 out of 10 products contain microplastics as part of their ingredients.

Despite their benefits in cosmetics, when these particles are washed down the drain, they can end up in waterways, **where they are ingested by fish and other marine creatures**, leading to potentially harmful effects on their health.

The European Commission requested that ECHA (European Chemical Agency) assess the use of intentionally added microplastic particles in cosmetic products. ECHA discovered that cosmetic companies used between 540 and 1120 tonnes of microplastics per year (and just for leave-on products).

AN "UNNOTICEABLE" WAY IN WHICH MICROPLASTICS ARE RELEASED INTO AQUATIC ECOSYSTEMS.
Source: beat themicrobead.org



In response to growing consumer demand for natural- and organic-based products, companies are switching to replace microplastic components with natural alternatives.

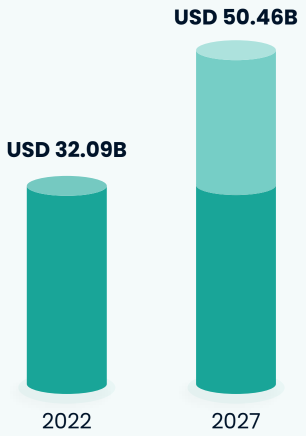
Many countries have banned microbeads in cosmetics products. Additionally, **companies have begun replacing microplastics with natural alternatives, such as seeds or rice**, which can provide the same exfoliating effect without harming the environment.

The global cosmetics market lies in third place as the fastest growth sector. In 2021, it was worth USD 287.94B, and is projected to reach USD 415.29B by 2028. This growth equates to a CAGR of 5% in the next seven years.

However, there is a growing consumer inclination toward the adoption of bio-based products, which are mainly due to rising health and environmental concerns. Both factors are expected to drive the future market for nature- and organic-based cosmetics to reach from USD 32.09B in 2022 to USD 50.46B by 2027 at 9.76% CAGR.

Millenial women are the main users of natural and organic beauty and personal care products, compared to women from any other generation. For example, three-quarters of millennials use natural and organic beauty products, compared to only 61% of Baby Boomers.

GLOBAL NATURE- AND ORGANIC-BASED COSMETICS MARKETS.
Source: Research and Markets.



Market forecast to grow at a CAGR of 9.5%

Examples of cosmetic companies that have started to replace microplastics with organic ingredients:

Lush

Lush uses natural ingredients like ground-up aduki beans, ground almonds, and sea salt as exfoliants in its products instead of microbeads.

Weleda

Weleda has stated that they do not use any added microplastics or silicones in their products. Weleda Birch Body Scrub, for instance, contains natural wax beads made of carnauba and beeswax.

02

Microplastics in the paint industry

Paint is the top source of microplastics globally. Plastic polymers are often used as additives in binders, fillers, and color pigments, making up to 37% of paint components.

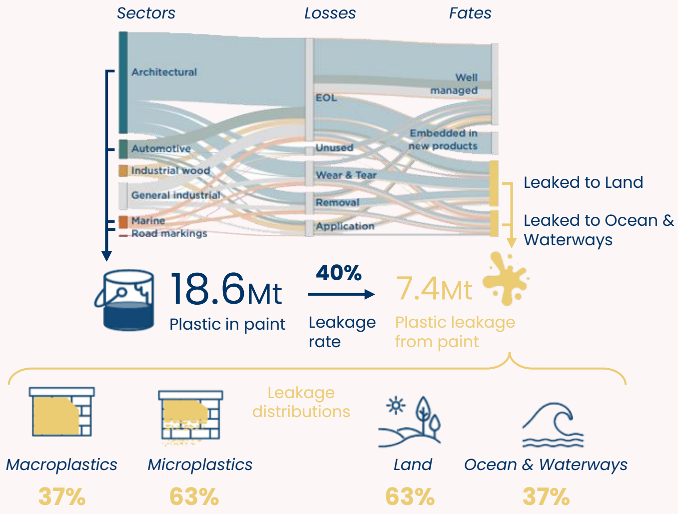
When paints are applied to surfaces, microplastics are released into the environment during application, wear & tear and removal, unused paint, or the end-of-life of the painted objects.

A new report has found that the total leakage from paint is estimated between 5.2 – 9.8 M tons/ year. Thus, paint is the largest source of microplastic leakage into the ocean and waterways compared to any other sources of microplastics (e.g. textiles, fibers, and tire dust).

Although the paint industry is aware that microplastics can harm the environment, it makes no active effort to cut back on its emissions. The rationale is that plastic polymers are necessary to make a paint layer that can cover and shield surfaces for a long period. Hence, emissions cannot be prevented.

Few plastic-free paint products are on the market, but these are not yet appropriate for multiple painting purposes.

THE FLOW OF PLASTIC IN PAINT FROM NET INPUT ON THE MARKET BY SECTOR TO THE OCEAN.
Source: Environmental Action.



The durability of paint products is a crucial factor that influences clients' purchasing decisions. Bio-based paints have yet to match the durability of traditional paints.

In 2021, the global paint and coatings industry was estimated to be valued at USD 160B. By 2029, this sector's market will surpass USD 235B.

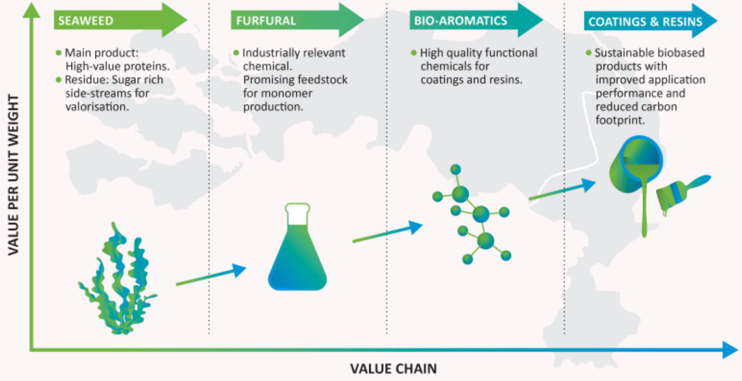
Newer paint companies have entered the market promoting the use of **bio-materials like cellulose, starch as binders, fillers, or other natural components**. However, the biobased and biodegradable paint and coating market is predominantly focused on producing products with lower or non-volatile organic compound emissions.

To a lesser extent, paint companies are producing products that do not contain intentionally added microplastics (e.g., Earthborn, Auro, Lakeland, etc.).

Most companies (e.g., Nordic Countries) are implementing strategies to reduce the release of microplastics during the manufacturing and application processes, by offering:

- ✓ improved durability of paint products (>12 years),
- ✓ continuous supporting extensive research efforts to find better substitutes of petroleum-based polymers and ingredients for bio-based alternatives,
- ✓ the addition of enzymes to plastics which accelerates the degradation of the plastics in the environment,
- ✓ and the production of mineral-based and self-healing paints, among others.

SEAWEED YIELDS HIGH-VALUE PROTEINS AND NON-EDIBLE SUGAR STREAMS, WHICH CAN BE CONVERTED INTO BIOBASED AROMATICS FOR COATINGS. Source: Zscore.



ZCORE: From Seaweed to Coating Resin Application

Examples of measures that some paint companies are taking to address microplastic pollution:

ECOS Paints

ECOS Paints produces non-toxic, eco-friendly paints using various natural materials, including cellulose, clay, and plant oils.

MIT

Biodegradable silk materials are being presented by researchers at MIT as an alternative to the use of microplastics to produce paint. Silk is recognized as safe for food or medical use, as it is non-toxic and degrades naturally in the body.

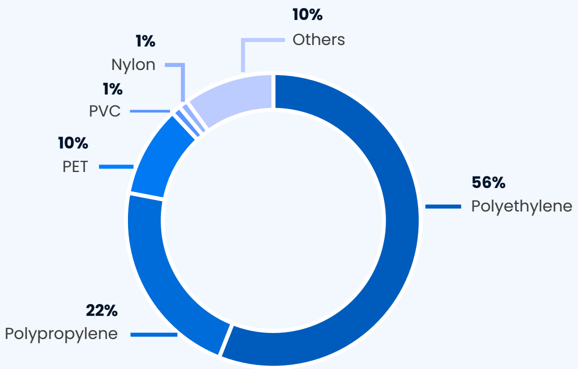
03

Microplastics in the packaging industry

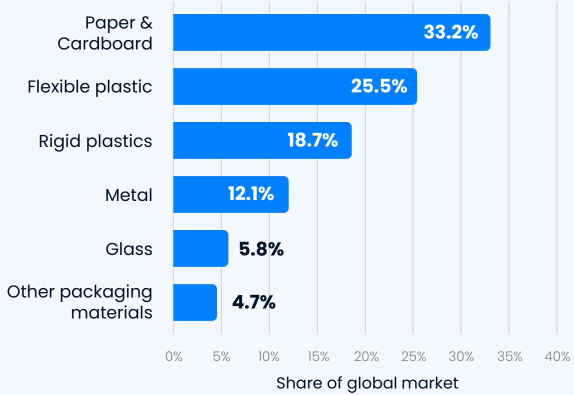
The packaging industry, a major source of secondary microplastics, depends on multi-thermoplastic resins to produce flexible and rigid plastics utilized for different packaging purposes.

Microplastics are a significant concern in the packaging sector, as **many packaging materials degrade overtime into smaller and smaller fragments** producing microplastics that are released into the environment during use, disposal, or recycling. These microplastics can come from a variety of sources, including plastic films, coatings, and additives.

GLOBAL PLASTIC PACKAGING MARKET AND THEIR DEPENDENCE ON THERMOPLASTICS.
Source: Plastic News.



GLOBAL DEMAND OF PACKAGING MATERIALS WITH PLASTICS (FLEXIBLE AND RIGID) MAKING UP TO 44% OF THE TOTAL VOLUME.
Source: Statista.



The global volume of plastic packaging poses a challenge for reducing microplastic pollution, but the rapidly growing market for biodegradable and compostable plastics offers a promising alternative.

The sheer volume of packaging plastic-based materials that are produced and used globally makes it difficult to implement large-scale solutions that can effectively reduce microplastic pollution.

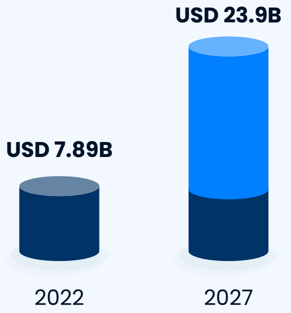
In 2021, the global plastic market was estimated to be worth USD 109B. Polyethylene had the highest market revenue share in 2021, accounting for more than 25 % of total demand.

Polyethylene is primarily used in the packaging industry and experienced a rising demand for packaged food, trays, milk and fruit juice bottles, crates, food packaging caps, drums, and other liquid food packaging during COVID-19.

Lately, biodegradable and compostable plastics are emerging as an alternative to plastics. Biodegradable are derived from natural sugars, vegetable fats, cellulose, plant starch, and waste oils. New R&D indicates the potential use of seaweeds and insects that can also be used to make bio-polymers.

The market for biodegradable and compostable was estimated at USD 7.89B in 2022 and is projected to reach up to USD 23.9B by 2027.

GLOBAL BIODEGRADABLE AND COMPOSTABLE PLASTIC MARKET FORECASTED BY 2027.
Source: Research and Markets.



Market forecast to grow at a CAGR of 9.5%

Examples of measures that can be taken at different stages of the packaging lifecycle to address microplastics:

UPSTREAM MEASURES

These involve changes to the design, material selection, and manufacturing processes of packaging materials.
For example, **Nestle recently launched a range of YES! snack bars in a new wrapper made from paper and a coating of a biodegradable polymer**.

DOWNSTREAM MEASURES

These involve changes to the disposal, recycling, or recovery of packaging materials to prevent the release of microplastics into the environment.
For example, **Filtrol produces washing machine filters that can capture up to 90% of microfibers released during the laundry cycle**.

04

Microplastics in the textile industry

Polyester is the main plastic utilized in the textile industry degrading later into polluting microfibers.

Microfibers (**tiny threads of plastics**, including elastane, nylon, and acrylic) are released throughout the life cycle of textiles, **including during production**, **usage**, **washing**, **and disposal**.

The production of polyester, a plastic-based synthetic textile, increased nearly by 900% between 1980 and 2014. In 2021, global polyester fiber production stood at 60.53M metric tons.

The European Environment Agency estimates that 8% of European microplastics released to oceans come from polyester textiles, and globally these proportions reach between 16 - 35%.

In total, between 200,000 - 500,000 tons/year of microplastics originate from textiles, which end up in the marine environments and other waterways.

Fast fashion accounts for high levels of such releases because fast fashion garments are used for a short time and tend to wear out quickly due to their low quality.

MICROSCOPIC PLASTIC FIBERS RELEASED BY LAUNDRY.
Source: Planetcare.

60% of textiles today are made from plastic fibers.

700,000 plastic microfibers get released during an average load of laundry.

Microplastic has been found in our food and drinking water.

An average 6 kg load of laundry releases more than 700,000 microscopic plastic fibers into wastewater. Plastic fibers come from synthetic textiles like polyester.

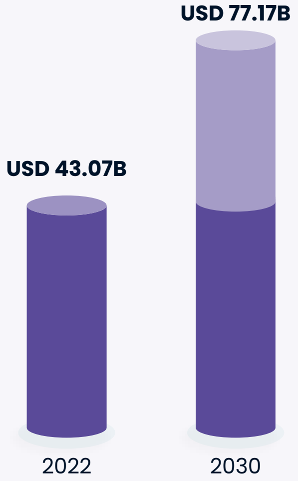
The textile industry is also experiencing a revolutionary change utilizing more certified natural components that can replace the use of microfibers.

In response, many brands are using **recycled textiles** as a "sustainable" alternative to address the environmental impact of microfibers. However, despite being recycled, microfibers are still shed from these products. In contrast, **bio-based fibers** and **biodegradable synthetic fibers** have been launched to the market.

The global market size for eco-fibers (i.e., bio-based alternatives such as organic cotton, hemp, and other sources of eco fibers) was estimated at USD 44.95B in 2023 with a revenue forecast in 2030 of USD 77.17B.

The market is anticipated to be driven by the rising popularity of organic materials. Textile industries are increasingly opting for organic fibers because their production does not pollute surface water, soil, or air compared to the use of synthetic fibers.

GLOBAL ECO FIBER MARKET.
Source: Research and Markets.



Market forecast to grow at a CAGR of 7.6%

Examples of textile companies replacing synthetic microfibers with natural components:

Kintra Fibers

Kintra Fibers in partnership with PANGAIA have announced the development of a 100% bio-based fiber from corn and wheat to replace their non-degradable counterparts

Ananas Anam & Bananatex

Ananas Anam and Bananatex are two companies that produce organic fabrics from pineapple and banana fibers

EXPERT Insights

Bernard Lebelle

CEO The Green Link, AI-enhanced Sustainability Strategy Management & Reporting Portal

Bernard Lebelle is the CEO of The Green Link, a Sustainability Software Editor, providing companies that want to improve their environmental footprint with an AI-enhanced, sustainability-focused strategy management portal with libraries of over 6,000+ proven solutions (best-practices, cleantechs, alternative materials..).

An ex-member of Deloitte's Global Innovation Executive Committee, Bernard is a senior innovation leader with over 25+ years of international experience and a member of the Expert Network of the World Economic Forum.

What are some of the key challenges that businesses face when trying to implement sustainable solutions to address microplastic pollution?

The first challenge for companies will be to address questions such as, where are we? What is the plastic pollution we're generating? And then, can we know anything about where that pollution is coming from? So how much do you know about the suppliers? Do you have full traceability of the components? How do I start?

Does the company need to go back to the drawing board, think design, think marketing, think procurement, and sometimes even production? So going back to the drawing board is tough for companies because sometimes they have stranded assets.

Businesses may have already invested in equipment and materials that are not sustainable and may be hesitant to take a financial loss by replacing them with more sustainable options. There may also be a lack of awareness among designers about the latest advances in sustainable materials.

These challenges apply to both B2C and B2B practices.

To address these challenges, businesses may need to prioritize sustainability in their decision-making, be willing to make financial investments in sustainable solutions and work towards greater traceability and transparency in their supply chains.

> **The first challenge is understanding where the company stands regarding the plastic pollution they are making and then understanding the same from their value chain. There is a financial component to transitioning to more sustainable production, which may require companies to make difficult decisions.**

What are the potential impacts of microplastics on B2B practices, and how should people start thinking about it?

The potential impacts of microplastics on B2B practices could be significant. For example, if a company is using products or materials that contain microplastics, it could face reputational risks if these microplastics end up in the environment and contribute to pollution or harm to wildlife. This could result in a loss of customers and revenue. Additionally, companies may face regulatory risks if new regulations are introduced that limit or ban microplastics.

To start thinking about the impacts of microplastics on B2B practices, companies should first assess whether they are using any products or materials that contain microplastics. This could involve reviewing supplier contracts, product specifications, and material safety data sheets. Once a company has identified any potential sources of microplastics, it can then explore more environmentally friendly alternatives.

Companies may also consider how they communicate about using microplastics to customers, investors, and other stakeholders.

This could involve developing a clear policy on microplastics and sustainability and being transparent about any efforts to reduce or eliminate their use.

Companies should start thinking about the potential impacts of microplastics on B2B practices by taking a proactive approach to sustainability and environmental responsibility.

> **By identifying and addressing potential risks associated with microplastics, companies can protect their reputation and revenue and contribute to a more sustainable future.**

How open are companies to making a complete switch - for example, to completely changing to another supplier or are they more likely to start working slowly with alternative suppliers?

The willingness of companies to make a complete switch varies and depends on various factors. For example, some companies may start working slowly with alternative suppliers to test the waters, while others may make a complete switch if they have the necessary resources, commitment, and understanding of the benefits of the switch.

However, several conditions need to be met to achieve this, such as having the C-suite understand the need for change, securing funds, gaining shareholder support, and educating the employees about the new approach. Additionally, it may be necessary to retool the team, seek external help, and consider alternatives from other industries to find the best solutions.

While only a few companies are willing to make significant changes, some, such as Ikea, Novo Nordisk, and Lego, are taking the lead in embracing alternate solutions supporting new suppliers to scale their productions.

Any new alternative material will have a high initial cost of production. The ability to create a larger material volume always helps drive production costs down. But that requires funding which is always a struggle for startups.

So if companies truly want alternative materials and suppliers, they need to create the demand for it and pre-order a large volume to kickstart scaling the production process.

That's what Apple did in 2018 when they placed an order from Alcoa Corporation and Rio Tinto Aluminum for the 1st batch of aluminum created via a new carbon-free smelting process.

> **98% of the time suppliers will go into incremental improvements, because that's the linear thinking of the 20th century.**

How might avoiding microplastics impact further up in the value chain and are suppliers of microplastics thinking of what they can do in order to stop supplying such products, but maybe switch to something else?

The drive to avoid microplastics in industries such as textiles and cosmetics will further impact the value chain.

Suppliers of microplastics may need to switch to alternative materials. However, the ability to make such changes depends on the size and budget of the supplier and their ability to support their upper supply chain.

To encourage suppliers to make changes, contractual pressure from procurement can be applied. However, this may only lead to incremental improvement as suppliers might not be willing to rock the boat too much and undergo a massive transformation.

Companies, therefore, need to adopt a broader mindset and consider alternative procurement supplies that they were not previously aware of. This means rethinking sourcing and casting a wider net to identify newcomers.

Another element that will play a key role will be stricter regulations. While no global consensus has yet been reached on harmful chemicals like PFAS (per- and polyfluoroalkyl substances also known as “forever chemicals”), it is just a matter of time before new regulation kicks in.

These new regulations will give no other options to current suppliers but to rethink their operations.

> **A broader mindset is needed to tackle the microplastic problem in industries.**

What is the process for finding the balance between profitability and sustainability commitments?

Finding the value beyond the balance sheet in business transformation.

When considering a sustained transformation in a business, it is important to take into account the value created beyond just the financial balance sheet.

It is challenging to amortize the previous investments and write them off as a loss, especially for companies with heavy equipment and investments in construction or heavy maintenance.

This could significantly impact the profitability perspective and require a lot of explanation to shareholders, particularly for publicly quoted companies.

Family-owned businesses tend to have a long-term perspective on investments due to their role as stewards for future generations. This makes it easier for them to take extraordinary action to survive a crisis.

Publicly-listed companies, however, face more pressure to prioritize short-term profitability due to quarterly reports and financial analyses.

As a result, it can be challenging for publicly listed companies to justify ditching significant investments made in the past.

Transforming sustainability into profit.

Becoming more sustainable can create value for businesses, including increased brand value, attracting new customers, and the potential to charge higher prices for eco-friendly products or services.

By transforming sustainability efforts into pricing and additional margins, businesses can create significant value from a direct top-line to bottom-line perspective.

What is the process for finding the balance between profitability and sustainability commitments?

Finding the hidden costs and benefits of attracting and retaining talent.

When considering the benefits of becoming more sustainable, it's important to consider the hidden costs of attracting and retaining talent.

Many people, particularly from Gen X to Gen Z, are leaving companies that are not environmentally friendly. As a result, HR costs associated with retaining or recruiting employees can be significant.

By embracing sustainability, companies can attract and retain new talent, reducing costs associated with recruitment, training, and turnover.

This creates internal value by building brand equity and employee satisfaction. Going green can help companies reduce straight operating costs and create a more positive work environment, benefiting both the company and its employees.

Accessing greener funds.

Becoming greener has not only environmental benefits but also financial advantages. By adopting sustainable practices, businesses can gain access to greener funds and enjoy better interest rates.

French banks have introduced specific loans backed by a company's environmental footprint, offering lower interest rates if the company can demonstrate a reduction in their CO_2 emissions.

This financial benefit is just one aspect of the value created by going green. Adopting sustainable practices can also enhance a company's brand, attract new talent, and retain existing staff, and can attract long-term shareholders who believe in a company's commitment to sustainability.

These factors can contribute to significant value creation not fully captured on a company's annual profit and loss sheet.

What is the process for finding the balance between profitability and sustainability commitments?

Defending sustainable decisions in the C-suite.

Defending sustainable decisions is crucial when making commitments in the C-suite, even if it means abandoning a multi-million dollar investment. However, looking at it solely from a financial perspective can cause companies to miss out on potential avenues for recycling, upcycling, and a circular economy.

Machinery and its components can still be recycled, even if it means dismantling it. By doing so, scarce resources such as copper, gold, and lithium can be repurposed, and money can still be made.

Linear thinking in the financial community fails to account for the maturity of investments and the potential for circular economic practices.

Considering the broader impacts of financial decisions beyond immediate financial gains or losses is important.

Overall, there are no good reasons not to embrace sustainability. At The Green Link, we believe companies that decide not to change won't be in business by the end of the decade. The pressure is mounting for every company, from customers, employees, shareholders, and regulators.

Profitability derives from being "in business," and when sustainability becomes the primary criteria to have a "license to operate," those who have not embraced it early enough will struggle to survive.

> **Creating value should go beyond finances. Sustained transformation through brand equity, employee satisfaction, and green funds can add hidden value. Sustainable practices attract long-term shareholders and create additional margins. Looking only at finances offers only a limited perspective.**

Do you see technologies such as blockchain or AI playing a role in solving (or reducing) the microplastic problem?

While an Ethereum-like blockchain with low environmental impact could be useful, I am more inclined to bet on AI being more helpful on environmental issues.

AI can play a key role in many different ways, ranging from mitigation (with the ability to predict where patches of microplastics at sea might migrate based on weather patterns, ocean currents, and other environmental factors) to support in designing new materials or molecules that could biodegrade using machine-learning approaches.

Blockchain is essentially just a recording mechanism that enables accountability and accuracy, but it doesn't necessarily change anything regarding microplastic reduction or prevention.

We need actions that can move the needle, even if it's just by one inch, and create real traction by changing how we produce and consume. Of course, 100% data accuracy is not the most important thing; we must focus on creating a positive impact and driving change.

> **Blockchain may enable accountability and accuracy, but to create real change in sustainability, we need to focus on actions that can move the needle and drastically change how we produce and consume.**

Cross-industry strategies and initiatives to reduce microplastics

Green strategies offer several potential benefits. Industries that are plastic-dependent can identify and adapt strategies that align best with their sustainability goals.

- **Product redesigning** (to **reduce** the amount of plastic used, extend product life, and allow repair and **reuse**).
- **Recyclability and Recovery** support as a sustainable long-term solution (helps the plastic waste management).
- Ban certain types of **single-use plastics**.
- Improve **wastewater treatment** technologies.
- Develop **new bioplastics** and **compostable products**.
- Establish and comply to a **maximum microplastic releasing limit** for each source (tires, cosmetics, cigarettes, textiles, packaging, etc.).
- **Leaking prevention** by applying best practice handling rules and regular staff training.

Numerous companies are committing to reduce, recycle, and eliminate the use of plastics, and hence microplastics from their different commercial activities.

Cosmetics

Estee Lauder, which is already zero waste to landfills since 2003, is now committed to making its packaging recyclable, refillable, reusable, recycled, or recoverable by 2025.

Unilever 2025 plans are to eliminate non essential plastic packaging, replace single-use plastics by reusable ones, and make 100% of its plastic packaging reusable, recyclable, or compostable.

Ethique, since 2012, has replaced its liquid products to solid (bars) packaged in cardboard boxes, so it aims to keep preventing up to 10 million bottles, jars, and tubes from being made by 2025.

Textiles

prAna goal is for 100% of its products to be made with preferred fibers (organic, recycled, cellulose fibers, hemp and materials by 2025. The company has committed 80% of materials to be bluesign® approved by 2030.

Ralph Lauren is working towards making all packaging materials recyclable, reusable, or sustainably sourced and achieving 100% sustainably sourced key materials by 2025.

Banana Republic will reach by 2023 its commitment of using 50% more sustainable fibers which includes the upcycling post-consumer bottle into garments.

Numerous companies are committing to reduce, recycle, and eliminate the use of plastics, and hence microplastics from their different commercial activities.

Food industry

Sierra Nevada has a wastewater treatment plant that removes 95% of the organic material before municipal processing. SN also sends its byproducts to livestock farms.

McDonald's has decided to make 100% of its packaging utilizing materials that come from renewable, recycled, or certified sustainable sources by 2026.

Starbucks will let its customers use their personal reusable cups for drive-thru and mobile orders in the United States and Canada by 2023.

ASDA has committed to removing 3 billion pieces of plastic from their own-brand products making them recyclable by 2025.

General Mills plans to make all its brands packaging 100% recyclable or reusable by 2030.

Evian is planning on changing all its plastic bottles to recyclable plastic by 2025.

Whole Foods plans on placing reusable containers, cloth produce bags, and reusable grocery bags next to non-reusable alternatives.

Numerous companies are committing to reduce, recycle, and eliminate the use of plastics, and hence microplastics from their different commercial activities.

Air transportation sector

American Airlines is banning plastic straws and stirrers on its flights and offering reusable bags to pack up to-go orders.

United Airlines since 2019 has banned plastic straws and cocktail picks on its flights.

Delta has banned single-use plastic bottles and cups, and its blankets and pillows are made of bamboo-based materials.

Entertainment

SeaWorld, in all its 12 theme parks, has eliminated single-use plastic straws and bags.

Walt Disney plans on making all plastic products and packaging that the company uses with at least 30% of recycled content by 2030. It has also committed to using recycled, sustainably sourced, or lower-impact alternative content in textiles.

Tech

Microsoft plans on eliminating single-use plastics in its packaging, by 2025, including plastic films, its primary product, and IT asset packaging.

Numerous companies are committing to reduce, recycle, and eliminate the use of plastics, and hence microplastics from their different commercial activities.

Chemicals

Sabic has recently launched a recyclable resin product made with ocean-bound plastic waste.

Dow plans on collecting, reusing, or recycling 1 million metric tons through its direct actions and partnerships by 2030. There is also investment in technologies to increase their recycling capacities worldwide.

BASF has a Chemcycling™ program that turns waste plastics into valuable resources, solutions in biodegradable materials, and organic recycling processes.

Others

Method Clean Happy is making all their hand wash, dish soap, and spray cleaners, 1-PET plastic bottles, from 100% post-consumer resin.

Terracycle, since 2019, has implemented a circular delivery service that allows consumers to buy items using reusable containers.

PRESCOUTER

Looking ahead:
The regulatory landscape for microplastics

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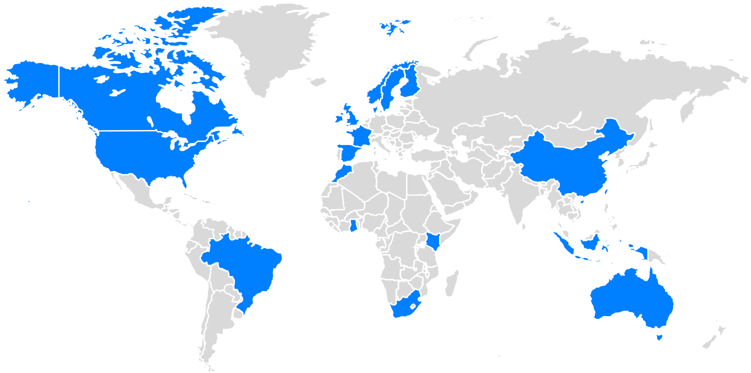
The regulatory landscape for microplastics



2014

South Africa delegates plastic management responsibilities to producers.

2015

Morocco bans use of plastic bags.

2016

Microplastics, in the **Nordic region**, is regulated by the The Nordic Council of Ministers. Cosmetics are required to be *Eco Labelled*.

2017

England banned on microbeads in rinse-off personal care products.

2018

US banned the manufacturing and selling of cosmetics containing microbeads.

Brazil banned the use of plastic microparticles in cosmetics and single use plastics.

2019

Ireland banned the sale, manufacture, import and export of microplastics-based products.

Canada banned the manufacture and import of all microbeads-based toiletries.

Australia launched a National Plastics Plan to reduce plastic waste and pollution.

2020

Ghana has adopted a circular economy-based management policy to plastics.

2021

China banned production and sales of cosmetic rinse-off products and any daily chemical product containing microbead <5 mm.

Singapore developed a comprehensive waste management system to address microplastics in water.

Philippines passed a series of bills to reduce the use of plastics and microplastics.

2022

Spain issues new regulations to promote plastic packaging recycling and added microplastics.

EU restricts the use of microplastics in cosmetics, cleaning products, pesticides, and sport fields.

2023

2024

2025

By 2025, **France** will require all new washing machines to have microfiber filters.

New policies that address microplastics pollution have been or are being developed. Regulations already in place that target specific subsets of microplastics can be found across the Americas, Europe, Asia, and Africa.

U.S.

U.S. Act also applies to products that are cosmetics and “over-the-counter" drugs, such as toothpastes.

In 2015, the US Congress passed the Microbead-Free Waters Act, which banned the manufacture and sale of rinse-off cosmetic products containing microbeads. The ban came into effect in 2018.

Canada

In Canada, the use of, manufacture, import, and sale of toiletries with microplastics used to exfoliate or cleanse is not allowed.

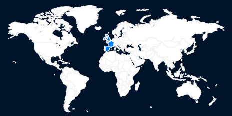
In 2019, The Government of Canada banned the manufacture and import of all toiletries that contain plastic microbeads. The ban also includes all sales of microbeads-based toiletries.

Brazil

Brazil is the only South American country with a bill that bans microplastics in the production of cosmetic products.

The Brazilian Senate has proposed bill no. 263/2018 regarding the prohibition of plastic microparticles in the composition of cosmetic products and single-use plastic manufacturing, importation, distribution, and marketing.

New policies that address microplastics pollution have been or are being developed. Regulations already in place that target specific subsets of microplastics can be found across the Americas, Europe, Asia, and Africa.



France

France is gradually banning the use of intentionally added microplastics.

By January 1, 2024, France will ban the sale of medical devices containing microplastics. At the start of 2025, the country will require that all new washing machines have a device to filter out plastic microfibers.

Spain

Spain issues new regulations to promote plastic packaging recycling.

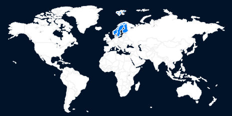
On March 31, 2022, Spanish Parliament passed the Law 7/2022 on waste and contaminated soil for a circular economy, banning the use of phthalates and bisphenol A in food packaging, supporting the reusability of food packaging. This law also includes the ban of added microplastics (<5 mm).

UK

To tackle plastic pollution, England has introduced a ban on microbeads in rinse-off personal care products.

In 2017, England proposed the Environmental Protection (Microbeads) (England) Regulations 2017. These regulations ban the manufacture and sale of rinse-off personal care products containing microbeads. The regulations apply only to England and Wales. Moreover, England has tackled plastic pollution by introducing a plastic packaging tax on packaging that contains less than 30% recycled plastic and measures to restrict the supply of plastic straws, plastic drink stirrers, and plastic-stemmed cotton buds.

New policies that address microplastics pollution have been or are being developed. Regulations already in place that target specific subsets of microplastics can be found across the Americas, Europe, Asia, and Africa.



Europe

Europe restricts the use of synthetic polymer microplastics in cosmetics, cleaning products, pesticides, and sport fields.

In 2022, the European Commission released a draft proposal to restrict intentionally added microplastics. The restriction comprised microplastics (>5 mm) and microfibers (> 15 mm) used in products on intention and may result in environmental release.

Ireland

The sale, manufacture, import, and export of products containing microplastics are banned in Ireland.

Ireland is now regulated by the Microbeads (Prohibition) Act 2019. Plastic microbeads that are used in soaps, shower gels, and facial scrubs to exfoliate the skin, toothpaste, and abrasive cleaners are banned. The Act also prohibits the disposal of any substance containing microbeads by pouring it down the drain or into marine or freshwater environments.

Nordic Ecolabelling

The Nordic Council

Microplastics, in the Nordic region, is regulated by the The Nordic Council of Ministers which determine the rules for the Nordic Eco-labeling of Products.

Denmark, Iceland, Norway, Sweden, and Finland use cosmetics ecolabel as a sign of the prohibition of microplastics in the products or their raw materials. The eco-labeling is part of the Nordic Swan Ecolabel initiative introduced by the Nordic Council of Ministers.

New policies that address microplastics pollution have been or are being developed. Regulations already in place that target specific subsets of microplastics can be found across the Americas, Europe, Asia, and Africa.

Australia

Australia has launched a National Plastics Plan to reduce plastic waste and pollution.

In 2019, Australia phased out the use of microbeads in rinse-off cosmetics, personal care, and cleaning products. By 2030, the country will work with the textile and white goods sectors on an industry-led phase-in of microfiber filters on new residential and commercial washing machines.

Singapore

Singapore has developed a comprehensive waste management system that addresses microplastics water pollution.

To address the issue of marine plastic litter and microplastics, Singapore has in place stringent legislation and regulations on pollution control and waste management and a comprehensive waste and water management system to minimize waste at source and prevent the discharge of litter into the sea.

China

China has banned the production and sales of cosmetic rinse-off products and any daily chemical product containing microbead <5 mm.

China has taken several measures to address plastic pollution, such as prohibiting the distribution of free plastic bags, a ban on microbeads in personal care items, and implementing Extended Producer Responsibility (EPR) regulations, among other initiatives. The China National Development and Reform Commission issued a Catalogue of Plastics Products Prohibited or Restricted from Production, Sale, and Use for public consultation.

Philippines

The Philippines is proposing a series of bills to reduce the use of plastics and microplastics.

Responsible for 50% of the world's plastic waste, the Philippines announced plans to file bills banning or limiting the use of single-use plastics and microplastics.

In other regions such as Africa, some regulations only focus on larger plastics that can generate microplastics when they accidentally end up in the environment.

Morocco

Morocco bans the use of plastic bags.

Morocco has implemented a ban on the production, import, sale, and use of plastic bags, which has helped to reduce plastic pollution in the country. Law 77.15 prohibits the manufacture, import, export, marketing, and use of plastic bags.

South Africa

South Africa delegates plastic management responsibilities to producers.

South Africa has implemented an extended producer responsibility (EPR) scheme for packaging waste. Under this scheme, producers are responsible for the end-of-life management of their packaging products, including the collection and recycling of waste.

Ghana

Ghana has adopted a circular economy-based management policy for plastics.

In 2020, Ghana has launched a National Plastics Management Policy to reduce plastic waste and increase recycling rates. The country is also promoting using biodegradable plastics as an alternative to traditional plastics.

Kenya

Kenya implemented a plastic bag ban for secondary packaging and has adopted the UNEA's plastic treaty.

In 2022, Kenya has adopted the "End Plastic Pollution: Towards an Internationally Legally Binding Instrument" draft treaty as a negotiating process to end plastic pollution. Since 2018, the country introduced Plastic Bags Control and Regulations.

California has emerged as the world's model state to have an aggressive and clear path developed to end microplastics. To have an effect, regulations will also need to be mirrored by other US states, and other countries.

A TIMELINE OF THE DEVELOPMENT OF CALIFORNIA MICROPLASTIC REGULATIONS.
Source: Water Finance and Management.

pre 2015

National:
At least 15 states passed microbead bans.

2015

National:
The Microbead Free Water Act (USA) is passed

2016

2017

2018

National:
Save Our Seas 2.0. Microplastics reduction amendment is signed.

California:
SB-1422 – California Safe Drinking Water Act: Microplastics is passed
SB-1263 – Ocean Protection Council: Statewide Microplastics Strategy is passed.

2019

Texas:
A plastics manufacturer receives a $50 million fine from TDEQ for microplastic, or 'nurdle', discharge.

2020

California:
SB-1422 – Definition of microplastic is approved.

2021

California:
SB-1422 – The State water Resources Control Board will complete the following: adopt a standard methodology; implement 4-year monitoring; accredit laboratories; establish health-based guidance.

AB-802 – Aims to limit discharge of microfibers from laundry facilities. (Proposed)

SB-1263 – Statewide Microplastics Strategy will be submitted.

EPA region 3 Microplastics Monitoring & Science Strategy for the Chesapeake Bay established.

National:
The Break Free from Plastic Pollution Act – Requires microfiber filters and study of best practices for upstream microfiber prevention. (Proposed)

2022

2023

2024

California:
SB-1263 – Statewide Microplastics Strategy adopted and implemented.

2025

California:
SB-1422 – Reiteration phase begins.

2026

California:
SB-1263 – Precautionary framework is revisited.

Nonetheless, a knowledge gap is one of the main hurdles preventing the development of proper microplastic pollution legislations at local, national, and regional scales.

The Organisation for Economic Cooperation and Development (OECD) recognizes that so far, **microplastic policies are less developed than macroplastic policies**. Especially the policies related to the mitigation effectiveness of unintentionally released microplastics.

Governance mitigation response → **GAP** → **Developing a clear policy**

↑

The existence of specific knowledge gaps, socio-economic, and environmental differences, as well as variations in waste management and regulatory practices around the world, may hinder achieving a common and clear global policy.

- Aligned international strategies are needed to mitigate microplastic impacts, as their ubiquitous nature often exceeds national jurisdiction limits.
- Microplastic regulation should incentivize both innovation and environmental safety using specific pathways
- Top-down and bottom-up studies to identify microplastic pollution “hot spots” around the world.
- Increasing awareness of the environmental impacts of consumer choices.
- More research on the atmosphere and territorial environment.
- More microplastics hazard fate data is needed.
- Add labels to microplastic-free alternatives products.
- More research on the toxicity of microplastics ingested and long-term monitoring of their change into nanoplastics is needed.

Optimally, policies should strategically target the use of microplastics across different plastic-intensive industries to ameliorate their environmental effects.

POLICY APPROACHES	OBJECTIVES	GENERAL POLICY TOOLS
Source-directed	Manufacture products with less or without toxic components that might generate microplastics (ban single-use products)	• Minimum standards; • Certifications and green public commitments; • Restriction in advertisements • Taxes and mandatory charges including regulation of consumption (annual, registration, etc.).
Use-oriented	Reduce microplastic emissions/release to the environment Educate customers on the risks of mismanaged plastic waste	• Minimum standards for complementary products (e.g. washing machines, vehicles, roads, etc.); • Restrictions on selected products uses (e.g. stricter speed limits for vehicles); • Public information campaigns; • Consumer-oriented labeling and information schemes
End-of-pipe	Improve wastewater treatment facilities Preserve water quality by removing contaminants before reintroducing the used water into the environment	• Proper disposal of wastewater sludge and management of stormwater; • Proper collection and management of road runoff; • Regulatory and economic instruments to support wastewater treatment • Apply trash-sorting policies
End-of-life	Prevent plastic waste or leakage (accidental losses) to the environment	• Regulatory interventions (green public acquisition criteria) • More strict requirements for collecting and managing plastic used products (e.g. textiles, tyres, etc.) • Awareness-raising campaigns

In sum, plastic-intensive industries should adopt the best strategies that can help them transition away from their heavy dependence on plastics.

A ban on microplastics in products or a requirement to use biodegradable alternatives instead.

Labeling requirements for products that contain microplastics to inform consumers of their potential environmental impact.

Collaboration between industries, academia, and regulatory agencies to develop effective and practical regulations that can be widely adopted.

Providing incentives and support for companies to implement best practices for managing and disposing of waste from paint production and use.

Investing in research and development to better understand the sources, pathways, and impacts of microplastic pollution and to identify effective strategies for mitigating it.

Microplastics removal technologies

Several well-established technologies are currently used for the removal of microplastics during water treatment.

A COMPARISON OF TREATMENT TECHNOLOGIES FOR THE REMOVAL OF MICROPLASTICS FROM WATER.
Source: East China Normal University.

Approach	Removal Technology	Advantages	Disadvantages	Microplastic size	Efficiency
Physical	Filtration	High removal efficiency	Membrane fouling, transmembrane pressure required	1.65 µm - 5 mm	97 - 100%
	Adsorption	High removal efficiency, simple operation	Requires the use of adsorbents	183 nm - 1µm	89 - 96%
	Magnetic	Economical and simple operation	Requires magnetic materials	1µm - 900 µm	63 - 100%
Chemical	Coagulation	Simple operation, low cost	Requires flocculants	< 5000 µm	40.5 - 77.83%
	Chemical Oxidation	High degradation rate, usable for nanoplastics	High energy consumption, requires addition of catalysts	100 µm - 200 µm	>30 - 58%
Biological	Biodegradation	Partial or complete degradation	Poor degradation efficiency, high time consumption	< 100 µm	20.4 - 90.9%

However, newer technologies currently being developed and tested for the removal of microplastics from drinkable water are showing high-efficiency levels.

A COMPARISON OF IN-DEVELOPMENT TREATMENT TECHNOLOGIES FOR THE REMOVAL OF MICROPLASTICS FROM WATER.
Source: Sources are linked at efficiency levels.

Approach	Removal Technology	Advantages	Disadvantages	Microplastic size	Efficiency
Physical	Magnetic separation	Use of magnetic nanoparticles to bind to microplastics and separated them from water using magnetic fields.	Technology in testing stage	200–900 µm	<86.87 %
	Nanofiltration	Uses membranes with smaller pores than traditional ultrafiltration membranes.	Technology in testing stage	25–5,000 µm	~99%
	Graphene oxide-coated ceramic membrane	Good anti-fouling properties	Ongoing research to investigate applications in water treatment	0.1 to 10 µm	>90%
Physico-chemical	Electrochemical treatment	High removal efficiency, selective removal, low energy consumption	High cost of electrodes, careful optimization of electrodes, ongoing research	>1 µm	>90%
Chemical	Advanced oxidation processes	It has the potential for complete decomposition of microplastics.	At current stage, AOPs mostly affect the surface chemistry of microplastics.	>10 µm	>80%

The Covalent Triazene Frameworks (CTFs) has the potential to remove VOCs and microplastics with a 99.9% efficiency level in just 10 seconds!

Promising removal tech example

Covalent triazene frameworks are porous materials made up of repeating cells of triazene molecules. The materials have unique structural properties that make them relevant for water filtration.

Researchers from the Institute of Science and Technology in South Korea have developed a laboratory prototype that uses CTFs in water filtration. The CTF membranes selectively allow the passage of water molecules managing to block volatile organic components (VOCs) and phenolic microplastics.

The technology has been reported as one of the best unrivaled water purification technologies with the highest ever recorded purification efficiency (99.9%) and the process can be completed in 10 seconds.

The materials can be reused without losing their properties. The purification of VOCs is achievable through the absorption of sunlight, which is converted into heat to purify the water. This step can remove over 98% of VOCs.

The prototype combining both types of membranes was able to remove over 99.9% of VOCs and microplastics.

A laboratory prototype of the covalent triazine frameworks (CTFs). Authors reported its exceptional efficiency for the removal of VOCs and microplastics. The CTFs are full of microscopic pits and holes that capture all kinds of pollutants via solar-driven water evaporation. Source: Advanced Materials.

Potential Next Steps

Stay Ahead of Regulatory Changes

As microplastics become a focus of new environmental regulations, it's essential to anticipate these changes. We provide in-depth primary and secondary research to keep you informed about potential regulatory shifts and their implications for your business activities and strategic planning.

Accelerate Sustainable Innovation

The challenge of microplastics is an opportunity for innovation. We can work with your teams to explore new materials, designs, and manufacturing processes that minimize or eliminate microplastics. Our experts can help identify and assess the viability of potential alternatives.

Understand Your Impact

Every organization has a unique microplastic footprint. It's essential to understand the specifics of your situation, from the products you manufacture to the materials you use. Our experts can assess industrial processes to understand potential microplastic pollution levels.

Leverage Collaborative Research

The field of microplastics research is vast and growing. By collaborating with other organizations, researchers, and nonprofits, you can accelerate your efforts to reduce microplastics. We can facilitate these collaborations and help you integrate external insights into your R&D processes.

Engage with us at
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Marija is the Technical Director for PreScouter's Chemical, Materials, and Packaging verticals. She has worked across topics such as product and process improvement and development and sustainability throughout the chemicals, materials, and packaging industry. Marija completed her Master's degree in Chemical Engineering from Belgrade University and her PhD in Organometallic Chemistry and Catalysis at the Swiss Federal Institute of Technology (ETH Zurich). Prior to her PhD, Marija worked in the chemical industry on the synthesis of new textile dyes.

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Sanierlly holds a BSc and an MSc degree in Chemical Engineering. Her study areas were food preservation and Excel VBA applied to thermodynamics problems. She is a specialist in Food Quality & Safety and has gained experience as a scholar here in PreScouter, working on Chemicals, Natural Resources, Materials and Healthcare & Life Sciences projects. Currently, Sanierlly is pursuing her Ph.D. in Organic Chemistry focused on injectable hydrogels for drug delivery.

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Jorge's diverse interests are primarily centered on environmental sustainability. Jorge strives to bridge the gap between theory and practice by offering practical solutions to the complex challenges in achieving sustainable development. He offers insightful analysis and high-quality information on the latest disruptive technologies, which he believes could have a significant impact. Jorge holds a Master's degree in Conservation and Development, a Ph.D. in Biology and Statistics from University of Florida and Syracuse University, respectively, and a diploma in Green Economy from Toronto Metropolitan University.

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