MICROPLASTICS AND PUBLIC HEALTH

ACKNOWLEDGED RISKS AND EU POLICY ACTION

POLICY BRIEFING

PLASTIC SOUP FOUNDATION

IN COLLABORATION WITH

GREEN IMPACT

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1. Executive Summary

Micro- and nanoplastics represent an escalating public health and environmental crisis, with a growing body of peer-reviewed evidence demonstrating their presence in human blood, breast milk, lungs, brain tissue, placenta, and even in children's urine. These particles, once released into the environment, seem virtually impossible to remove and act as vectors for toxic substances, including endocrine disruptors, heavy metals, persistent organic pollutants (POPs), and antibiotic resistance genes. Exposure occurs via ingestion, inhalation, and dermal contact, with documented effects ranging from inflammation and oxidative stress to neurotoxicity, reproductive toxicity, developmental disorders, and carcinogenicity. Especially vulnerable populations - including children, pregnant women, and frontline communities - face disproportionate health risks, while environmental accumulation threatens ecosystems and biodiversity.

The 2024–2029 EU political cycle offers a historic window to implement systemic, science-based, and enforceable measures to mitigate these risks. This Policy Brief provides a comprehensive overview of the latest toxicological research and identifies strategic actions for policymakers to accelerate the phase-out of hazardous polymers, strengthen producer responsibility, and enhance health protection under key EU frameworks. It underscores the urgent need to embed microplastic prevention within the forthcoming Circular Economy Act, the Action Plan for the Chemicals Industry, the EU Bioeconomy Strategy, and the European Water Resilience Strategy. While recent legislative steps—such as the REACH restriction on intentionally added microplastics and the proposed regulation on pellet loss—are commendable, major regulatory gaps

remain in addressing secondary microplastic formation, harmonised monitoring, and substitution incentives for safer materials.
Europe must lead by example: The EU has the mandate and the moral responsibility to champion legally binding international provisions on microplastic control, product redesign, and health monitoring. Coordinated action across Member States, robust investment in research and innovation, and the adoption of common standards for detection, risk assessment, and remediation will be critical to prevent irreversible damage to public health and the environment. The time to act is now - and the EU must be bold, ambitious, and uncompromising in its commitment to protect current and future generations from the pervasive threat of microplastics.

2. Scientists Speak Out on Microplastics and Health

Professor Patricia Hunt - School of Molecular Biosciences at Washington State University: "*I've been locked into plasticising chemicals (like bisphenols and phthalates - chemicals that are endocrine disrupting chemicals) for over 20 years now, and everything we've done in the laboratory with these chemicals has convinced me that these chemicals not only can affect our fertility and our general health - they already are. We also know that some of the effects of these chemicals are transgenerational. That means they can affect subsequent generations even though those generations aren't themselves exposed.*"[1]

Professor Dr. Lukas Kenner - Cancer researcher and deputy director of the Clinical Institute of Pathology at the Medical University of Vienna: "*We know that microplastic particles can enter the embryo through the placental barrier.* [...] *The unborn child is the one to take the biggest load of those plastic particles. I'm afraid of the fact that plastic particles could lead to early onset cancer and that the accumulation of plastic in the world and in our ecosystems can lead to more and more cancer formation in earlier years of peoples' lives. That would be basically a disaster.*"[2]

Professor Dr. Thais Mauad - Associate Professor at University of Sao Paulo: "*There has been a lot of research showing that microplastics are present in our body - in each organ researchers have looked at, they found microplastics. We were the first to demonstrate that microplastics can reach the brain.* [...] *I confess that I became a little bit worried about how easy it is for particles to enter our brains. The brain is supposed to be our most protected organ.* [...] *The particles we found in the brain were mostly polypropylene, polyester, polyethylene - plastics widely produced and present in packaging, clothes, and furniture. This is very disturbing. I am afraid of plastics because of this widespread contamination. The fact*

[1] From the video: "Plastic Health Summit 2021 - Prof. Dr. Patricia Hunt", November 18, 2021, https://www.youtube.com/watch?v=YzUR4Wta6fo
[2] From the video: "Scientists Speak Out #1 - Prof Dr. Lukas Kenner - Plastic & Cancer", April 24, 2024, https://www.youtube.com/watch?v=-d1VGA1tZL0&t=135s

that the microplastics affect DNA structure causing DNA damage has several consequences for us."[3]

Professor Dr. Shanna Swan - Icahn School of Medicine at Mount Sinai: "*I believe we are in crisis. I believe that the plastics in our lives are threatening our survival as a species and the survival of all planetary life. There cannot be a bigger threat.* [...] *Sperm count has declined 1% per year. Since 2000, the rate has increased to about 2.6% per year. Other species exposed to the same chemicals are declining too - and they are not choosing to delay childbearing. [...] My message to the petrochemical industry is you have no right to be poisoning people in multiple ways. The health effects of these chemicals on people are criminal. They did not request this exposure, they did not sign up for this exposure, and you are threatening their health - and perhaps the survival of planetary species."*[4]

3. Recommendations for EU Policymakers

- A substantial review of the **Waste Framework Directive** should be a priority during this European mandate and be part of the announced Circular Economy Act. Particularly, **the Act should include a review the Environmental Producer Responsibility (EPR)** schemes to make producers responsible for the whole life cycle of the product, not only the end-of-life - including the release of microplastics during use and degradation phases. Therefore, EPR schemes need to actively finance waste prevention, reuse, repair, and substitution of of polymer-based materials, through dedicated repair and reuse funds and infrastructure, and targeted support for microplastic-free design, and aligned policy measures.
- The **European Chemicals Industry Action Plan** should include as urgent priority fiscal incentives and tax measures to boost demand for clean chemicals and to accelerate the substitution of hazardous and persistent polymers. The upcoming EU Innovation and Substitution Hubs as well as the program Horizon Europe should make available increased funds to accelerate the development of safer, more sustainable chemical substitutes and to support R&D on safer, sustainable, and microplastic-free chemical substitutes.
- The workplan on textiles/apparel to be adopted by 2027 under the **Ecodesign for Sustainable Products Regulation (ESPR)** should include concrete measures to prevent microplastics pollution of both waste streams and water, including concrete and binding measures to mitigate **microplastic shedding throughout the textile lifecycle** — from fibre production to washing and disposal. These measures must include standards for microfibre release, durability criteria, mandatory filtration technologies, and design-for-recyclability protocols.

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[3] From the video: "Scientists Speak Out #2 - Prof Thais Mauad - Plastic & Brains", November 29, 2024, https://www.youtube.com/watch?v=slmexHHJ7Lg&t=331s

[4] From the video: "Scientists Speak Out #3 - Prof dr Shanna Swan. Plastic & Fertility", August 13, 2025, https://www.youtube.com/watch?v=4-XmUkqAxWc&t=484s

- The flagship actions included in the **EU Water Resilience Strategy**, including the revision of the **Water Framework Directive** (by 2027), should urgently address the microplastics pollution of water bodies, treating it as a major health and environmental risk, embedding urgent and enforceable targets across **freshwater and marine policies**.
- Specifically, when discussing the above initiatives or other relevant proposals, these actions should be proposed and supported:
    - Accelerating bans on high-risk microplastic sources
    - Removing market barriers for alternative materials and systems, including **bio-based and biodegradable materials** (e.g. packaging from agri-waste or natural fibres), through harmonised standards and support under the **Bioeconomy Strategy**.
    - **Avoid regressive waste management costs** on EU citizens by shifting towards **producer-responsibility-based funding** under the WFD, rather than general plastic taxes on consumers (e.g. rethink the implementation of the **Single Use Plastics Directive** in this light).
    - **Strengthen research funding** under the **post-2027 Multiannual Financial Framework**, with a specific call under Horizon successor programmes for cross-disciplinary health-environment microplastics research.
    - **Ensure strong EU leadership in the Global Plastic Treaty**, with a mandate to pursue legally binding provisions on microplastic production, release, and monitoring — particularly in the lead-up to **INC-5.2 in Geneva (August 2025)**.
    - **Improve public awareness and education** campaigns on health and environmental risks of microplastics, especially for vulnerable groups.
    - In parallel, the **EU should significantly scale up investment in the development, deployment and market uptake of alternatives to conventional plastics**, in order to reduce structural dependence on polymer-based materials. This requires coordinated support for innovation, infrastructure and standards that enable safe, affordable and high-performing alternatives to move from niche applications to widespread use across key sectors.

4. EU Legislative Landscape

The European Union has progressively built a regulatory architecture to start addressing the growing problem of microplastics, integrating measures into broader environmental, health, and circular economy frameworks. Central to this landscape are the **Circular Economy Action Plan** and the **Zero Pollution Action Plan**: the Commission's aim is to cut emissions of microplastics by 30% and marine plastic litter by 50% by 2030. These objectives frame the Commission's longer-term goal of

achieving pollution levels “no longer harmful” by 2050. Key milestones include the **2023 REACH restriction banning intentionally added microplastics in products** and a **proposed regulation on pellet loss prevention**, which directly targets intentional and unintentional microplastic releases. Other legislative instruments already in force are particularly relevant with regards to the effect of microplastics and nanoplastics (and their effects on health). The **Marine Strategy Framework Directive (MSFD)**, adopted in 2008, is the EU’s main marine protection law and mandates coordinated national strategies to achieve “Good Environmental Status.” Its Descriptor 10 addresses marine litter, including microplastics, and requires harmonised monitoring across Member States. The **Fertilising Products Regulation (FPR)**, in force since July 2022, limits impurities in fertilizers, including plastics, glass, and metals, while obliging manufacturers to apply quality control. Additives must meet biodegradability standards by 2026, though Controlled Release Fertilizers remain exempt, leaving gaps in addressing polymer leakage. The **Single-Use Plastics Directive (SUPD)** bans or restricts ten high-impact items responsible for 70% of marine litter, complementing recycling targets and design measures such as tethered caps. The **REACH framework** remains the cornerstone of EU chemical regulation, with a 2023 amendment banning synthetic polymer microparticles in cosmetics and consumer products—expected to prevent 500,000 tons of microplastic emissions over two decades. Finally, the **Microplastics Restriction Regulation (EU 2023/2055)** establishes staggered phase-outs across product categories, balancing industry adaptation with environmental protection.

Ongoing proposals aim to expand the scope. The **Drinking Water Directive** (2020/2184) mandates harmonised methods to monitor microplastics in tap water, with the Commission preparing inclusion on the official watch list. The **Pellet Loss Regulation** (2023) introduces mandatory loss-prevention measures across supply chains, with the goal of reducing pellet losses by up to 83%. Internationally, the EU plays a proactive role in the negotiation of the **Global Plastic Treaty**, advocating for bans on intentionally added microplastics and harmonised global monitoring. Furthermore, the EU has aligned its internal framework with international obligations under the **Basel Convention**, notably following the entry into force of the **Plastic Waste Amendments** in January 2021. As a result, exports of plastic waste from the EU to non-OECD countries are largely prohibited, while shipments within the EU and to OECD countries are subject to stricter classification, notification and prior informed consent requirements. These rules significantly enhance transparency and traceability of plastic waste movements, reduce the risk of illegal exports and environmentally unsound treatment, and reinforce the EU’s objective of addressing plastic pollution at source by strengthening domestic waste management and recycling capacity. In doing so, EU waste shipment rules complement product, chemicals and environmental legislation by tackling plastic and microplastic pollution not only at the production and use stages, but also at the end-of-life and transboundary movement stages.

Despite this progress, significant **gaps remain**. Detection methods for particles under 300 microns are inconsistent, hampering monitoring and threshold setting under the MSFD. The FPR’s exemptions and reliance on industry self-enforcement create risks

of uneven compliance. The REACH ban has long transition periods (until 2035 for some cosmetics) and exemptions for soluble or biodegradable polymers. The SUPD, while effective on macroplastics, does not explicitly address fragmentation into microplastics. Moreover, the Microplastics Restriction Regulation excludes liquid and natural polymers, which may still contribute to pollution. Enforcement across Member States is uneven, and data collection lacks harmonisation, undermining policy coherence.

Overall, the EU legislative landscape demonstrates clear ambition and progress but suffers from **fragmentation, delayed timelines, and loopholes**. Stronger harmonisation, shorter transition periods, and explicit provisions for secondary microplastics are needed. A critical next step will be to operationalise monitoring, ensure robust enforcement, and integrate microplastic controls into the broader Circular Economy and Zero Pollution objectives.

5. EU Commission's Political Guidelines 2024–2029

The European Commission's strategic orientation for 2024–2029 embeds microplastic reduction within a broader set of environmental, economic, and health objectives, even if not addressed as a standalone priority. Microplastics are considered part of the Commission's **Green Deal, Circular Economy, and "Quality of Life" agenda**, linking pollution prevention to human health, ecosystem resilience, and competitiveness. The guidelines provide a **political mandate to translate scientific evidence into systemic action**—notably through four flagship frameworks: the **Circular Economy Act**, the **Action Plan for the Chemicals Industry**, the **European Water Resilience Strategy**, and the **Bioeconomy Strategy**.

The **Circular Economy Act**, expected in 2026, is a cornerstone initiative. Building upon existing strategies, it aims to reduce waste, promote resource efficiency, and redesign products for durability, recyclability, and safe material use. For microplastics, this creates a legislative opening to address both primary and secondary emissions at the design stage. Anticipated measures include **mandatory waste sorting**, stronger eco-design criteria, and requirements for recycled content, thus incentivising substitution of hazardous polymers. This Act will also likely align with Extended Producer Responsibility schemes, ensuring polluters finance microplastic-free alternatives.

The **Action Plan for the Chemicals Industry** complements this by targeting innovation and resilience in a sector facing global competition and green transition pressures. The creation of a **Critical Chemical Alliance** will support strategically important sites, reduce external dependencies, and accelerate safer substitutes to persistent plastics. This is crucial since many microplastics originate from polymer additives. By aligning investment through Important Projects of Common European

Interest (IPCEIs), the plan seeks to boost research and manufacturing capacity for clean, microplastic-free materials.

Water protection represents another central pillar. The **European Water Resilience Strategy** directly links microplastics with PFAS and other pollutants, recognising their role in degrading water quality and threatening health. Its flagship actions are designed to: (a) restore natural water cycles by limiting pollutants such as microplastics at source, (b) guarantee universal access to clean and affordable drinking water, and (c) ensure robust monitoring across the supply chain. Integration with revisions to the **Marine Waters Directive** and the **Drinking Water Directive** positions microplastic control as both an environmental and social equity issue.

The **Bioeconomy Strategy**, adopted in November 2025, provides a parallel avenue to reduce reliance on fossil-based plastics. By promoting bio-based, biodegradable, and non-toxic alternatives, the EU hopes to phase out persistent plastics across packaging, textiles, and agriculture. This aligns with rural development, biotechnology innovation, and climate neutrality goals. Crucially, stakeholder consultations and targeted workshops are shaping how this strategy can deliver **microplastic-free value chains** while supporting rural economies and global leadership in bio-based materials.

Funding and research initiatives reinforce these guidelines. **Horizon Europe** and national collaboration frameworks are mobilising substantial resources into microplastic-health research, harmonisation of analytical methods, and ecosystem-level studies. Projects like **PlastHealth** investigate toxicological pathways, while Horizon calls focus on comprehensive aquatic litter assessment, standardised monitoring, and open data infrastructures. A Member State collaboration framework will align environmental monitoring with health surveillance, enabling cross-border pilot studies. Internationally, initiatives such as the **Clean Oceans Initiative**, which has already mobilised €4 billion, demonstrate Europe's leverage in financing solutions.

Finally, **monitoring and reporting obligations** underpin the entire guidelines package. By 2029, the Commission will operationalise **EU-wide harmonised data collection**, integrating microplastics into water, wastewater, and bathing directives. Extended Producer Responsibility schemes will finance enhanced wastewater treatment to capture micropollutants, while digital tracking systems (linked to EMODnet and EU Open Data portals) will standardise reporting. These obligations are designed not only to close knowledge gaps but also to **ensure enforceability and public transparency**.

Overall, the 2024–2029 political guidelines offer a coherent framework where microplastic prevention is indirectly but strongly embedded. By aligning industrial policy, water resilience, and bioeconomy development with harmonised monitoring, the Commission is setting the stage for legally enforceable and innovation-driven action. The challenge for policymakers will be to ensure that these guidelines translate into **binding standards, accelerated timelines, and adequate funding** so that microplastic pollution is reduced at its source rather than merely managed downstream.

6. Scientific State of the Art

Scientific evidence has rapidly advanced in recent years, transforming microplastics from a perceived nuisance into a recognised **global health and environmental threat**. Defined as synthetic solid particles of 1 µm–5 mm (microplastics) and 1–1000 nm (nanoplastics), these particles are now confirmed to permeate the food chain and accumulate in human tissues. Sources are both **primary** (intentionally manufactured particles in cosmetics, cleaning agents, industrial pellets) and **secondary** (fragments from plastic degradation in the environment). Exposure routes are multiple—ingestion, inhalation, and dermal absorption—with studies detecting microplastics in blood, breast milk, lungs, placenta, brain tissue, and even children's urine.

The scientific consensus highlights **ingestion** as a dominant pathway, with seafood, drinking water, bottled beverages, and vegetables identified as major vectors. Heating food or beverages in plastic containers accelerates particle release, a particular risk for infants consuming formula in plastic bottles. **Inhalation** is also significant, especially in urban and industrialised environments, where airborne microplastics penetrate deep into the lungs. Alarmingly, airborne particles have also been detected in remote alpine and polar regions, underlining their global dispersion. **Dermal exposure**, though less studied, occurs via cosmetics, personal care products, and masks, with evidence that nanoplastics can penetrate skin cells.

Emerging research connects microplastics to a wide range of health impacts. Laboratory and animal studies show effects including intestinal disruption, cardiovascular damage, neurotoxicity, and reproductive harm. At the cellular level, microplastics induce inflammation, oxidative stress, mitochondrial dysfunction, apoptosis, and DNA damage. Specific scientific concerns include **carcinogenic potential**, with studies linking microplastics to tumour promotion, immune suppression, and genotoxicity. Elevated concentrations have been observed in lung, colorectal, and prostate cancer tissues. **Developmental teratogenicity** is also a focus: studies in mice show parental exposure to nanoplastics causing skeletal malformations, impaired learning, and neurochemical changes in offspring. **Neurological risks** are underscored by findings that nanoplastics cross the blood–brain barrier, disrupt synaptic function, and exacerbate gut–brain axis inflammation. **Children** are particularly vulnerable, with microplastics linked to preterm birth, endocrine disruption, respiratory inflammation, behavioural issues, and organ damage.

Beyond their physical presence, microplastics pose additional risks through the **leaching of embedded chemical additives**. Recent comprehensive reviews show that microplastics can release flame retardants, plasticizers and antioxidants - many with endocrine-disrupting, neurotoxic and reproductive effects - particularly after ingestion, where digestive enzymes, acids, fats and oils accelerate degradation and chemical migration, underscoring microplastics as an active chemical exposure pathway rather than inert particles.

Microplastics do not act alone but also as **vectors of other pollutants**. They absorb heavy metals, persistent organic pollutants (POPs), pesticides, phthalates,

bisphenols, and PFAS, creating complex toxic cocktails. For example, aged microplastics bind cadmium and mercury more efficiently, while pesticide interactions increase persistence and alter toxicity profiles. Nanoplastics can also enhance the spread of **antibiotic resistance genes (ARGs)** by promoting bacterial uptake of exogenous DNA, raising serious concerns for antimicrobial resistance. Interactions with viruses have been documented, with nanoplastics facilitating viral replication and weakening host immune responses in fish models. These synergistic interactions amplify risks well beyond the particles themselves.

Despite this alarming evidence, critical **knowledge gaps remain**. Most studies use pristine laboratory-made polystyrene beads, poorly reflecting the irregular, weathered microplastics found in real environments. Research often applies high-dose, short-term exposures, whereas humans face chronic, low-level exposures. Comprehensive assessments of genotoxicity, mutagenicity, and carcinogenicity are still lacking. Analytical challenges compound these gaps: current detection methods (microscopy, spectroscopy, mass spectrometry) face resolution limits, risk sample contamination, or require destructive processes. Nanoplastics are especially difficult to measure due to their size and reactivity. Innovations such as optical tweezers, micro/nanorobots, and AI-enhanced imaging show promise, but standardised protocols are urgently needed.

In conclusion, the state of the art leaves no doubt: microplastics and nanoplastics are present in the human body, interact synergistically with toxic pollutants, and pose risks across multiple health domains. While definitive causal links in humans remain under investigation, the precautionary principle is warranted. Policymakers should treat the scientific evidence as a call for **preventive regulation, harmonised monitoring, and prioritised research funding**. The longer gaps persist in knowledge and regulation, the higher the risk of irreversible damage to human health and ecosystems.

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