FREQUENTLY ASKED QUESTIONS ON PLASTICS AND CHEMICALS

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IPEN
for a toxics-free future

CONTENTS

1. HOW ARE PLASTICS MADE?

Plastics are a combination of carbon and chemicals — most of the which are petrochemicals, substances made from fossil fuels such as oil and gas. Different chemicals added to plastics provide a wide variety of properties to create the many kinds of plastic materials sold today.

2. HOW MANY CHEMICALS ARE FOUND IN PLASTIC?

More than 13,000 chemicals are used in plastics of which more than 3,000 have been identified as toxic (often called "chemicals of concern" or "potential concern"). Of these toxic chemicals, almost one thousand used in plastics are linked to cancer, DNA mutations, or harm to reproduction, and more than one thousand are known to be toxic to the aquatic environment. Equally concerning, there are about 6,000 chemicals in plastics for which we have no safety information.

Resources: Global governance of plastics and associated chemicals, Troubling Toxics

3. HOW ARE CHEMICALS IN PLASTICS CLASSIFIED?

The chemicals that are associated with plastics are broadly classified into five groups. Plastic chemicals include:

- monomers
- polymers
- additives
- non-intentionally added substances (NIAS)
- associated substances produced through the life cycle

MONOMERS AND POLYMERS

Monomers are the basic building blocks of plastics—they are small molecules. Mono means one and poly means many. Through chemical processes, monomers link together to create polymers. For example, ethylene is a monomer that linked together becomes the polymer polyethylene. Similarly, styrene becomes polystyrene, propylene becomes polypropylene, and so on for other monomers and polymers.

Thus, polymers are repeating units of monomers—like long chains. All plastics have a backbone made from polymers. The term polymer is also used to describe some natural chains of monomers, like sugars, but unlike natural substances, polymers in plastics are synthetic or highly modified chemicals.

Many polymers, or the monomers that make polymers, are toxic. For example, styrene is a monomer that has been linked to an increased risk for cancer among exposed workers.

ADDITIVES

Additives are chemicals added to plastic to provide specific properties, such as color, softness, protection from sunlight, fire protection, and many others. Additives can make up more than half of a plastic material. For example, phthalates are toxic chemical additives used in some plastics, and the composition of some soft, flexible plastics can be 50% or more phthalates. Additives are often not chemically bound to the polymer backbones of plastics, so may leach readily from the material.

Examples: Benzotriazole UV-stabilizers, chlorinated paraffins, bisphenols, brominated flame retardant chemicals

NON-INTENTIONALLY ADDED SUBSTANCES

Non-Intentionally Added Substances (NIAS) are substances that are created and end up in plastics due to different processes along the life cycle (such as reactions during production, degradation, and others). Many NIAS are toxic.

While they are called "non-intentionally added," in most cases it is well known that they will be produced and will contaminate plastics. Thus, "obligatory contaminants" may be a more accurate term.

In plastic recycling, chemicals used in primary plastics (meaning plastics that have been produced new instead of from recycled materials) are passed along into recycled materials, even when they serve no purpose in the recycled plastic. For example, highly toxic flame retardants are used in plastics for electronics, such as in computers or monitors that may require plastics that can resist high heat. But when these electronic plastic wastes are recycled, the recycled material contains toxic flame retardants. When this recycled plastic is used to make toys or other consumer goods, the flame retardants serve no purpose but pose significant health threats. Since the chemicals are part of the plastic it is not possible to separate them from the materials during regular recycling processes.

These toxic implications of plastic recycling demonstrate the importance of focusing on upstream solutions, including through regulating and eliminating the use of toxic chemicals and ensuring transparency and traceability of chemical content throughout the full life cycle.

Examples: Brominated flame retardants, Alkanes, Phthalates.

ASSOCIATED CHEMICALS PRODUCED THROUGH THE LIFE CYCLE

Like NIAS, there are many toxic chemicals that are known to be produced throughout the full plastics life cycle, from sourcing to wastes. These are sometimes called "unintentionally produced" substances but in most cases could more accurately be called "obligatory by-products" since it is generally well-known that they will be produced. For example, obtaining feedstock (oil and gas) for plastics is linked with toxic chemical exposures. It is well-known that the oil and gas industries are highly polluting, with workers and fenceline communities (communities living near industrial facilities) facing potential health impacts such as cancer, liver damage, immunodeficiency, and neurological symptoms. Plastic waste disposal via burning is also associated with releases of highly toxic chemicals that pose health threats to waste workers and nearby communities.

Examples: Dioxins, Polyaromatic hydrocarbons (PAHs)

Resources: A deep-dive into Plastic Monomers, Additives and Processing Aids, Identification of unexpected chemical contaminants in baby food coming from plastic packaging migration

4. WHY SHOULD A GLOBAL PLASTICS TREATY ADDRESS TOXIC CHEMICALS, INCLUDING POLYMERS AND ADDITIVES?

The March 2022 UNEA Plastic Treaty resolution (Resolution 5/14) mandates the negotiation of an international treaty to end plastic pollution, noting the related "risks to human health and adverse effects on human well-being and the environment." These risks can only be addressed if controls on toxic chemicals are included in a Treaty.

Plastics contain toxic chemicals that are not internationally regulated but spread internationally in plastic materials. These toxic chemicals in plastics threaten human health and the environment.

People and the environment are directly harmed throughout the entire life cycle of plastics: from hazardous emissions and toxic exposures associated with the extraction of fossil fuels, toxics released during production of plastics and chemicals, and toxic exposures from the use and disposal of plastics.

Resources: Troubling Toxics, Plastics, EDCs and Health, An introduction to plastics and toxic chemicals

5. DON'T OTHER MULTILATERAL ENVIRONMENTAL AGREEMENTS (MEAS) ALREADY REGULATE ALL THE CHEMICALS IN PLASTICS?

There are more than 13,000 chemicals in plastics of which 3,000 are known to be toxic and another 6,000 have no safety data. But less than 1% (128 of 13,000 chemicals) of the chemicals used in plastics are currently regulated under existing international multilateral environmental agreements (MEAs).

The Stockholm Convention only provides global bans or restrictions on chemicals that are Persistent Organic Pollutants (POPs), while the Montreal Protocol only regulates Ozone Depleting Substances (ODS). The Rotterdam Convention only provides information on the trade of a few specific chemicals, some of which are used in plastics. These MEAs individually or in combination cannot address the wide range of chemicals in plastics.

Resources: Global governance of plastics and associated chemicals, Troubling Toxics

6. WHAT WOULD BE SUITABLE CRITERIA TO INCLUDE FOR REGULATING CHEMICALS UNDER THE TREATY?

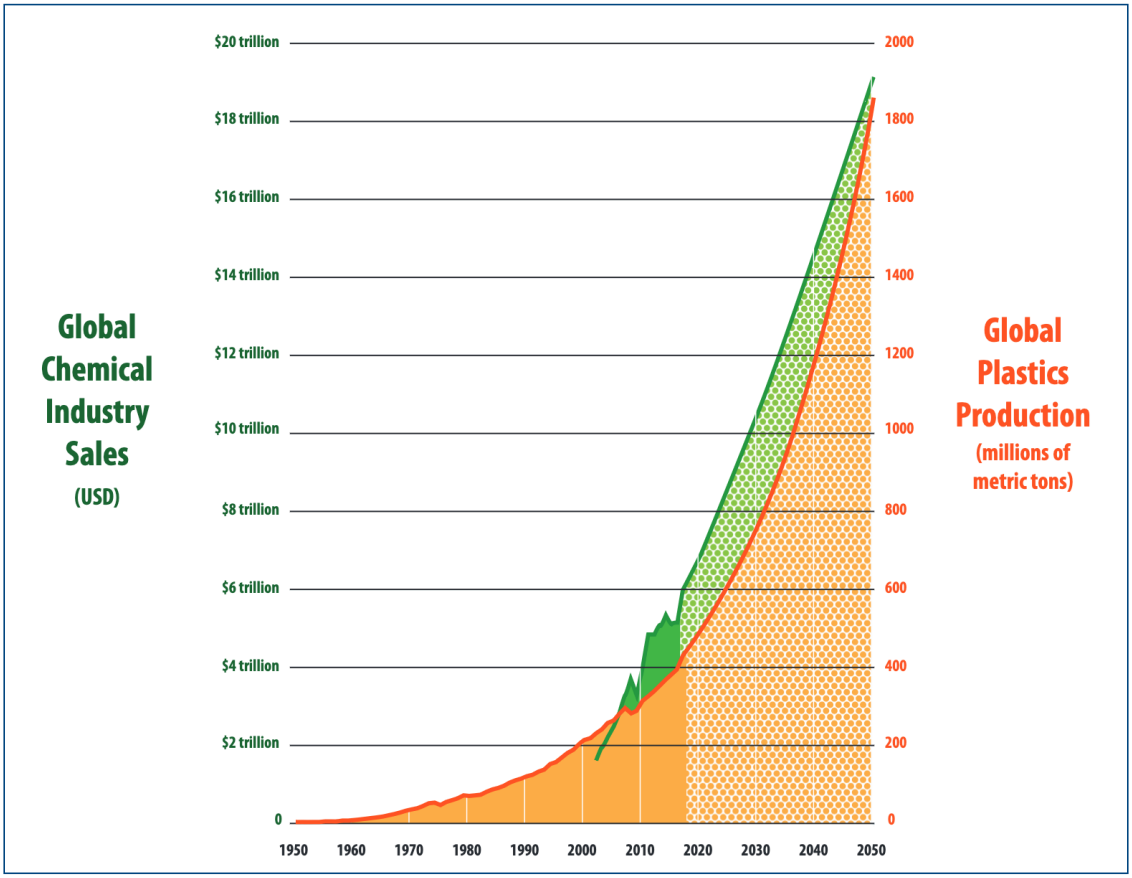
Criteria for identifying chemicals to be controlled under the Treaty could include the following:

a. Chemicals and classes of chemicals associated with plastics, either as plastic ingredients, processing aids, NIAS, and chemicals unintentionally produced during the plastics life cycle.

b. Chemicals for which there is no available toxicity data.

c. Chemicals that increase barriers to circularity of plastics.

d. Chemicals for which there is evidence of known or potential adverse effects for human health or the environment.



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The criteria under (d) may include:

- Substances that are carcinogens, mutagens, or reproductive toxicants.
- Substances that are endocrine disruptors.
- Substances that affect the immune system, the neurological system, or a specific organ.
- Substances that are persistent, bioaccumulative, and toxic in the environment.
- Substances that are persistent, mobile, and toxic.

By reducing the amount of chemicals used to make plastics and by replacing hazardous chemicals with safer alternatives, plastics can become simpler and safer.

Resources: Global Governance of plastics and associated chemicals, Troubling Toxics

7. WHAT ARE SOME OF THE CHEMICALS THAT SHOULD BE INCLUDED IN A FIRST LIST OF CHEMICALS TO BE REGULATED UNDER THE TREATY?

Just as the Stockholm Convention identified the "dirty dozen" chemicals for elimination, the Plastics Treaty should have the ambition to identify an initial list of chemicals to be regulated and eliminated under the treaty based on the criteria listed above (see question 6). There are thousands of chemicals currently used in plastics for which there is no toxicity data, and these should be avoided until they are proven safe. But there is overwhelming evidence that the following groups are hazardous and should be included in a list of toxic chemicals for elimination:

- **Brominated flame retardants (BFRs):** BFRs are added to several types of plastics, especially electronics. They are endocrine disrupting chemicals (EDCs) linked with infertility and can disrupt male and female reproductive development, alter thyroid development, and affect neurodevelopment.
- **Chlorinated paraffins:** Chlorinated paraffins are used as flame retardants and in some products to make plastics more flexible. They are endocrine disrupting chemicals and are suspected to cause cancer in humans. Studies have also shown that they affect the liver, kidneys, and the thyroid gland in humans.
- **Polyaromatic hydrocarbons (PAHs):** PAHs are found in certain plastics due to the use of specific additives or as non-intentionally added substances. Several PAHs are classified as carcinogenic, mutagenic, or toxic for reproduction.
- **Alkylphenols:** Alkylphenols are used as additives and intermediates in plastics. Several alkylphenols are endocrine disruptors, and studies have linked exposure to alkylphenols to increased occurrence of several types of cancers, including endometrial and breast cancer.
- **Bisphenols:** Bisphenols are used as chemical building blocks in hard polycarbonate plastics and in some epoxy resins. They are also used as additives and are found in many common plastic products. Bisphenols are endocrine disruptors and have been associated with breast, prostate, ovarian, and endometrial cancers.
- **Phthalates:** Phthalates, sometimes called "everywhere chemicals" due to their widespread use, are used as plasticizers, additives that make plastic products flexible. Phthalates are endocrine disrupting chemicals that can reduce testosterone and estrogen levels, block thyroid hormone action, and have been identified as reproductive toxicants.
- **Benzotriazole ultraviolet (UV) stabilizers:** UV stabilizers are used to prevent the degradation of plastic products in sunlight. Several studies demonstrate that UV stabilizers are endocrine disrupting chemicals and can impede fertility and development.

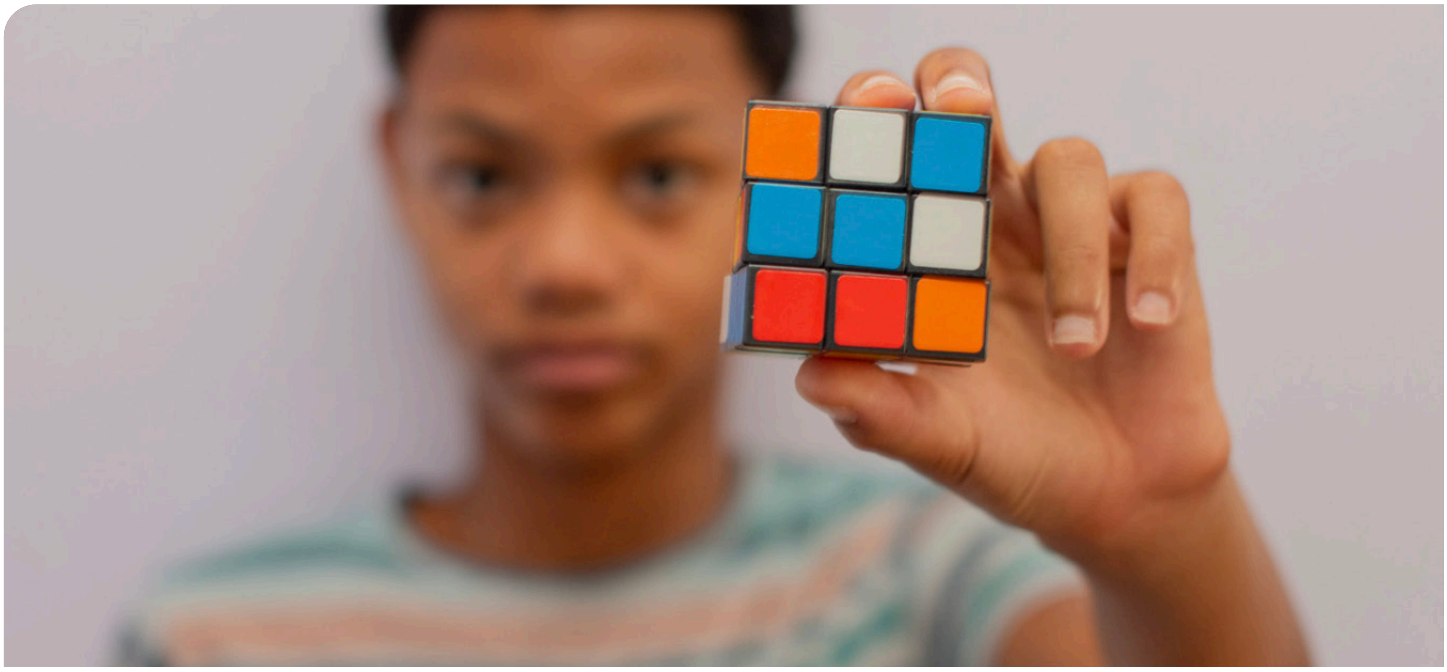
- **Per- and polyfluoroalkyl substances (PFAS):** PFAS are known as "forever chemicals" because they persist in the environment and accumulate in the bodies of wildlife and people. PFAS are used in the production of side-chain fluorinated polymers and fluoropolymers like polytetrafluoroethylene (PTFE). They are used to make textiles water- or stain-resistant and in food packaging for grease-resistance, among many other uses. PFAS are endocrine disrupting chemicals that affect the immune system, liver, and thyroid function. They alter puberty, raise breast cancer risk, and are associated with kidney, testicular, prostate, and ovarian cancers, and non-Hodgkin's lymphoma.
- **Brominated dioxins:** Dioxins are by-products of industrial and combustion processes and occur in the production of plastics with brominated flame retardants and when plastics are incinerated. There are no safe levels of dioxin exposures. Dioxins affect brain development, are associated with increased risk of multiple cancers, and can affect the immune system.
- **Toxic metals:** Several groups of toxic metals are used in plastics for various purposes, such as providing color or as stabilizers to prevent degradation. Metals in plastics include lead chromates and other lead compounds, chromium compounds, and cadmium compounds. They have a wide range of health impacts. For example, lead exposures are neurotoxic and there is no safe level of lead exposure for children.

In addition to the above-mentioned chemical groups, there are individual chemicals that are important to address, including but not limited to polymers such as polystyrene, polyurethane, and polyvinylchloride. These chemicals and above-mentioned groups of chemicals should be prioritized for control measures and could be part of an initial list included in the Plastics Treaty.

Resources: Global Governance of plastics and associated chemicals, Troubling Toxics

8. ARE THERE SAFE AND CIRCULAR PLASTICS?

There are no known circular plastics, meaning plastics that would allow for 100% recycling where one plastic bottle becomes a new plastic bottle. Plastic recycling is an inefficient process that has repeatedly been shown to spread toxic chemicals into new products. This comes back to the fact that thousands of chemicals in plastics are known to be toxic and thousands more have no safety information. Plastics are not labeled so there is no way to know when they contain toxic chemicals and no way to track toxic chemicals in plastics. This lack of transparency, traceability, and available data means that there are no plastics that can be considered safe, since it is not possible to know if they contain toxic chemicals. These gaps are key obstacles to a safe, circular economy. Thus, there are no known safe and circular plastics, which is why it is so important to address toxic chemicals under the future instrument.



9. WHAT IS THE DIFFERENCE BETWEEN A HAZARD-BASED AND A RISK-BASED APPROACH?

A hazard-based approach begins with the presumption that toxic chemicals are too dangerous to be used safely. Under a hazard-based approach, the toxicity of a chemical is enough to warrant health-protective regulations to prevent health harm.

A risk-based approach is based on the outdated assumption that a safe level of exposure to toxic chemicals can be established. This assumption disregards endocrine disrupting properties and other so-called non-threshold toxic impacts. It requires long, costly, and often assumptions-biased evaluations of toxicity, exposure routes and levels, chemical leaching, and risk versus benefit analyses. In addition, it is impossible to anticipate all the exposures to toxic chemicals in plastics throughout their life cycle given their global spread. In many instances, risk-based regulations resulted in years or even decades of toxic exposures that could have been avoided with a hazard-based approach. For example, for years the use of a risk-based approach allowed concentrations of Bisphenol A in plastic baby products and other consumer goods in the EU that were 20,000 times higher than what is considered safe today.[1]

Therefore, a hazard-based approach is the only feasible and most health-protective approach for addressing toxic chemicals in plastics.

10. WOULDN'T PLASTIC RECYCLING BE A GOOD SOLUTION?

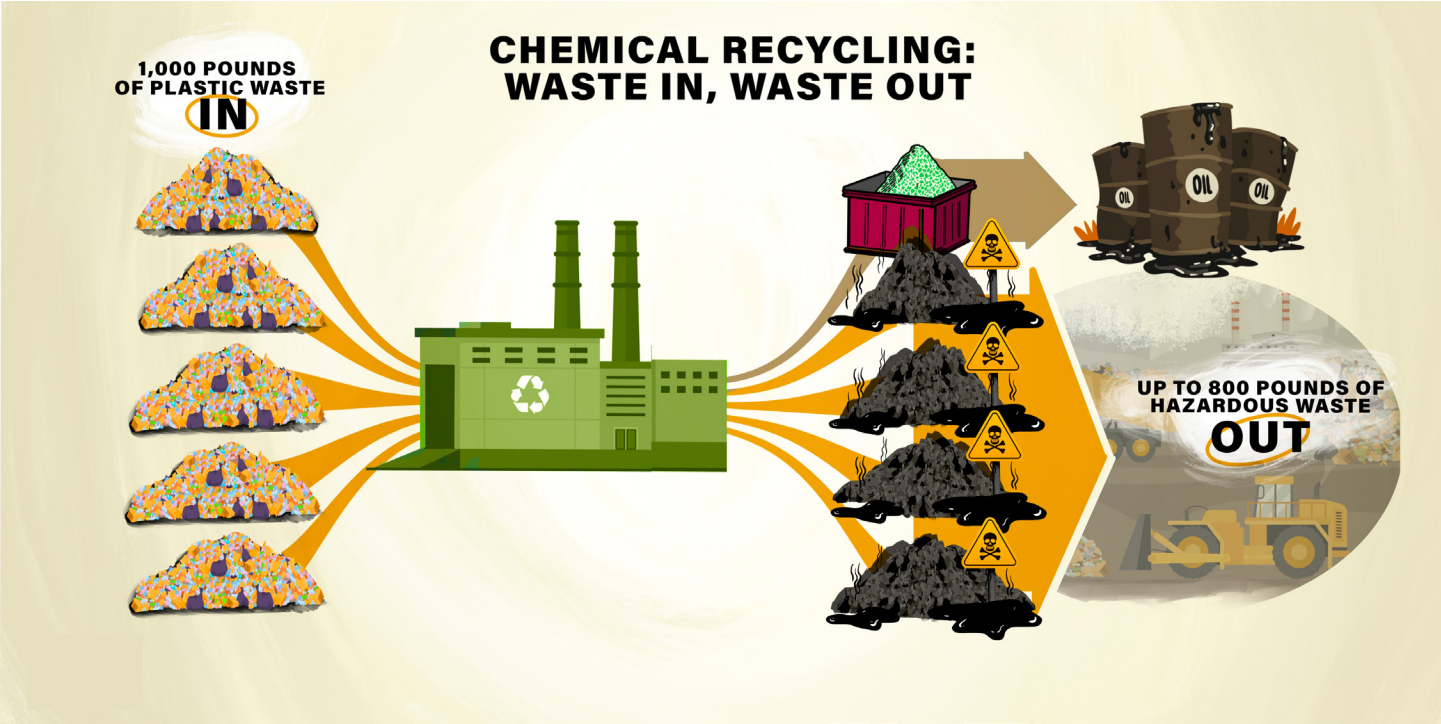
Because plastics are made with toxic chemicals, recycling plastic spreads toxic chemicals in uncontrollable ways, posing threats to the environment and jeopardizing human health, especially recycling workers' health.

Research has shown that recycled plastics contain more toxic chemicals than primary plastics. Chemicals in plastics are not labeled, so when mixed plastics are recycled, the new material contains a toxic soup of chemicals combined from the primary plastics — creating new materials with a completely unknown chemical composition. Also, when plastics are used to handle chemicals, they can contain contaminants that spread to the recycled plastic. For example, when a plastic bottle used to store pesticides is recycled, the pesticide may be found in the recycled plastic material. Chemicals may also combine and be generated in recycling processes, for example during heating, creating new hazardous chemicals found in the recycled material.

Additionally, it is important to note that plastics recycling has failed to work for decades. Recycling volumes are often reported as the volume of plastic sent to recycling, instead of how much is being recycled. Developed countries often use the phrase "recycling plastics" as a cover for exporting toxic plastic waste to developing countries, where it is often burned or landfilled.

Resources: A dataset of organic pollutants identified and quantified in recycled polyethylene pellets, Plastic Waste Trade: The Hidden Numbers, Widespread chemical contamination of recycled plastic pellets globally, Forever Toxic

1 In 2023, the European Food Safety Authority (EFSA) lowered the tolerable daily intake for Bisphenol A to 0.2 nanograms (0.2ng or 0.2 billionths of a gram) per kilogram of body weight per day, which is 20,000 times lower than in previous regulations. See https://www.efsa.europa.eu/en/topics/topic/bisphenol



11. WHAT ABOUT CHEMICAL RECYCLING?

Chemical recycling (sometimes misleadingly called "advanced" recycling) is often presented as a novel idea that will help solve the plastics crisis. But chemical recycling is nothing new – in fact, it has failed to work for decades. It is inefficient, energy-intensive, contributes to climate change, and creates large amounts of toxic wastes and toxic emissions, while producing few recycled plastics or any other useful products.

Resources: Chemical Recycling: A Dangerous Deception

12. SOME PLASTIC ALTERNATIVES ARE ALSO MADE WITH CHEMICALS. HOW ARE THEY BETTER THAN PLASTICS?

The INC should ensure that innovation does not lead to the adoption of new products and practices that may also pose threats to human health and the environment, such as using PFAS-containing paper packaging as a substitute for plastics packaging. Criteria to evaluate alternatives need to be scientifically robust.

Overall, it is important that alternatives are evaluated and that the INC avoids promoting greenwashing and false solutions, such as recycled content.

13. WHAT ABOUT BIOPLASTICS?

The term "bioplastics" is often used interchangeably to describe biobased plastics and biodegradable plastics. Both have been shown to contain toxic chemicals and most of the time the biodegradability claims are exaggerated. For some types of plastics marketed as biodegradable, the plastics simply break down into smaller pieces, creating microplastics. Others only biodegrade under very specific conditions in industrial composts and even then, may still release toxic chemicals.

Resources: Are bioplastics and plant-based materials safer than conventional plastics? In vitro toxicity and chemical composition, Biodegradable Plastics and Marine Litter: Misconceptions, concerns and impacts on marine environments

14. ARE WE TRYING TO GET RID OF ALL PLASTICS IN THIS TREATY?

No, we are not trying to ban all plastics, but right now, plastic is out of control and the production volumes of plastics need to decrease. It is also crucial to ensure that plastics do not contain toxic chemicals and that they are produced and managed in a sustainable way throughout the life cycle to eliminate harms to human health and the environment.

15. DO WE NEED TO MANAGE PRODUCTION TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT? CAN'T WE JUST PHASE OUT TOXIC CHEMICALS USED IN THE PLASTICS?

Plastics are made from chemicals, many of which are toxic, and ensuring that plastic materials are toxics-free is vital to ensure the protection of human health and the environment. However, even if all toxic chemicals that are used in plastics were magically replaced tomorrow, the current massive volumes of plastics that are being produced would still harm human health and the environment and lead to the exposure of toxic chemicals throughout the life cycle, including:

DURING SOURCING

Petrochemicals for plastics and many chemical additives are derived from fossil fuels such as oil and gas. The extraction of fossil fuels relies on the use of toxic chemicals (e.g. PFAS) and leads to releases and emissions of other toxic chemicals (e.g. PAHs).

DURING PRODUCTION AND USE

Non-intentionally added substances such as degradation products can be produced in and leach from plastics, posing health threats to workers and consumers.

DURING WASTE MANAGEMENT

Several types of waste management rely on burning plastics, including incinerators, chemical recycling, and producing refuse-derived fuels. Incinerating plastics creates highly toxic chemicals such as PAHs and dioxins that are released and contaminate nearby communities.

In addition to toxic chemicals, there is growing evidence of the many ways that plastic particles such as microplastics and nanoplastics can harm human health and the environment. In addition, the high production volumes of plastics exacerbate climate change, as plastic production requires massive inputs of fossil fuels and production facilities can produce greenhouse gasses.

The Plastics Treaty provides a chance to protect human health and the environment. These will both require banning toxic chemicals and managing plastic production volumes.

16. IS POLYMER PRODUCTION (REDUCTION) OUTSIDE OF THE UNEA RESOLUTION MANDATE?

No. The UNEA resolution mandate requires "a comprehensive approach that addresses the full life cycle of plastic…". For a successful treaty to prevent harm to health, it is critical to reduce plastics production—prioritizing elimination of plastics with toxic chemicals, including monomers and polymers, their feedstocks, and precursors.

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