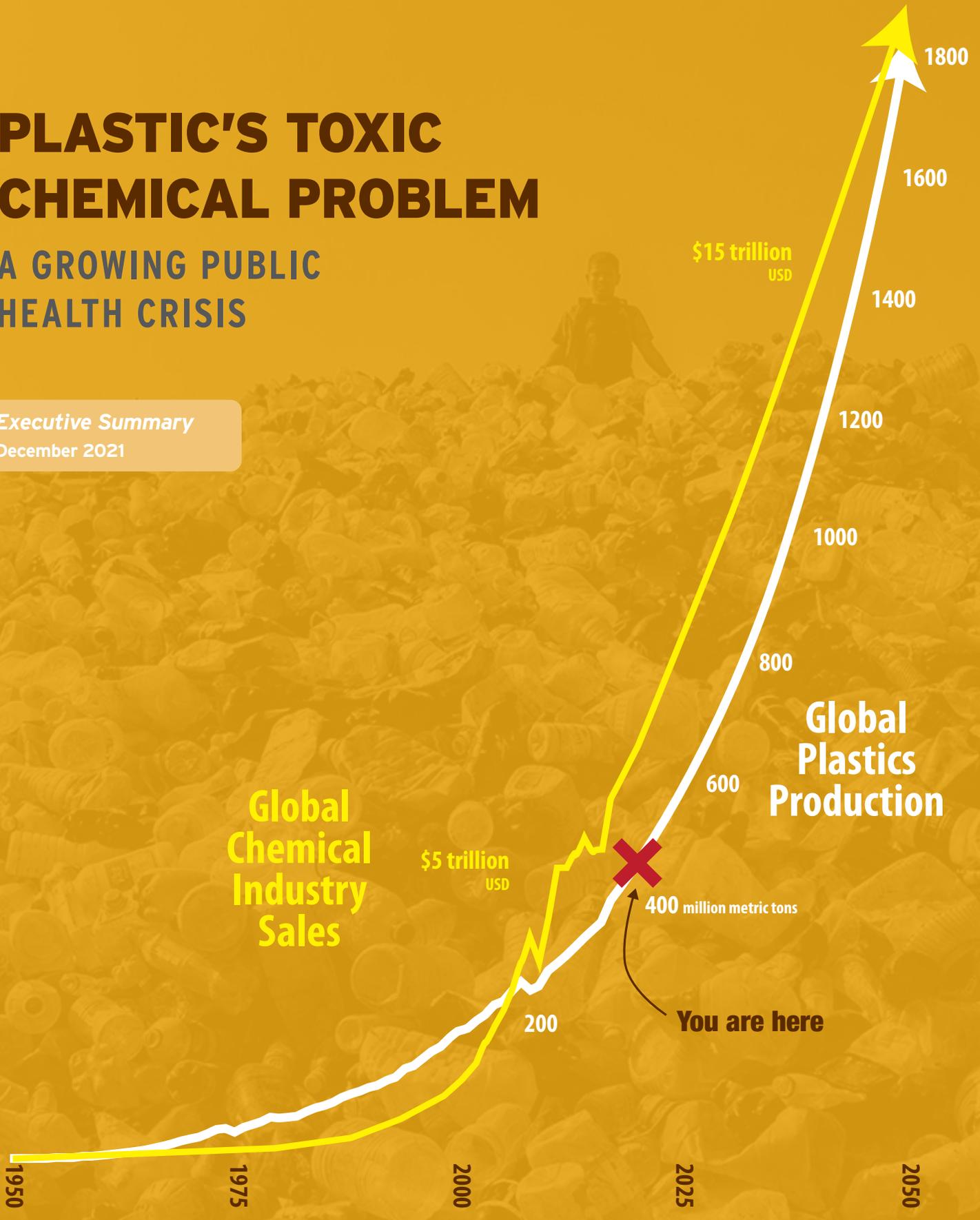


PLASTIC'S TOXIC CHEMICAL PROBLEM

A GROWING PUBLIC HEALTH CRISIS

Executive Summary
December 2021



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This executive summary encapsulates two reports:

BEACH PLASTIC PELLETS STUDY, *Plastic pellets found all over the world contain toxic chemicals* (joint IPEN-IPW report)

RECYCLED PLASTIC PELLETS STUDY, *Widespread chemical contamination of recycled plastic pellets globally* (IPEN report)



IPEN is a network of over 600 non-governmental organizations working in more than 120 countries to reduce and eliminate the harm to human health and the environment from toxic chemicals. IPEN's campaign on Toxic Chemicals in Plastics seeks to eliminate harm from chemicals in plastics when plastics are produced, used, recycled, and discarded.

www.ipen.org



International Pellet Watch is a nonprofit ecotoxicological research group whose mission is to monitor the occurrences of persistent organic pollutants (POPs), plastic waste, and plastic pellets in particular, around the world. Based at Tokyo University of Agriculture and Technology, Laboratory of Organic Geochemistry in Tokyo, Japan, the group has been gathering data and educating the public about the hazards of plastic waste since 2005.

www.pelletwatch.org

Front cover: Data for skyrocketing revenue in global chemicals industry from *Global Chemicals Outlook II* (2019); data for plastics growth derived from GRID-Arendal, Maphoto/Riccardo Pravettoni. Photo: Plastic bottles being prepared for recycling in Bangladesh. Alamy.com





KEY POINTS

- IPEN and IPW studies show that throughout their life cycle, plastics transport and release toxic chemicals globally, posing serious threats to human health and ecosystems.
- How we manage plastics will be critical in the coming years. Several international instruments are already trying to tackle identified issues.
- The new studies demonstrate that plastics are a significant source of toxic chemical pollutants, so it is crucial that all initiatives that aim to create more sustainable uses of plastics look beyond waste to address harm and damage relating to toxic chemical additives in plastics.

IPEN IS CALLING FOR AN INTERNATIONAL PLASTICS TREATY TO:

- Ban the use of toxic chemical additives in plastics, identify essential uses of plastics, scale down all other production and phase out all non-circular plastics;
- Apply extended producer responsibility programs to ensure industry bears the costs of plastics throughout their life cycle;
- Require essential uses of plastics to be designed for durability and reuse;
- Ensure end-of-life treatment of plastics waste does not release toxic chemicals, litter, or contribute to climate change, and bans waste export and incineration; and
- Include funding for implementation and monitoring.

In the meantime, greater transparency on toxic chemical additives used in plastics is needed, along with data on the quantities of plastics made, traded, and disposed of.

INTRODUCTION: WHAT'S THE PROBLEM WITH PLASTICS?

There are several aspects of plastics that present risks to human health and the environment. These include the component monomers, some of which are known to be toxic, as well as the chemicals intentionally added to all plastics to make them function in their intended uses. These chemical additives include plasticizers, flame retardants, UV stabilizers, and colors. Further, dangerous by-products are created during plastics production and waste management.

People and the environment are exposed when these chemicals leach from plastic products or are emitted from production, recycling, and waste facilities. Toxic chemical additives also present a serious barrier to recycling plastics waste, as there is no information available internationally on which chemicals are present and in what amount, leading to unquantifiable risks associated with recycled material.

INTERNATIONAL ACTION

The international community has already taken some action against plastics. For example, the Basel Convention, which aims to prevent the shipment of hazardous wastes from developed to less developed countries, has been amended to include plastic waste.

The Stockholm Convention on Persistent Organic Pollutants (POPs) is reviewing bans for several toxic chemical additives and considering the potential of plastics to transport chemical pollutants in the environment.

And under the auspices of the UN Environment Assembly (UNEA) governments are discussing a global instrument to tackle marine litter and plastic pollution. The next UNEA meeting to discuss this instrument is to be held in February 2022.

IPEN NETWORK INVESTIGATES THE PROBLEM AROUND THE WORLD

Several scientific studies have indicated that plastics play a significant role in transporting toxic chemicals around the world, threatening both human health and the environment.

To get a global picture of the situation, IPEN recently worked with International Pellet Watch (IPW) and its NGO partners in 35 countries to investigate the extent of the problem relating to toxic chemicals present in:

- spilt or lost pre-production plastic pellets found on beaches; and
- recycled plastic pellets purchased from recycling facilities around the world.

Both studies reveal the presence of toxic chemical additives in beach pre-production and recycled plastic pellets that pose multiple health threats to humans and the environment. For some toxic chemical additives, any exposure can trigger health impacts, such as certain cancers or changes to hormone activity (known as endocrine disruption), which can lead to reproductive, growth, and cognitive impairment. Many of the additives have several other known health impacts, persist in the environment, and bioaccumulate in exposed organisms.

A recent systematic review (Wiesinger et al. 2021) estimated that over 10,000 chemicals are used in plastics; over 5,000 of these are chemical additives that contribute to the function of products. The review noted that many of these chemicals are harmful, yet only a few are subject to any regulatory control.

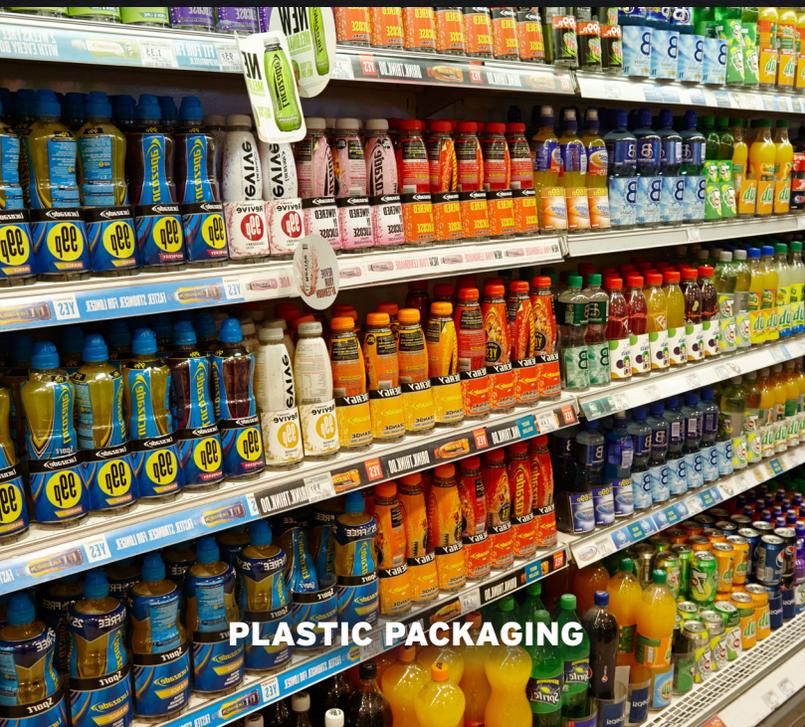
In fact, regulatory information on the safety of many chemical additives is not complete, and there is little to no knowledge about the risks associated with exposure to the complex mixture of toxic chemicals currently transported and released from plastic pellets.



PRODUCTION



PLASTIC PELLETS



PLASTIC PACKAGING



PLASTIC WASTE



RECYCLED PLASTIC REPROCESSING



RECYCLED PLASTIC PRODUCTS

A DEEPER DIVE INTO IPEN'S GLOBAL STUDIES

BEACH PLASTIC PELLET STUDY

The IPEN and IPW study, *Plastic pellets found all over the world contain toxic chemicals*, examined the presence and concentration of two groups of toxic chemicals in beach pellets in over 20 countries. Beach pellets are pre-production pellets



Beach pellet collection in Costa Rica. Photo: RAPAL

lost during the manufacture of plastic products or spilled when the pellets are transported. The pellets travel through waterways and oceans, ending up on beaches around the world. Pre-production plastic pellets are the feedstock used to manufacture new plastic products.

The toxic chemicals assessed included:

- **UV Stabilizers** Ten benzotriazole UV (BUV) light stabilizers, which are intentionally added to plastics to prevent degradation by sunlight. Several are regulated in the EU and one, UV-328, is being recommended for a global ban through addition to the Stockholm Convention on Persistent Organic Pollutants (POPs); and
- **PCBs** Pollutants known as PCBs (polychlorinated biphenyls), were banned under the Stockholm Convention in 2001, but because of their widespread use, are still found in the environment. IPEN examined the role of beached plastic pellets in absorbing and transporting 13 different PCB compounds in the environment.

The study found beach pellets at 22 test locations, which included sites in Africa, North and South America, Asia, Australia, the Caribbean, and Europe.

The samples were analysed by Ms. Mona Ali-doust and colleagues of the Tokyo University of Agriculture and Technology under supervision of Professor Hideshige Takada, who has tracked toxic chemicals in plastic pellets since 2005 as part of the International Pellet Watch initiative.

They found that all samples from all locations contained all ten BUVs and all 13 PCBs included in the study. Half of the locations had samples with PCB levels that were highly or extremely polluted.

Known hazards associated with BUVs include their toxicity to aquatic life with long-lasting effects. Several chemicals in the BUV group are also being assessed as persistent, bioaccumulative, and toxic (known as PBTs) and as endocrine disruptors. Because of their structural similarity, IPEN believes BUVs should be investigated as a group, similar to the approach being taken by a number of regulatory authorities to PFAS (per- and poly-fluoroalkyl substances) - known as "forever chemicals".



The hazards associated with PCBs are myriad. Based on their toxicity and environmental persistence they were banned, as a group, under the Stockholm Convention in 2001. In 2015, the International Agency for Research on Cancer (IARC) formally agreed to classify PCBs as carcinogenic and a 2018 study indicated that PCBs still threaten the long-term viability of killer whales. Because of their widespread use in industrial equipment such as transformers, and other sectors including paper, plastics, lubricants, and paints, they still pollute the environment through legacy products already on the market prior to the ban. There is a goal, under the Stockholm Convention, to achieve environmentally sound management of PCB waste by 2028.

The IPEN beach pellet study demonstrates how the plastics industry causes problems even before products enter the marketplace and reach the consumer. By acting as a vector for toxic chemical additives like BUVs, and existing toxic pollutants, like PCBs, pre-production plastic pellets are an important factor threatening the environment and human health.

IPEN beach pellet study recommendations

To tackle the problem of toxic chemical additives in plastics entering the environment, international agencies and policy makers should:

- Support the addition of UV-328 to Appendix A in the Stockholm Convention without exemptions;
- Accelerate the phase-out of ‘groups’ of toxic chemicals, rather than taking a substance-by-substance approach;
- Establish a right-to-know regulation that requires producers to publicly disclose substances and chemical additives used in products;
- Ensure that the polluter pays principle is enforced; and
- Ensure that companies producing and handling pellets adopt strategies to avoid spills into the environment.

The plastics industry should:

- Establish routines to prevent the release of plastic pellets during production, transport and storage;
- Stop adding toxic chemicals to plastics products;
- If some additives are essential for specific plastic products, the safety of those additives should be confirmed by a third-party organization; and
- List plastic ingredients, including additives, on labels and make chemical content of plastics traceable throughout its life and waste stages.

Overall, governments should work towards decreasing the production of non-essential plastics, including ending subsidies for fossil fuel extraction and plastic production facilities. Global agreements should prevent the release of plastics into the environment.

RECYCLED PLASTIC PELLET STUDY

IPEN's second study, *Widespread chemical contamination of recycled plastic pellets globally*, examined the presence of 18 chemical additives that are found in recycled pellets available on the market around the world. Of these, 12 have confirmed health impacts; information on the remaining six is insufficient to determine their safety.

Some countries are pursuing plastics recycling as one option for dealing with large amounts of waste generated each year, however, collection and recycling rates have remained an obstacle. Further, policy makers should be concerned about the toxic nature of plastics, and the fact that chemical additives do not need to be labelled or monitored throughout the supply chain.



Shredded plastic waste being recycled into plastic pellets in Sri Lanka. Photo: CEJ

Plastics are traded internationally and some low- and middle-income countries accept large volumes of plastics waste, including electronics, which contain a heavy load of toxic chemical additives, from higher-income countries. These countries often lack the infrastructure required to monitor or control chemical hazards from this waste.

Chemical additives are not removed when plastic material is recycled and turned into pellets, so they end up in recycled pellets – which are then used in a range of new consumer products, such as

kitchen utensils, toys and furniture. Chemical additives can also react within the recycling process to generate more toxic substances, such as dioxins.

IPEN's recycled pellet study analyzed recycled pellets for:

- **Flame Retardants** 11 flame retardants, including polybrominated diphenylethers (deca-, octa- and penta-BDE), hexabromocyclododecane (HBCD) and tetrabromobisphenol A (TBBPA), and newer, replacement brominated flame retardants including 1,2-bis(2,4,6-tribromophenoxy)ethane (BTBPE) and octabromo-1,3,3-trimethylphenyl-1-indan (OBIND);
- **Bisphenol A** (BPA);
- **UV Light Stabilizers** Six benzotriazole ultraviolet stabilizers (BUVs), including UV-327, UV-328, and UV-P.

All of these chemicals are present in plastic waste and have associated human health impacts, including disruption to endocrine, immune, and reproductive systems. Even the replacement flame retardant chemicals, BTBPE and OBIND, are slow to degrade and have been found in the Arctic, as they can be transported long distances.

High-density polyethylene (HDPE) was selected as the test material as it is one of the most used and recycled plastics today.

IPEN's NGO partners bought HDPE pellets from local recycling companies in 24 locations across Africa, Latin America, Asia, and Europe. The samples were analyzed at the University of Chemistry and Technology Prague, in the Czech Republic. All of the samples contained at least one chemical additive and 21 samples contained additives from each of the three groups tested. Only one sample, from Vietnam, contained just a single type of contaminant. A total of 18 chemical additives were included in the study and over half of the samples contained 11 or more of these additives.

The study demonstrates that chemical contamination of recycled plastic pellets is a widespread problem. Further, the presence of brominated flame retardants and bisphenol A in all samples, (other than those bought in Vietnam) indicates that plastics waste from electronics and polycar-



bonate products generally feed into HDPE recycling streams globally.

Almost all recycled pellet samples analyzed contained the flame retardant decaBDE, which was banned under the Stockholm Convention in 2017, with no exemptions for recycling. 17 out of the 23 countries in this study have ratified this decision, including the two countries where decaBDE was not detected. Two other BDEs, penta and octa, were present at lower frequencies and at lower levels, indicating that their elimination, agreed to in 2009, has started to take effect.

One conclusion of the report is that widespread and uncontrollable use of toxic chemical additives in plastic products makes much of the recycled plastic waste an unacceptable raw material for making new products. This is important as new products can cause high levels of exposure to humans and the environment, and are especially dangerous for children and other vulnerable groups. Continued use of toxic chemical additives in plastics render most plastics in use today 'non-circular'.

IPEN recycled pellet study recommendations

To stop toxic chemical additives in plastics damaging the circular economy, international agencies and policy makers should:

- Implement the same chemical safety rules to materials made with recycled plastics, as to those made from virgin plastics;
- Accelerate the phase-out of 'groups' of toxic chemicals, rather than taking a substance-by-substance approach;
- Use regulation to promote safe non-chemical alternatives that support the transition to a circular economy; and
- Halt the export of plastic waste containing toxic chemical additives, especially electronics.

Manufacturers should:

- Redesign products to allow for a toxics-free circular economy, including the phase out toxic chemical additives, and avoiding use of alternatives that are known or suspected to be toxic; and
- List plastic ingredients, including additives, on labels and make chemical content of plastics traceable throughout its life and waste stages.

Overall, governments should work towards decreasing the production of non-essential plastics, including ending subsidies for fossil fuel extraction and plastic production facilities. Global agreements should prevent the release of plastics into the environment.



NEXT STEPS

In working with its international network of participating NGOs, and IPW, on these studies, IPEN calls for action to protect all people, including women, children, and communities in low- and middle-income countries that are particularly vulnerable to the threats from plastics production, use, and end-of-life management. The two studies demonstrate that problems exist at different stages of plastic product life cycles, from pre-production to recycling, resulting in people and wildlife being exposed to a vast array of toxic chemicals.

As there is no international legal right-to-know what chemicals are in plastics, and information on many chemical additives is limited, there is

little people can do to protect themselves. Many low- and middle-income countries will struggle to deal with the implications of these issues as they have insufficient capacity to manage global trade in plastics and plastics waste. This makes the need for international action on plastics all the more important. Considering the impacts exposed by these studies across the world, it is vital that mechanisms for raising financial resources, technical support, and capacity building are also included in any international agreement.

FREQUENTLY ASKED QUESTIONS

What is the magnitude of the problem associated with beached pellets?

The exact amount of plastic pellets entering the environment is not known, but it is estimated to be in the hundreds of thousands of tons each year; in the present study plastic pellets were found at 22 beaches, including sites in Africa, North and South America, Asia, Australia, the Caribbean, and Europe. A voluntary industry initiative, Operation Clean Sweep, has not published any data on pellet losses. In 2012, the Honolulu Framework called for such information, and if it was not forthcoming, suggested that regulations to prevent pre-production pellets entering the environment should be introduced.

[Honolulu Strategy](#)
[Operation Clean Sweep](#)

What is the magnitude of the problem associated with recycled pellets?

It should be noted that the IPEN recycled pellet study focused on three types of toxic chemical additives only, but there are a multitude of hazardous chemicals used as additives in plastic pellets. A recent systematic review found that over 10,000 chemicals are used in plastic products (Wiesinger et al. 2021). Of these, 2,486 are of potential concern in terms of their toxic properties; but more than half of them are not controlled in any way. Another study assessed the chemical content of products made from a variety of recycled plastics, and found that overall they contained more chemical components than products made from virgin polymers (Lowe et al. 2021).

[Wiesinger et al. 2021](#)
[Lowe et al. 2021](#)

How come toxic chemical additives are used in plastics?

It may be surprising to discover that toxic chemical additives are extensively used in plastic products. They are used to make the products functional. Consumers might expect that regulations would prevent them being exposed to substances that have the potential to cause them health problems, or threaten life in the oceans through discarded plastic products. Primarily, this situation has arisen as the plastics industry took hold in a time before regulations to assess chemicals used in products existed. By the time regulators started catching up (and in most countries around the world, there is still no such legislation today), tens of thousands of products had already made their way into people's everyday lives. This issue is incredibly important, as many chemicals in products are linked to multiple health effects. These include causing cancer, reproductive diseases, and endocrine (hormone) disruption, which leads to obesity, growth problems, and cognitive function impairments. Chemicals can also have skin, eye, and respiratory system impacts, and be toxic to specific organs, as well as having multiple environmental effects such as persistence and bioaccumulation.

Evidence of health and environmental impacts and what regulators are doing?

Polybrominated biphenyl ethers (PBDEs) and hexabromocyclododecane (HBCD) are known to disrupt human hormone (endocrine), immune, reproductive, and nervous systems, as well as negatively impacting the IQ of children. Three PBDEs, penta-, octa- and decaBDE, and HBCD have been added to the Stockholm Convention. Tetrabromobisphenol A (TBBPA or TBBA) is produced in the highest volumes, but it is known as an endocrine disruptor, and 1,2-bis(2,4,6-tribromophenoxy) ethane (BTBPE) and octabromo-1,3,3-trimethylphenyl-1-indan (OBIND) are increasingly being used as replacements, but they also persist in the environment and have been found in the Arctic - indicating that they can be transported long distances through the environment.

Bisphenol A (BPA) has multiple health impacts, including on the reproductive, metabolic, immune, and nervous systems. It has been shown to impact fetal brain development. In the EU, BPA is classed as a substance of very high concern, and its use is restricted in baby bottles, food contact products, and till receipts. It is also prohibited for use in baby bottles in many additional countries, for example China, Colombia, and the US.

Benzotriazole UV stabilizers are a group of additives used to slow down plastics' degradation from light exposure. They have been found in



human breast milk, urine, and fatty tissue. While many are being used, information on their health and environmental impacts are scarce (for example, many BUV entries in the European Chemicals Agency database indicate that data is lacking). Nevertheless, the EU has classified several of them as persistent, bioaccumulative, and toxic, and as substances of very high concern. UV-328 is currently proposed to be added to the Stockholm Convention. Information from companies on UV-327 indicates that the additive may cause damage to organs, is harmful to aquatic life with long-lasting effects, causes serious eye irritation, and may cause respiratory system irritation.

Polychlorinated biphenyls (PCBs) consist of over 200 compounds, which were widely used in industrial applications including transformers and heat exchangers between 1930-1990. PCBs have been shown to cause cancer in animals and have effects on the immune, reproductive, nervous, and endocrine systems, as well as other health effects. Concerns about their safety saw several countries ban their use in the 1970s, and a global ban was agreed in 2001 when they were in the first batch of chemicals added to the Stockholm Convention.

Why strong international action to control plastic products and waste is needed urgently

Chemical additives are used in vast quantities in plastic products to make them functional (up to 30-40% of some plastics are plasticizer additives). Many of these additives are classified as toxic or their hazardous properties are being investigated (for many there is simply no information on their safety).

All stages of plastics production – use, recycling, and disposal – expose people and ecosystems to toxic chemicals. This includes: spilled or lost pre-production pellets which are transported into the marine environment and onto beaches; transfer of plastics additives from products into house dust, air, and food; leaching from plastic products in landfills; and emissions from the incineration of plastic wastes.

Plastic products may have become ubiquitous in everyday life, but that shouldn't be a reason to continue their use in the light of growing knowledge of the pollution and health risks they present.

The huge volumes of plastics in circulation and generated as waste means fast action is required to turn the tap off so further pollution is prevented. Once plastics are in the environment they take centuries to degrade. Once the toxic chemicals in plastics are dispersed into the environment, it is impossible to remove them.