PAPER INSTEAD OF PLASTIC? SAME SINGLE-USE TRAP

Why substituting single use plastic for other single use materials won't solve the ocean pollution crisis

Plastic pollution has emerged as a **defining environmental challenge** of the 21st century, with particularly devastating consequences for marine ecosystems.

EACH YEAR, AN ESTIMATED 19 TO 23 MILLION TONNES OF PLASTIC

enter aquatic ecosystems.

Plastic pollution causes **environmental impacts throughout the entire life cycle of plastics :**



As plastic is derived from petroleum, it represents a **secondary endeavour** of the fossil fuel and petrochemical multinationals.

The process of **manufacturing plastic** accounts for...

5% of global GHG emissions !

These various pollutions result in the dispersion of a significant amount of chemicals and additives which **strongly impact both marine and human life.**

Currently, the ocean holds an estimated **150 MILLION TONNES OF PLASTIC.**

The surge of global plastic production has grown from **1.5 million tonnes** in 1950 to **450 million tonnes** in 2020 and projected to reach **736 million tonnes** by 2040.



In Europe, single-use plastics dominate beach litter, making up **50% of the waste**, with the top ten items accounting for 86% of the total.

In western Europe, the average annual plastic consumption is around 150kg per person, which is **more than twice the global average** of 60kg !

150 kg / year

Although recycling is often promoted as a solution to plastic pollution, its impact remains **highly limited** :

ONLY 9% OF ALL PLASTIC WASTE HAS EVER BEEN RECYCLED.

THE SUP DIRECTIVE

In July 2021, **the Single-Use Plastics Directive banned the placing on the market of numerous single-use plastic items** (plastic cutlery, straws, cotton swabs, stirrers, ...) within the EU. While raising widespread awareness of the impacts of plastics on marine ecosystems, biodiversity, and human health remains an ongoing process, the directive has already led to a reduction in the presence of certain single-use plastic items on the market.

One consequence that was not fully anticipated has been the increased use of alternative single-use materials (such as composite cardboard straws containing plastic or bamboo cutlery). While these products were introduced as substitutes for single-use plastics, **growing evidence indicates that many can have impacts on marine ecosystems and human health comparable to those of the plastic items they replace.**

Why single-use paper cannot be considered more sustainable than single-use plastic ?

THE EXAMPLE OF THE PAPER CUP'S JOURNEY

Paper cups can be **misperceived as greener alternatives**. Marketed as natural and renewable alternatives to plastic, most paper cups are actually composite products :

paperboard — plastic coating!

This matters because the **environmental impact of a product** - in this case, single-use paper and cardboard items, including food packaging and take-away containers - is not determined solely by its visible outer material.

It depends on the **entire life cycle of the product** : how it is manufactured, which chemicals are added, how it is used, and whether it can be effectively recycled or safely returned to the environment.

THE MAKING OF SINGLE-USE PAPER: NOT SO RENEWABLE

The first common claim is that paper is made out of renewable resources, unlike most plastics, which are derived from fossil fuels. **This is partly true, but incomplete**. Producing paper still requires :

forests and land, water, chemicals, energy,

and large-scale demand for disposable paper products **still creates pressure** on ecosystems and supply chains.

Single-use paper products are made out of a pulp whose raw material is **wood**. Although wood is considered a renewable resource, the increased need for wood to produce more single-use paper products can lead to **deforestation, floods, and drought** in the areas that provide the raw material.

The pulp and paper industry, which provides cellulose pulp and paper, bio-based energy and chemicals, is one of the **largest energy consumers, greenhouse gases (GHG) and pollutant emitters** among manufacturing industries.

"RENEWABLE" ≠ "IMPACT-FREE"!

Paper cups depend on functionalization

Functionalizing paper cups, like most items that comes in contact with food, requires adding barrier properties, such as **hydrophobicity** (water resistance) and **oleophobicity** (resistance to oils and fats), to enable them to safely contain liquids and food.

The most common barrier is a thin layer of polyethylene (PE), a petroleum-based plastic, or sometimes PLA, a bioplastic - layers are hard to separate and thus recycle if even possible. This barrier is what prevents leakage, but it also makes the cup a **mixed-material** (mixed with plastic !) and thus **difficult to recycle at scale.**

PE
PLA

Usage phase: single use paper/cardboard are often not chemically neutral

Another common claim is that paper cups are safer because they do not create microplastics deposits in the same way as conventional plastic cups.

This is misleading because many paper cups and single use papers still contain **plastic linings or coatings**, and thus also contain **chemical additives** from manufacturing and barrier treatments.

Research has found that paper food-contact materials can release harmful substances due to the cocktail of substances used to make the product :

FUNCTIONAL — WATERPROOF — HEAT-RESISTANT — PRINTABLE

Paper products contain petroleum-based materials, and high amounts of chemicals in paper-based single-use products (such as chlorine, sulfuric acid, etc.) have been reported, averaging 1.8 g of untreated and non-recyclable chemical contaminants being released to the natural environment **per paper cup**.

These chemicals included three mutagenic and eight carcinogenic chemical substances that can leach from the studied straws **within 5 min of exposure** to the environment or beverages.

FOREVER CHEMICALS AND HEALTH IMPACTS

According to a study published in the Belgian scientific journal *Food Additives & Contaminants*, PFAS concentrations were found to be **three times higher** in water-resistant paper food packaging than in equivalent plastic packaging, reaching approximately 3 ng/g.

The study, based on a comparison between water-resistance paper packaging and plastic packaging, concludes that: "These plant-based 'eco-friendly' straws are not necessarily a more sustainable alternative to plastic straws, as they may represent an **additional source of PFAS exposure for both humans and the environment.**"

PFAS are commonly used to waterproof and functionalize paper and cardboard packaging, providing the grease- and water-resistant barrier properties required for many food-contact applications. Often referred to as "forever chemicals" because they are **extremely persistent and resistant to degradation**, PFAS have been widely used in industrial applications since the 1940s.

Exposure to the most studied PFAS has already been linked to an array of adverse health effects such as :

- liver dysfunction
- an increased risk of cancers
- delayed puberty
- thyroid disorders (including hypothyroidism)
- reduced immune response to vaccines

...**and significant environmental contamination.**

END OF LIFE: BIODEGRADABLE DOES NOT MEAN HARMLESS

Paper degrades faster than plastic in many environments, but that does not make paper cups environmentally benign. Both inside and outside of waste systems, its plastic lining and chemical treatments **cause pollution**, especially in rivers and oceans.

Single use papers and cardboard can be considered to have **impacts comparable to single use plastics** due to the presence of lining which harms the environment, particularly marine environments and wildlife, in the same way single use plastics would (persist in ecosystems for centuries, fragmenting into microplastics that contaminate water, soil, and food chains).

The story of recycling

Recycling now depends on separating fiber from plastic - that separation requires **specialized infrastructure** and many systems do not have the capacity to process composite cups efficiently.

This leads single-use products to often be **discarded in landfills,** contaminating the environment and potentially human health.

Plastic products are easily recycled after use but can also be reused by the primary user in various applications, whereas paper cups have very low chances of being reused and it is very difficult to recycle them due to the application of polymer coatings inside the paper cups.

PAPER CUPS: NOT THE ONLY EXAMPLE OF UNSUSTAINABLE SINGLE-USE PAPER/CARDBOARD

Fruit juice cartons (aseptic beverage cartons)
These are often perceived as a sustainable alternative to plastic bottles, but they are actually **complex multi-material packaging**. A typical juice carton contains :



Because these materials are permanently bonded together, they are **difficult and costly to recycle**. They cannot be recycled through aluminium can streams, and they require specialized recycling facilities that are not widely available in many regions.

Ice cream tubs

Many manufacturers have replaced plastic tubs with **paperboard containers**, but these are often lined with plastic coating on both sides.

PLA (polylactic acid), a bioplastic which is derived from renewable feedstocks such as corn or sugarcane, is increasingly used for this purpose.

However, PLA alone performs poorly at very low temperatures, so it is often **blended with PBAT, a fossil-based biodegradable plastic**, to improve flexibility and durability.

As a result, these containers remain composite materials that are **difficult to recycle** in conventional paper recycling streams.

THE BIGGER PICTURE: WHY SINGLE-USE PERSISTS

The dominance of single-use packaging is not simply a matter of consumer preference. It is also shaped by **industrial design choices, packaging supply chains, branding, and lobbying.**

Fossil fuel industries need a secondary market, especially in light of the rise of renewable energies.

Paper can be used as a substitute in green marketing narratives, but that does not challenge the root problem:

A BUSINESS MODEL BUILT AROUND DISPOSABILITY.

That means paper cups can be used as a form of greenwashing, when they are in fact used to prioritise convenience, profitable models, secondary markets and linear economy systems - rather than circular ones - while hiding **their full environmental cost**.

SOLUTIONS: WHAT SHOULD CHANGE?

Public policy/governance

Key idea: reduce demand at the source rather than make disposable items marginally less harmful.

Move from material substitution to single-use products waste prevention. **The best cup/waste is the one that is never produced.** That means questioning the need for single-use items and reducing their use in cafés, offices, schools, events, and take-away systems.

Systemically expand reusable systems: deposit-return cups, shared cup libraries, on-site washable cups, and refill infrastructures are already workable alternatives.

Support material-neutral policy (material neutral approach): regulation should not encourage paper use simply because it is not plastic. Rules should focus on total footprint, reuse, toxicity, recyclability in real systems, and reduction of single-use items overall. This also entails a clear and comprehensive definition of materials considered to be plastic, including when low percentages of plastic are present in the item itself.

Businesses and individual citizens

Contribute to the existing and expanding systems encouraging reuse.

Behavioral and cultural adjustments : normalizing **reusable containers**, encouraging **bulk and refill systems**, and **making reusable options convenient** at the point of sale can shift habits at scale.

It is important to note that individual actions matter most when they help build new norms and infrastructure, rather than serve as a substitute for policy!

LEAVE THE DISHES HERE

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