THE TREATMENT OF MICROFIBERS

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IN LIFE CYCLE ANALYSIS AND PRODUCT ENVIRONMENTAL FOOTPRINT APPLICATIONS

INDEX

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NB. Opinions expressed are those of the authors and are not necessarily those of Cotton Incorporated or The Bremen Cotton Exchange.

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EXECUTIVE SUMMARY:

(In the interests of brevity, this summary does not include sources. For these, please see the associated text in the body of the report)

Plastic microfibres are microscopic particles generated by the physical and chemical degradation of consumer and industrial plastic products including apparel. They are commonly categorized as microplastics - particles less than 5 millimeters (about 0.2 in or 5,000 microns) across – and nanoplastics - particles between 1-1,000 nanometers (1 micron = 1,000 nanometers) across. Plastic microfibres are found in every ecosystem on Earth even in the remotest locations - from the Mariana Trench to Everest, and from Antarctica to Tibet. Microplastics affect everyone and everything, everywhere.

Worldwide, anxiety about this ubiquity and its potential impacts on human and environmental health is increasing. Chemicals associated with these synthetic textile polymers are a key aspect of this concern. Polyester (PET) polymers are the primary polymers used in synthetic apparel. Some 2,566 chemicals are either marketed for use in PET, are present in PET, or are released from PET. Only 31 of these are known to be not hazardous, 31%, are known to be hazardous, but the vast majority are without hazard data. In other words, they may be chemicals of concern, or they may not be. We just don't know.

The impact of microfibers remains uncertain but evidence of serious harm is mounting A study published in May 2024, noted a higher risk of a composite of myocardial infarction, stroke, or death from any cause in patients where micro and nanoplastics were detected, than in those in whom these particles were not detected. In a study published in September 2024, micro and nano-plastics were identified in the human bone marrow of leukemia patients. Another 2024 study found that samples from livers, kidneys, and brains of autopsied bodies exhibited significant increases in micro and nanoplastics between 2016 and 2024. Brain samples from those who had dementia, including Alzheimer's disease, contained up to 10 times more plastic by weight than healthy samples.

The petrochemical industry is approximately 100 years old. Polyester has been produced in volume for less than 70 years. But serious environmental and human health implications associated with the buildup of microplastics and nanoplastics are already being identified.

In contrast, natural fibers have been produced, used, and worn for thousands of years, and we do not see a buildup of these fibers in the environment or our bodies or their impact on human health.

- In short, plastic microfibers are a completely different hazard category than other microfibers and must be treated as such in Life Cycle Assessments (LCAs) and Product Environmental Footprints (PEFs). Recognizing this fundamental difference, the European Commission's March 2024 resolution on the Green Claims Directive, specified that the PEF for Apparel and Footwear must incorporate a microplastic assessment. The PEF Technical Secretariat, however, has unilaterally decided to 'transition' the term "microplastics" to "fiber fragments", and to replace 'microplastic release' with the release of all microfiber types, including natural fibers. Moreover, the PEFCR will be based on the premise that there is no difference between plastic and any other type of microfiber, other than durability and rates of shedding. The French PEF has adopted a similar approach. That approach is inconsistent, both with the EU Commission's intent and with prevailing science.

- The sources tapped by both the French and EU PEFs to evaluate microfiber impact are not scientific organizations but commercial entities. The potential conflict of interest stemming from the involvement of stakeholders deeply tied to the production of plastic apparel, throughout the PEF process, is pertinent and significant. Such conflicts could undermine the scientific foundations of environmental legislation and impede the effective management of long-term environmental challenges. Microfibers affect everyone everywhere. Consultation on their treatment must be global and broad-based.

- In 2019 plastic waste from all sources amounted to 353.3 million tonnes of which 11% was clothing and other textile waste (by 2023 waste had risen to 398.9 million tonnes). Waste that is not handled correctly leaks into the natural environment. In 2019, plastic waste leakage from littering, intentional or illegal dumping, accidental release, and poorly managed landfills totaled 60 million tonnes. Of this, approximately 8.3 million tonnes came from apparel - and only ≈1.3 million tonnes of that was in the form of microfibers. The other 7 million tonnes were leaked as macroplastics - primarily as waste synthetic clothing. In other words, washing apparel as a source of fiber release - once believed to be the primary concern - is now known to be largely irrelevant. Not only are fibers released constantly in wear, but the most important source of micro and nano plastics going forward will not be apparel in production and use. It will be particles and fibers released from the accumulation of mismanaged apparel waste that has leaked into the natural environment. If macro plastic production, waste, and leakage are not addressed as a matter of urgency, we will inevitably be left with a global microplastic problem well beyond the reach of LCAs and PEFs. Current EU and French PEF and associated LCA proposals, to restrict the inventory and impact calculations to fiber fragment shedding through the domestic laundering process and their impact on the marine environment, are completely inadequate.

- Toxic fiber treatments are a concern However, both the French and the EU PEF are intended for use by brands making claims for specific items of apparel. Whether a finishing treatment has or has not been applied will be known. To be remotely valid any PEF should reflect this with a Finishing option. The EU PEF offers one. The French PEF does not. If a microfiber complement is to be added to natural fibers because treatments can be harmful. Then, this should automatically be related to whether a finishing option was or was not selected. It should not be slapped onto every natural fiber, willy-nilly in a haphazard and unscientific manner, as both the EU and French PEF currently propose.

- Fashion value chain LCAs/PEFs must make it clear that plastic fibers contain hazardous chemicals, and such fibers may create exposure to the different chemicals used throughout the item's life cycle. Just as packaging for tobacco products must include a health warning, we suggest that the following warning might be appropriate on point-of-sale packaging for all products containing synthetic fibers:

"Caution: Plastic Clothing May Be Hazardous to Your Health, that of your Family, and that of every other living creature."

PREAMBLE

In the face of escalating climate change and environmental degradation, companies and regulators have sought to aid more sustainable decision-making by determining the environmental impact of products. To this end, Life Cycle Analysis/Assessment (LCA) and LCA-based Product Environmental Footprint (PEF) tools have been developed. LCAs are used to quantify the product's environmental impact throughout its entire life cycle, from the energy and raw materials used in its production to the waste generated when it reaches its end-of-life, and to assess the potential environmental impacts of these factors in terms of carbon (greenhouse gas, GHG) emissions, water use, eutrophication, toxin release, etc. A PEF is a method for combining and communicating these environmental impacts in a single metric. Both are generally presented as scientific, rigorous, and precise, permitting objective and impartial evaluation of the relative impacts of the products concerned. In reality, LCAs [1] and PEFs [2] are highly subjective. A range of system boundaries and methodologies are acceptable under ISO LCA standards. As a result, product A can appear more sustainable than product B under one system/methodology, while under another, the opposite applies. [3]

How the various impacts should be combined into a PEF is a further completely subjective decision. Weightings are inevitably highly subjective, and different choices will generate radically different outcomes. [4]

It follows automatically that how textile microfibers should be treated in LCA and PEF applications will be a subjective decision - a matter of opinion. It also follows that LCAs and PEFs should be deployed with caution, particularly when we consider that the Global North has commitments such as those defined by the Sustainable Development Goals (SDGs) and the Kunming Montreal Biodiversity Framework, that are not reflected in LCAs and may be undermined by an LCA-based approach. [5] Indeed, many argue that PEFs and LCAs should not be used to assess the sustainability or 'greenness' of a product at all. Their measurements are incomplete, unreliable, and will have too many unintended consequences.

This paper briefly evaluates current knowledge of microfiber impacts and recommends the approach we conclude should be taken if PEFs and LCAs are to be used. It is, however, not for us to say. Nor is it something that can be decided by a grouping of major brands and LCA providers. This is a subjective decision, so everyone impacted by the decision, particularly those in the Global South, should be consulted.

1 https://www.sciencedirect.com/science/article/abs/pii/S0048969717310203

2 https://op.europa.eu/en/publication-detail/-/publication/6c24e876-4833-11e8-be1d-01aa75ed71a1/language-en

3 https://gcbhr.org/insights/2022/07/the-rise-of-life-cycle-analysis-and-the-fall-of-sustainability-illustrations-from-the-apparel-and-leather-sector

4 https://www.veronicabateskassatly.com/read/weighting-what-it-does-and-why-it-matters

5 https://www.veronicabateskassatly.com/read/37th-international-cotton-conference-bremen-sustainability-and-legislation-in-textiles-and-apparel

PLASTICS IN TEXTILES AND APPAREL

Global fiber production reached 113 million tonnes in 2023. Of the total, natural fibers accounted for 31.5 million tonnes, or 28%. Synthetic fibers amounted to 74 million tonnes, 65% of the total, and manmade cellulosic fibers such as viscose, accounted for 7.6 million tonnes or 7% of world fiber production. (1)
There is no reliable data on how much of each fiber goes into apparel rather than industrial uses or home textiles. The most common natural fiber is cotton, accounting for 24.6 million tonnes (22%) of 2023 global fiber production. The United States is one of the largest consumer markets for apparel in the world, and nearly 100% of apparel sold in the U.S. is imported. Based on trade data, an estimated 80% of cotton is used in apparel applications, 15% in home furnishings, and roughly 5% is used in nonwoven applications. Similarly, a recent compilation of textile import data from Trade Data Monitor for the EU, US, and Japan found that more than 70% of the textiles imported by these markets are apparel. (2)

Wool is the second largest apparel fiber, accounting for one million tonnes, (1%) of world fiber use, and other apparel fibers, such as flax, silk, cashmere, hemp, and ramie, add another 600,000 tonnes (0.5% of the world fiber total). Hard natural fibers, including jute, coir, abaca, kenaf, sisal, and other agave fibers, amounted to 5 million tonnes (4%) of world fiber use in 2023.

The most common of the plastic fibers is polyester, which at 61 million tonnes, represents 54% of total fiber use in 2023. Again, based on trade data from the United States, apparel applications account for an estimated one-third of polyester use. Industrial applications, and uses ranging from automobile upholstery to home furnishings, account for the remainder.

Polyamide, including nylon, acrylic, polypropylene, and other plastic fibers accounted for 13 million tonnes (11%) of world fiber use in 2023.

In short, together, cotton and polyester account for 76% of the world's fiber supply. Focusing on these two fibers simplifies the discussion, while still covering the majority of the global impact of textile fibers.

A BRIEF HISTORY OF MICROPLASTICS

Microplastics are persistent microscopic (<5 mm in diameter) plastic materials that accumulate in the environment, which represent a range of particles <5 mm in size. Nanoplastics still lack a commonly agreed definition but a size range of 1–1,000 nm is typically used. (3)
Microplastic particles are exponentially more numerous in the nanometer-to-micrometer size range (nanoplastics), and their microscopic nature makes them virtually omnipresent. (4)

Different sources offer slightly different values, but broad brush, global production of plastics has increased from roughly zero in 1950, to 380 million tonnes in 2019, and over 400 million tonnes in 2022. (5)
A 2017 study published in Science Advances (6) estimated that as of 2015, 8.3 billion tonnes (Bt) of virgin plastics had been cumulatively produced and 6.3 Bt discarded as waste. Only 9% of this had been recycled, 12% was incinerated, and 79% simply piled up in landfills or the natural environment. The study's citation metrics are almost as informative as the values found. As of August 13, 2024, it had been downloaded nearly half a million times and cited almost 10,000 times. Over 30% of both metrics had occurred in the previous 12 months. (7)

(1) https://dnfi.org/dnfi-world-natural-fibre-update-october-2024
(2) https://www.nature.com/articles/s41467-024-49441-4
(3) https://www.sciencedirect.com/science/article/pii/S2590332224005414
(4) https://academic.oup.com/toxsci/article/199/1/81/7609801?login=false
(5) https://www.statista.com/statistics/282732/global-production-of-plastics-since-1950/#:~:text=The%20worldwide%20production%20of%20plastics,production%20has%20soared%20since%201950s.
(6) https://www.science.org/doi/10.1126/sciadv.1700782
(7) https://www.science.org/doi/10.1126/sciadv.1700782

Interest in and concern about the sheer volume of plastic production, waste, and potential pollution are growing - as they should be. In 2019 plastic waste from all sources amounted to 353.3 million tonnes (Mt) of which 11% was clothing and other textile waste. [1]
By 2023 plastic waste is estimated to have risen to 398.9 Mt and textile's share, to 11.4%. [2]
In 2019 alone, plastic leakage - defined as the quantity of plastic leaving human control and entering the natural environment - is estimated at 60 million tons. [3]
The global population in 2019 was 7.7 billion which translates into 7.8 kilos of mismanaged plastic waste for every man woman and child on the planet. Moreover, between 6 and 30% of this came from a single use - apparel.
As for microplastics, that concept was born in 2004 when analysis of local coastal sediment (plus 17 beaches across the UK) by a team at the University of Plymouth led by Professor R C Thompson, revealed small fragments - named microplastics for the first time - of 9 polymers, including polyester, in all locations. [4]
These particles were believed to have resulted from the degradation of larger items.

The first major study linking micro and nano plastic particles to shedding from clothing during washing "Accumulation of Microplastic on Shorelines Worldwide: Sources and Sinks" by M.A. Browne et. al., was published 7 years after the inaugural Plymouth study. This 2011 study defined micro and nanoplastics as debris <1 mm, and revealed that "An important source of microplastic appears to be through sewage contaminated by fibers from washing clothes." [5]
The study focused solely on marine accumulation and initially aquatic environments were almost the only area of concern. Popular solutions in the apparel sector included - and in some cases still include - fitting (better) filters to wastewater pipes from washing machines and washing clothes in guppy bags.

As studies have accumulated, however, it has become increasingly apparent that fibers are released by clothing at every life stage, from manufacture to disposal, and not just into water, but also into soil and air. Microplastics transition between land, water, and the atmosphere via the plastic cycle - "the continuous and complex movement of plastic materials between different abiotic and biotic ecosystem compartments, including humans." [6] - and [7]

The result - plastic microfibres are found in every ecosystem on Earth, from the slopes of Everest [8] and Mount Fuji [9], to the depths of the Mariana Trench. [10] From the snowy wastes of Antarctica [11], to the Tibetan Plateau [12], and Protected Areas of the United States. [13]

Guppy bags and washing machine filters will not address the problem. However, as M.A. Browne and co-authors subsequently pointed out (Analytical Methods, 2016), "Contamination is not the same as pollution (a biological response to a contaminant)." [14]
Accumulations of plastic and other waste on a beach, in the desert, or The Great Pacific Garbage Patch, are all visible eyesores, and their harm to species such as sea turtles is well documented. Microfibers are by definition almost invisible. Whether they are plastic, cellulosic, or protein in origin, simply reporting that they have been found in various locations, in greater or lesser quantities, proves nothing. To demonstrate that there is biological pollution "there must be evidence that the ecology of organisms is affected." [15]

In January 2019, SAPEA, the European Union's Science Advisory published an Evidence Review Report on micro and nanoplastic pollution synthesizing findings available up to that date. [16]

1 https://www.oecd-ilibrary.org/environment/global-plastics-outlook_aa1edf33-en
2 https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/10/policy-scenarios-for-eliminating-plastic-pollution-by-2040_28eb9536/76400890-en.pdf
3 https://www.nature.com/articles/s41467-024-49441-4
4 https://www.science.org/doi/abs/10.1126/science.1094559
5 https://pubs.acs.org/doi/abs/10.1021/es201811s
6 https://pubs.acs.org/doi/10.1021/acs.est.9b02942#
7 https://wires.onlinelibrary.wiley.com/doi/10.1002/wat2.1268
8 https://www.sciencedirect.com/science/article/pii/S2590332220305509
9 https://link.springer.com/article/10.1007/s10311-023-01626-x
10 https://royalsocietypublishing.org/doi/10.1098/rsos.180667 and https://oceanographicmagazine.com/news/eurythenes-plasticus/
11 https://tc.copernicus.org/articles/16/2127/2022/
12 https://www.sciencedirect.com/science/article/abs/pii/S0048969720371655?via%3Dihub
13 https://www.science.org/doi/10.1126/science.aaz5819
14 https://www.researchgate.net/publication/311093222_Some_problems_and_practicalities_in_design_and_interpretation_of_samples_of_microplastic_waste
15 https://www.researchgate.net/publication/311093222_Some_problems_and_practicalities_in_design_and_interpretation_of_samples_of_microplastic_waste
16 https://sapea.info/topic/microplastics/3/

A search of Google Scholar for the years 2011 to 2018, reveals that at that point there were around 10,000 results for 'microplastic pollution" and about 5,990 for "microplastic pollution human health". [1]
The SAPEA findings, in turn, informed the April 2019 Scientific Opinion 6 from the European Commission's Group of Chief Scientific Advisors. [2]
The conclusion of this scientific opinion effectively echoed the Browne and Anderson study of 2016. We quote, "Microplastics can be found in the air, water, and soil, where they may:

- **persist in the environment**
- **enter the food chain**
- **accumulate in living organisms.**

We do not yet know how damaging they may be for human health and the environment." [3]

In other words, the EU's advisors found that while in 2018, there was global evidence of contamination by plastic microfibers, that was not the same as pollution. Nonetheless, following the precautionary principle which requires that we equate the two, they recommended that the European Commission take steps to "PREVENT & REDUCE microplastic pollution", targeting the most polluting activities with politically and socio-economically feasible legal actions while establishing a global scientific platform to promote microplastic research and agreed-on standards.

The Opinion further stated: "These recommendations will inform EU future policies. They will also inform existing regulations." [4]

WHERE ARE WE NOW?

Since January 2019, and the completion of the SAPEA report, Google Scholar shows that a further ≈16,900 studies have been published on "microplastic pollution". Some 13,300 of these were published after January 2023, and 5,800 of those, between January and August this year. [5]

Indeed, in the first 25 days of September 2024, between one and 8 studies were published daily, with most days yielding at least 3. Google Scholar numbers are rough, ready, and approximate, but the orders of magnitude show a clear direction. Concern about the incidence of microplastic pollution and its potential impact on human and environmental health is increasing rapidly. And with good reason. The SAPEA report was informed largely by laboratory studies. There was an absence of population studies on human health effects. [6]

The situation today is very different. A study published in the September 2024 Journal of Hazardous Materials [7] notes that while the toxic effects of micro and nanoplastics on mouse bone marrow hematopoietic function (producing and replenishing blood cells) had already been demonstrated, the presence of micro and nanoplastics in the human bone marrow of leukemia patients has been detected for the first time. Indeed, as the Guardian points out, the past 12 months alone have seen an explosion of published research on human health effects, [8] with micro and nanoplastics found in human semen in both Italy [9] and China. [10]

1 https://pubs.acs.org/doi/10.1021/es201811s
2 https://op.europa.eu/en/publication-detail/-/publication/f235d1e3-7c4d-11e9-9f05-01aa75ed71a1/language-en/format-PDF/source-108645429
3 https://scientificadvice.eu/wp-content/uploads/SAM-Summary_Factsheets_A4_Microplastics_042022.pdf
4 https://scientificadvice.eu/wp-content/uploads/SAM-Summary_Factsheets_A4_Microplastics_042022.pdf
5 As of 08/26/2024
6 https://scientificadvice.eu/wp-content/uploads/SAM-Summary_Factsheets_A4_Microplastics_042022.pdf
7 https://www.sciencedirect.com/science/article/abs/pii/S0304389424018454
8 https://www.theguardian.com/environment/article/2024/aug/21/microplastics-brain-pollution-health
9 https://www.sciencedirect.com/science/article/pii/S0048969723045473#bb0330
10 https://pubmed.ncbi.nlm.nih.gov/38802004/

As the Italian study notes: "The scientific interest in assessing reproductive risk from contaminants is of particular concern in light of the reproductive emergency, especially in males, that has been occurring for several decades globally." [1]
A similar situation applies to the human placenta. An initial study of 6 placentas published in 2021, found micro and nanoplastics in 4 of them. [2]
An analysis of 62 placenta samples published in 2024, found microplastics were present in all. [3]
The concern here is that micro and nanoplastics may affect fetal development and cause adverse pregnancy outcomes in ways of which we are, as yet, unaware.

A study published in May 2024, following outcomes for 257 Italian patients with carotid artery plaque [4] found those patients in whom micro and nanoplastics were detected had a higher risk (2.1x) of a composite of myocardial infarction, stroke, or death from any cause at 34 months of follow-up than those in whom micro and nanoplastics were not detected in the fatty tissue of their arteries.

And the news gets worse. A 2024 pre-print study by the National Institutes of Health [5] found that the livers, kidneys, and brains of autopsied bodies in Albuquerque, NM, collected in 2016 and 2024, all contained microplastics, but the 91 brain samples contained up to 20 times more than the other major organs. Worse, all organs exhibited significant increases from 2016 to 2024. For the brain samples, the increase was ≈50%. Worse still, the Guardian reports that the latest version of the study, which has yet to be posted online, "looked at 12 brain samples from people who had died with dementia, including Alzheimer's disease. These brains contained up to 10 times more plastic by weight than healthy samples." [6]

Today then, the proposition that we are all ingesting micro and nanoplastics constantly - from the air that we breathe to the food that we eat and the water that we drink - is not contested. The question rather is how much? And here estimates vary depending on the methodology used. [7]
The most recent estimated daily intake of microplastics is 32.2 particles per day from food and drink alone (of which 52% are fibers). [8]

And how harmful is it?

We would urge moderation and caution. There is, however, considerably more real-world evidence of the possibility, even the probability of harm, than there was in 2018/19, and the evidence of harm is mounting. A September 2024 study published in Science: "Twenty Years of Microplastic Pollution Research—What Have We Learned?" neatly summarises the situation: "The environmental burden of microplastics continues to grow, so a combination of scientific, economic, and social interventions will be necessary to curb that growth." [9]

A final and crucial caveat. The aforementioned 2024 study of plastic leakage from the apparel industry [10] found that primary microplastics from wash and wear are a tiny fraction of the total. Total global apparel industry plastic leakage was estimated at ~8,300,000 metric tons of plastic per year. The ticking timebomb is the 98% that is leaked as macroplastics - primarily in the form of synthetic waste apparel (84%). [11]
As "Twenty years of microplastic pollution research" observes —"Even if it were possible to immediately halt emissions, quantities would continue to increase because of the fragmentation of legacy items." [12]

1 https://www.sciencedirect.com/science/article/pii/S0048969723045473#bb0100
2 https://www.sciencedirect.com/science/article/pii/S0160412020322297
3 https://pubmed.ncbi.nlm.nih.gov/38366932/
4 https://www.nejm.org/doi/full/10.1056/NEJMoa2309822
5 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11100893/
6 https://www.theguardian.com/environment/article/2024/aug/21/microplastics-brain-pollution-health
7 https://www.rdworldonline.com/microplastics-are-bad-but-ignoring-science-is-worse/
8 https://www.sciencedirect.com/science/article/abs/pii/S0379073824003281?via%3Dihub
9 https://www.science.org/doi/10.1126/science.adl2746
10 https://www.nature.com/articles/s41467-024-49441-4
11 https://cottontoday.cottoninc.com/wp-content/uploads/2024/06/Plastic_Leakage_Assessment_of_Global_Apparel_Industry_Topline_Report.pdf
12 https://www.science.org/doi/10.1126/science.adl2746

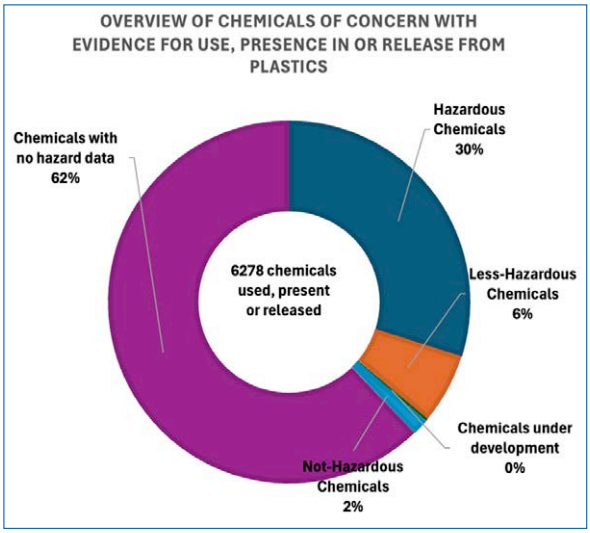
Eventually, every one of those roughly 7 million tons of legacy clothing waste will become a microplastic. This is ≈7 million tons last year, ≈7 million this year, and, since plastic fiber consumption is increasing steadily [1] ≈7+ million tons next year,...this amounts to tens of millions of tons of leaked plastic shirts, pants, dresses, and socks.... all slowly breaking down, infiltrating soil and water, and eventually, our bodies and those of almost every other living creature. If the apparel sector stops using plastics tomorrow, there are already millions of tons of leaked plastic clothing out there that will continue to add to global microfiber pollution for decades to come. [2]

And that is not all. Plastics, including polyester, emit two types of greenhouse gasses, ethylene and methane (as well as other hazardous gases including ethane) when they degrade in the environment. In other words, waste plastics exacerbate climate change. [3]

Indeed, a November 2024 paper published in One Earth, argues that plastic pollution exacerbates the impacts of all planetary boundaries, shrinking societies' options for mitigating pressures on not just climate change, but also biodiversity loss, freshwater and land system change, and biogeological flows. [4]

CHEMICALS

Chemical presence is a central aspect of the plastics issue. As one authority - Ian Mudway - put it recently "We are obsessed with the particles and I think we have forgotten to worry about the chemicals that these particles carry into the body" and its organs and tissues. [5]
The Research Council of Norway funded the 2024 PlastChem report, "State of the science on plastic chemicals - Identifying and addressing chemicals and polymers of concern." [6]



Based on Martin Wagner, Laura Monclús, Hans Peter H. Arp, Ksenia J. Groh, Mari E. Løseth, Jane Muncke, Zhanyun Wang, Raoul Wolf, Lisa Zimmermann (2024) State of the science on plastic chemicals - Identifying and addressing chemicals and polymers of concern, http://dx.doi.org/10.5281/zenodo.10701706.

This synthesized publicly available evidence on the hazardous properties of plastic chemicals and their presence in polymers. It identified almost 6,300 chemicals that are either marketed for use in plastics, or there is scientific evidence for their presence in, or release from plastics.

Only 1% are classified as not hazardous. Almost 60% have not even been assessed for their hazards. Of course, not all polymers contain every chemical of concern, but each major polymer type contains at least 400. [7]

PET polymers are the primary polymers used in synthetic apparel. The number of identified plastic chemicals used, present, and released by PET totals 2,566. Only 31 of these, a mere 1% of the total, are not hazardous. Some 806, or 31%, are hazardous, but the vast majority - 1,609 or 63% - are without hazard data. [8]

1 https://textileexchange.org/app/uploads/2024/09/Materials-Market-Report-2024.pdf
2 https://cottontoday.cottoninc.com/wp-content/uploads/2024/06/Plastic_Leakage_Assessment_of_Global_Apparel_Industry_Topline_Report.pdf
3 https://journals.plos.org/plosone/article?id=10.1371/journal.pone.020057
4 https://www.sciencedirect.com/science/article/pii/S2590332224005414#bib116
5 https://www.gresham.ac.uk/watch-now/microplastics-health (45:00)
6 https://zenodo.org/records/10701
7 http://dx.doi.org/10.5281/zenodo.10701706
8 https://zenodo.org/records/10701706

In other words, they may be chemicals of concern, i.e. acutely toxic, carcinogenic, mutagenic, corrosive, neurotoxic, or endocrine-disrupting.... or they may not be. [1] We just don't know. Nor do we know how many of these chemicals are present in the microplastic population. We also do not know the mechanisms (chemistry, kinetics, etc) of their release from the microplastic and their passage into organs/tissues/cells.

Detailed analysis of this topic is well beyond the reach of this paper. Here we note that the fear that micro and nanoplastics in our air, water, or food may transmit these toxic chemicals is particularly concerning in the case of apparel, because, as Dr. Mudway observes "it's not so much the length, it's the diameter". He describes synthetic microfibers as resembling javelins and so, in his opinion, posing greater health risks than other fragments. [2]

CHEMICAL TREATMENTS SHOULD NOT BE CONFUSED WITH FIBER TYPES

There is a further chemistry issue that is often muddled in the context of microfibers. We quote a leading industry initiative, Textile Exchange (TE): "While early discussions mainly focused on the release of synthetic fiber fragments into the marine environment as part of the bigger microplastic debate, the discussion is shifting towards seeing it as a challenge that is relevant for all fiber types. A key reason for this shift is that shedding of fiber fragments into the environment is not only about the physical presence of non-biodegradable fiber fragments in the environment; it is also about the chemicals that are carried along the fiber fragments." [3]

A similar statement was made this year by another apparel industry initiative, whose work we discuss in greater detail later in this report: The Microfiber Consortium (TMC). We quote "All textiles, all lifecycle stages - Fibre fragments shed during manufacture, consumer use (washing, drying, general wear), and as a result of disposal. Synthetic microfibres, such as polyester and nylon, do not biodegrade naturally. Natural fibers may degrade faster, but chemicals used in dyeing and finishing processes often allow them to persist and accumulate in the environment with, as yet, unknown toxicological effects." [4]

Both statements are misleading:

1 There are concerns about the chemicals applied to all fibers - including plastic polymers - as part of their functionalization ie. the application of dyes, finishes, flame-retardants, etc. These are vital in developing a product that will appeal to the consumer and that will last. But many i) will impact biodegradability, ii) are, or might be, toxic. This topic is too complex to cover in a short paper. Here we note only that for cotton fabrics the most common functional finishes are dyes, softening agents, durable press (wrinkle resistance and stability), water and stain repellents, and antimicrobials. Tests indicate cotton treated with all finishes except Durable Press degrades as rapidly or more rapidly than oak leaves in the same environment and on average, degrades as fast as unfinished cotton. [5]

As already noted, presence does not equate to pollution. As long as the treatments/finishes are not toxic and exhibit no toxicity in degradation, there is no reason to believe that cotton microfibers, even if they linger longer, are any more harmful than those derived from toilet paper, of which the average US citizen flushes around 20.5 kilos down the drain annually. By weight, one person's annual toilet tissue microfiber release is equivalent to washing 1.4 million cotton T-shirts. [6]

1 https://saicmknowledge.org/sites/default/files/1_1_guidance_understanding_cocs.pdf
2 https://www.gresham.ac.uk/watch-now/microplastics-health (30:00-36:00)
3 https://textileexchange.org/app/uploads/2021/04/Textile-Exchange_Preferred-Fiber-Material-Market-Report_2020.pdf
4 https://www.microfibreconsortium.com/tmc-progress-report-22-24
5 https://www.sciencedirect.com/science/article/abs/pii/S0025326X21000643
6 https://cottontoday.cottoninc.com/cotton-microfibers-biodegrade-faster-than-tissue-paper-in-wastewater-fresh-water-and-saltwater/

If the goal is to reduce cellulosic fibers per se, focusing on apparel will not make a meaningful reduction on a global scale. If the treatments/finishes are toxic, then we don't want them on our bodies in the first place. Consequently, funding research into whether natural fibers also shed microfibers is hardly advancing the frontiers of science. [1]

Moreover, similar, and in some cases identical, functionalizations are applied to polyester. The difference is that, for example, the toxic heavy metal antimony [2] can be used as a flame retardant on cotton and polyester. It [3] is also a catalyst in the production of polyester itself. Poly- and perfluoroalkyl substances (PFASs) are used as stain and water repellents on cotton and plastics alike. They are, like micro and nanoplastics, pervasive pollutants, deemed by some as "forever contaminants." Recent research indicates that PFASs and micro and nanoplastics can adsorb and sorb substances onto their surfaces, potentially amplifying each constituent's concentration in the environment. [4]

As a December 2024 study in Environmental Pollution put it: "The impact of PFAS is exacerbated by the presence of other persistent compounds, such as microplastics (MP), which can facilitate their sorption. The enhanced toxicity of MP for other persistent contaminants, including PFAS, can be mediated by biofilm formation, which intensifies the vector role of MP. Biofilms can also bioconcentrate PFAS in freshwater environments, and alter their transport and transformation. Additionally, MP and PFAS are often released simultaneously from consumer products, such as waterproof textiles, further exacerbating their environmental impact." [5]

In other words, many of these functionalizations further compound the toxicity of the plastic fibers themselves. It follows automatically that if fiber treatments/functionalization are a problem, or amplify the problem, then PEFs and LCAs must reflect this distinction. Only then will brands and consumers be able to choose the more sustainable, untreated, or less harmfully-treated option.

2 As evidenced by the publication of research papers, the discussion in the scientific community is not shifting towards "seeing it as a challenge that is relevant for all fiber types". The EU evidence review mentioned earlier did not consider microfiber sources other than plastics. [6]

Going forward, it is only the reduction of microplastic pollution that the EU's Chief Scientific Advisors believe should inform EU policies and regulations - not microfibers in general because a significant negative biological response to contamination in the case of other fibers had not been and still has not been identified. Indeed, it is hard to understand why cellulosic microparticles from cotton or linen would be more harmful to us and the environment than cellulosic microparticles from seaweed or grass, or why proteinaceous microfibers from wool or silk would be more harmful than those from our skin or that of our pets and work animals.

In short, plastic microfibers are a completely different risk category than other microfibers and must be handled as such in LCAs and PEFs. Indeed, the EU has specified that the PEF should include the impacts of microplastics. TE and TMC however, are advocating including impacts of both synthetic and natural microfibers instead, in contravention of scientific evidence.

1 https://www.microfibreconsortium.com/tmc-progress-report-22-24
2 https://nj.gov/health/eoh/rtkweb/documents/fs/0141.pdf
3 https://www.mdpi.com/2305-6304/11/5/406#B48-toxics-11-00406
4 https://www.bbjgroup.com/blog/unraveling-the-intricate-coexistence-of-microplastics-and-pfas-part-1
5 https://www.sciencedirect.com/science/article/pii/S0269749124018505?via%3Dihub
6 https://scientificadvice.eu/wp-content/uploads/SAM-Summary_Factsheets_A4_Microplastics_042022.pdf

THE CURRENT TREATMENT OF TEXTILE MICROFIBERS IN PRODUCT ENVIRONMENTAL (PEF) AND IMPACT ASSESSMENT.

One example of the planned treatment of microfibers in a PEF already exists. This is in the French PEF.

THE FRENCH PEF

Legislated to come into force in early 2024, as of January 2, 2025, the French PEF for textiles remains a work in progress. (1)

It is now in its second iteration. Microfiber impact is integrated into the final production environmental score as an LCA complement (unit = micro-points). This complement is added to the product's environmental impact post-normalization and weighting, as microfibers are not yet included in the PEF framework as a specific environmental category. (2)

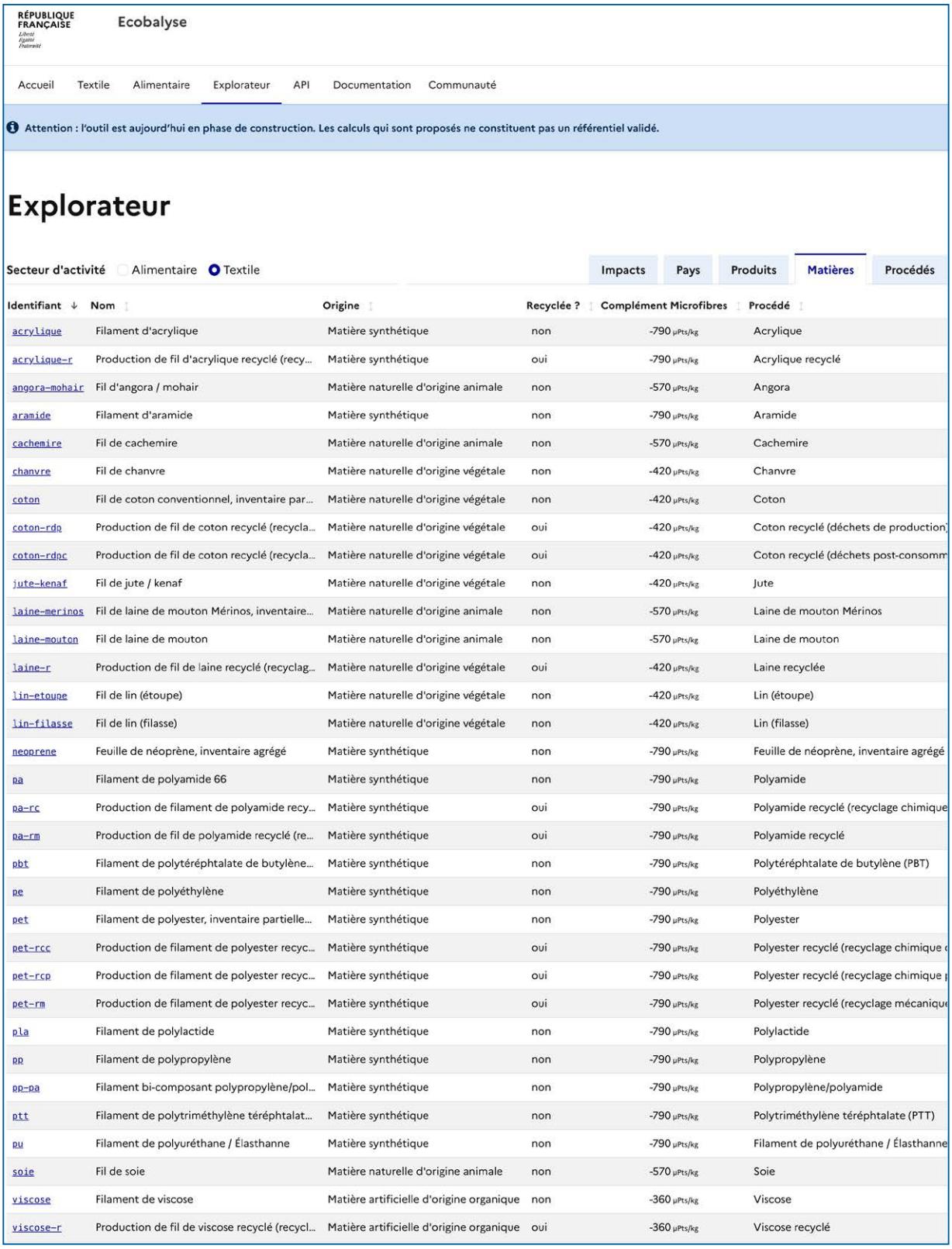
The original microfiber scores are shown in the chart below. As you can see, according to the French PEF, microfiber impact is not restricted to plastics. On the contrary, proteinaceous fibers such as silk were rated 70% as harmful as plastic fibers.

French PEF Textile Microfiber Complement on the next page >>

(1) https://ecobalyse.beta.gouv.fr/#/textile/simulator

(2) Email from Alban Fournier of Ecobalyse 9/12/2024

French PEF Textile Microfiber Complement as of 13/02/2024



RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

Ecobalyse

Accueil | Textile | Alimentaire | Explorateur | API | Documentation | Communauté

Attention : l'outil est aujourd'hui en phase de construction. Les calculs qui sont proposés ne constituent pas un référentiel validé.

Explorateur

Secteur d'activité ○ Alimentaire ◉ Textile

Impacts | Pays | Produits | Matières | Procédés

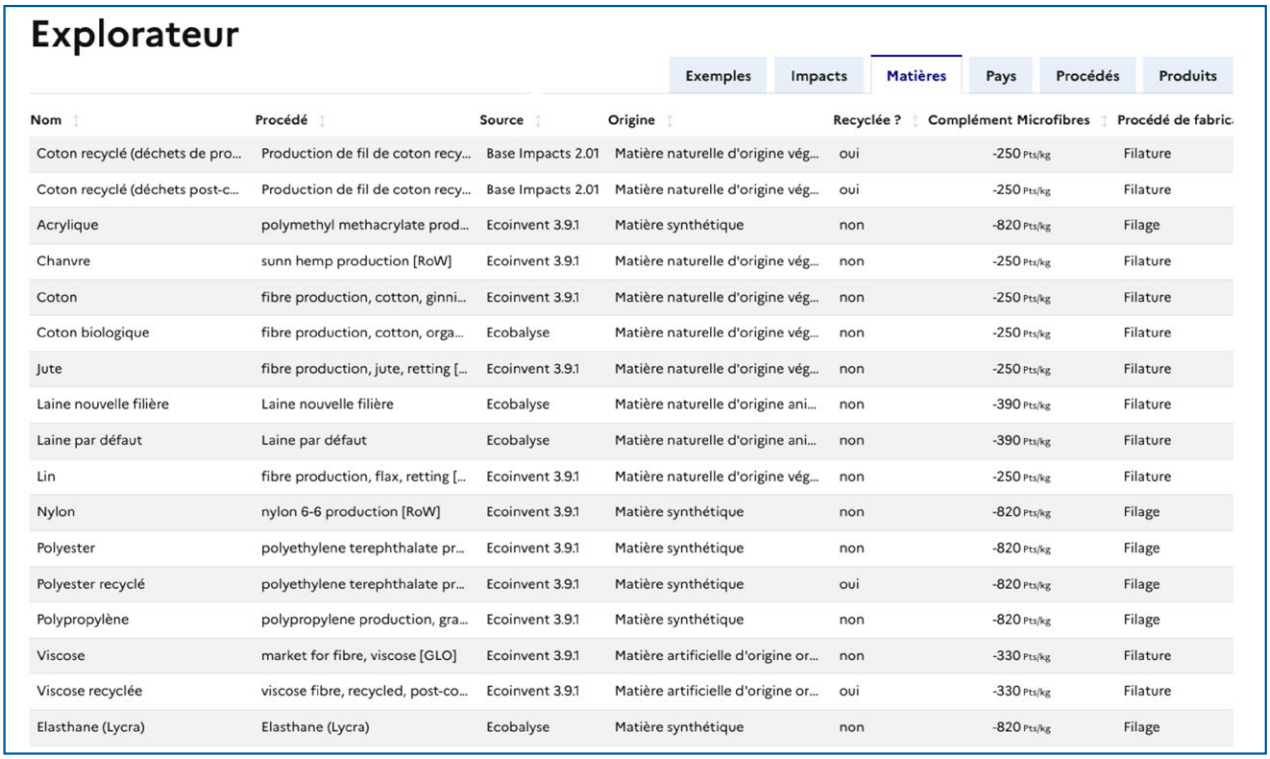
Identifiant	Nom	Origine	Recyclée ?	Complément Microfibres	Procédé
acrylique	Filament d'acrylique	Matière synthétique	non	-790 µPts/kg	Acrylique
acrylique-r	Production de fil d'acrylique recyclé (recy...	Matière synthétique	oui	-790 µPts/kg	Acrylique recyclé
angora-mohair	Fil d'angora / mohair	Matière naturelle d'origine animale	non	-570 µPts/kg	Angora
aramide	Filament d'aramide	Matière synthétique	non	-790 µPts/kg	Aramide
cachemire	Fil de cachemire	Matière naturelle d'origine animale	non	-570 µPts/kg	Cachemire
chanvre	Fil de chanvre	Matière naturelle d'origine végétale	non	-420 µPts/kg	Chanvre
coton	Fil de coton conventionnel, inventaire par...	Matière naturelle d'origine végétale	non	-420 µPts/kg	Coton
coton-rdp	Production de fil de coton recyclé (recycla...	Matière naturelle d'origine végétale	oui	-420 µPts/kg	Coton recyclé (déchets de production)
coton-rdpc	Production de fil de coton recyclé (recycla...	Matière naturelle d'origine végétale	oui	-420 µPts/kg	Coton recyclé (déchets post-consomm
jute-kenaf	Fil de jute / kenaf	Matière naturelle d'origine végétale	non	-420 µPts/kg	Jute
laine-merinos	Fil de laine de mouton Mérinos, inventaire...	Matière naturelle d'origine animale	non	-570 µPts/kg	Laine de mouton Mérinos
laine-mouton	Fil de laine de mouton	Matière naturelle d'origine animale	non	-570 µPts/kg	Laine de mouton
laine-r	Production de fil de laine recyclé (recyclag...	Matière naturelle d'origine végétale	oui	-420 µPts/kg	Laine recyclée
lin-etoupe	Fil de lin (étoupe)	Matière naturelle d'origine végétale	non	-420 µPts/kg	Lin (étoupe)
lin-filasse	Fil de lin (filasse)	Matière naturelle d'origine végétale	non	-420 µPts/kg	Lin (filasse)
neoprene	Feuille de néoprène, inventaire agrégé	Matière synthétique	non	-790 µPts/kg	Feuille de néoprène, inventaire agrégé
pa	Filament de polyamide 66	Matière synthétique	non	-790 µPts/kg	Polyamide
pa-rc	Production de filament de polyamide recy...	Matière synthétique	oui	-790 µPts/kg	Polyamide recyclé (recyclage chimique
pa-rm	Production de fil de polyamide recyclé (re...	Matière synthétique	oui	-790 µPts/kg	Polyamide recyclé
pbt	Filament de polytéréphtalate de butylène...	Matière synthétique	non	-790 µPts/kg	Polytéréphtalate de butylène (PBT)
pe	Filament de polyéthylène	Matière synthétique	non	-790 µPts/kg	Polyéthylène
pet	Filament de polyester, inventaire partielle...	Matière synthétique	non	-790 µPts/kg	Polyester
pet-rcc	Production de filament de polyester recyc...	Matière synthétique	oui	-790 µPts/kg	Polyester recyclé (recyclage chimique
pet-rcp	Production de filament de polyester recyc...	Matière synthétique	oui	-790 µPts/kg	Polyester recyclé (recyclage chimique
pet-rm	Production de filament de polyester recyc...	Matière synthétique	oui	-790 µPts/kg	Polyester recyclé (recyclage mécanique
pla	Filament de polylactide	Matière synthétique	non	-790 µPts/kg	Polylactide
pp	Filament de polypropylène	Matière synthétique	non	-790 µPts/kg	Polypropylène
pp-pa	Filament bi-composant polypropylène/pol...	Matière synthétique	non	-790 µPts/kg	Polypropylène/polyamide
ptt	Filament de polytriméthylène téréphtalat...	Matière synthétique	non	-790 µPts/kg	Polytriméthylène téréphtalate (PTT)
pu	Filament de polyuréthane / Élasthanne	Matière synthétique	non	-790 µPts/kg	Filament de polyuréthane / Élasthanne
soie	Fil de soie	Matière naturelle d'origine animale	non	-570 µPts/kg	Soie
viscose	Filament de viscose	Matière artificielle d'origine organique	non	-360 µPts/kg	Viscose
viscose-r	Production de fil de viscose recyclé (recycl...	Matière artificielle d'origine organique	oui	-360 µPts/kg	Viscose recyclé

Original screenshot available upon request.

The revised scores, which were still applicable as of December 9, 2024, are shown in the next table[1]

[1] Ecobalyse email of 9/12/2024

French PEF Textile Microfiber Complement as of 31/08/2024



Explorateur

Exemples | Impacts | Matières | Pays | Procédés | Produits

Nom	Procédé	Source	Origine	Recyclée ?	Complément Microfibres	Procédé de fabric
Coton recyclé (déchets de pro...	Production de fil de coton recy...	Base Impacts 2.01	Matière naturelle d'origine vég...	oui	-250 Pts/kg	Filature
Coton recyclé (déchets post-c...	Production de fil de coton recy...	Base Impacts 2.01	Matière naturelle d'origine vég...	oui	-250 Pts/kg	Filature
Acrylique	polymethyl methacrylate prod...	Ecoinvent 3.9.1	Matière synthétique	non	-820 Pts/kg	Filage
Chanvre	sunn hemp production [RoW]	Ecoinvent 3.9.1	Matière naturelle d'origine vég...	non	-250 Pts/kg	Filature
Coton	fibre production, cotton, ginni...	Ecoinvent 3.9.1	Matière naturelle d'origine vég...	non	-250 Pts/kg	Filature
Coton biologique	fibre production, cotton, orga...	Ecobalyse	Matière naturelle d'origine vég...	non	-250 Pts/kg	Filature
Jute	fibre production, jute, retting [...	Ecoinvent 3.9.1	Matière naturelle d'origine vég...	non	-250 Pts/kg	Filature
Laine nouvelle filière	Laine nouvelle filière	Ecobalyse	Matière naturelle d'origine ani...	non	-390 Pts/kg	Filature
Laine par défaut	Laine par défaut	Ecobalyse	Matière naturelle d'origine ani...	non	-390 Pts/kg	Filature
Lin	fibre production, flax, retting [...	Ecoinvent 3.9.1	Matière naturelle d'origine vég...	non	-250 Pts/kg	Filature
Nylon	nylon 6-6 production [RoW]	Ecoinvent 3.9.1	Matière synthétique	non	-820 Pts/kg	Filage
Polyester	polyethylene terephthalate pr...	Ecoinvent 3.9.1	Matière synthétique	non	-820 Pts/kg	Filage
Polyester recyclé	polyethylene terephthalate pr...	Ecoinvent 3.9.1	Matière synthétique	oui	-820 Pts/kg	Filage
Polypropylène	polypropylene production, gra...	Ecoinvent 3.9.1	Matière synthétique	non	-820 Pts/kg	Filage
Viscose	market for fibre, viscose [GLO]	Ecoinvent 3.9.1	Matière artificielle d'origine or...	non	-330 Pts/kg	Filature
Viscose recyclée	viscose fibre, recycled, post-co...	Ecoinvent 3.9.1	Matière artificielle d'origine or...	oui	-330 Pts/kg	Filature
Elasthane (Lycra)	Elasthane (Lycra)	Ecobalyse	Matière synthétique	non	-820 Pts/kg	Filage

https://ecobalyse.beta.gouv.fr/#/explore/textile/materials screenshot taken 31/08/24

The number of different fibers shown is greatly reduced. Silk, mohair, and cashmere are no longer available as options - but in the present context, this is of little importance. There were, and still are, only 4 different scores 1. A score for fossil-based fibers. This has increased from 790 to -820 Pts/kg. 2. A score for protein fibers such as silk, wool, or cashmere. This has fallen from 570 to -390 Pts/kg. 3. A score for man-made cellulosic fibers (viscose). This has fallen from 360 to -330 Pts/kg. And finally 4. A score for naturally occurring cellulosic fibers, like cotton or linen. This has fallen from 420 to -250 Pts/kg. We have been unable to find any explanation for the changes in scores. Why viscose fibers were previously deemed less harmful than cotton but now the opposite applies is not elucidated. Why the purported impact of cotton microfibers is only 60% of the previous estimate is not documented.

When we examine the explanation of the Microfiber compliment (1) it appears to be identical to the explanation given in the previous version - but the scores have changed. How is this possible? We reached out to Ecobalyse and received the following explanation: "Complements have evolved as per methodology enhancement. Specific parameters have been updated. Ecobalyse is developed hand-in-hand with industry and scientific experts in a test-and-learn approach. Hence we are able to regularly enhance the method and the open-source calculator to answer industry needs." (2)
No supporting documentation was provided and that scores are being changed to meet 'industry needs' is concerning.

(1) https://fabrique-numerique.gitbook.io/ecobalyse/textile/complements-hors-acv/microfibres

(2) Email from A.F. Ecobalyse 09/12/2024

This is not a report on the French PEF, and the Ecobalyse methodology is too confused and recondite to cover in detail here. Some further discussion of Ecopbalyse's response is provided in the box-out below. Those wishing to stick to the main text should skip directly to page 20.

ECOBALYSE AND THE FRENCH PEF

Ecobalyse was offered a Right of Reply and responded with several assertions and justifications. It is only fair that we should document these. However, the Ecobalyse model and arguments are convoluted. To avoid confusing the reader, the Ecobalyse response, where not covered elsewhere, is addressed in this box-out.

To prevent confusion, the following text passages are colored in this way:

Our response

Ecobalyse´s Statement

Reproduction from the report

1 Ecobalyse's contention:

3 parameters are taken into account to refine the [microfiber] complement :
- garment composition = fibre type (synthetic, animal-based, artificial, etc.)
- fibre intrinsic characteristics (degradation factor & shedding rate)

The methodology is based on the latest scientific knowledge at the end of 2023.

The main limitation encountered during methodology construction is the lack of reliable inventories. Indeed no scientific consensus exists yet on the main sources of microfiber emissions throughout the different life-cycle stages of a garment (emissions into water during wet treatment activities, emissions into water and air during use-phase, emissions into soil at the end of life, etc.).

Our response:

We agree that there is a lack of consensus on rates of microplastic emission. But the most important source of micro and nanoplastics going forward will not be apparel in production and use. It will be particles and fibers released from leaked apparel waste - current and legacy. Further, we contest the assertion, "The methodology is based on the latest scientific knowledge at the end of 2023." As this paper summaries the global scientific community is concerned solely with microplastic release - and that includes MariLCA. (1)

Only two entities are promoting the notion that natural microfibers are almost as harmful as plastic - namely, TMC and Quantis. Neither is a scientific organization. Both are commercial operations with vested interests.

(1) https://marilca.org/2023/11/30/characterization-factors-for-microplastics-impacts-in-lca-published/

2 **Ecobalyse's contention:**

The microfiber complement is a far smaller percentage of the total score for a cotton tee (3%) than for a polyester tee (14%). Several charts illustrating this point were provided.

Our response:

This is an arithmetic reflection of the fact that the base score for a cotton tee is significantly greater than that for a polyester tee. It is otherwise meaningless and so, irrelevant.

3 **Ecobalyse's contention:**

In response to the following passage:

"Which, roughly translated, states that the metric: "reflects the impact of a garment offering the worst characteristics from a microfiber point of view:
1) clothing made from fibers that are persistent in the environment,
2) clothing that releases significant microfibers over its life cycle."
This approach lacks scientific basis. We are talking about micro and nanoplastics - particles that are barely visible or invisible to the human eye. That they exist does not prove that they are harmful. As already noted, contamination is not the same as pollution, there must be evidence that the ecology of organisms is affected."

Ecobalyse offered the following statement:

"We agree… that is why we use a LCA-complement as a 100% quantitative approach along a garment life-cycle stages is impossible at the moment. The main objective of this complement is to integrate the microfibre dimension into the final garment score as it's not the case in other LCA frameworks as the last draft version of the PEFCR A&F… the European Commission has clearly stated that microfibers have to be integrated in the near future. We will be happy to adapt the method once microfibers are integrated into LCA as a new impact category".

Our response:

It is interesting that Ecobalyse believes that the EU PEF can't opt for a microfiber complement but must integrate the microfiber dimension. That would require an addition to the number of variables (currently 16) and a modification of the weightings. Further, as we see from our discussion of the EU PEF, the Technical Secretariat for Apparel and Footwear intends to add a microfiber complement similar to - or possibly identical to - that of the French PEF, as it is using the same sources.

4 **Ecobalyse's contention:**

In response to this passage in the report:

"We repeat we have been unable to find any studies demonstrating that microfibers of untreated cotton/silk/wool fibers are harmful in and of themselves. Cellulose is the most abundant organic compound on earth."

Ecobalyse offered the following statement:

We know that natural fibers are treated during wet-treatment processes which alters the intrinsic characteristics (e.g. biodegradation) of some natural fibers. Hence we applied a microfibers impact to natural fibers; this impact is significantly lower than the one applied to synthetics one as these fibers are intrinsically persistent."

Our response:

Ecobalyse provided no links to studies demonstrating that wet treatment negatively impacts the biodegradation of natural fibers. Nor did Ecobalyse refute the findings of the study we reference showing that cotton treated with all finishes except Durable Press degrades as rapidly or more rapidly than oak leaves in the same environment and on average degrades as fast as unfinished cotton. (1)
As noted, in the interest of simplicity and brevity, we have restricted the report's comparative analysis to cotton. But a similar study exists for wool. (2)
This found that both treated and untreated wool biodegraded readily. Indeed, machine-washable wool treated with chlorine-Hercosett shrink-resist biodegraded to a greater extent than untreated wool. Ecobalyse's claims do not, in any case, justify slapping a microfiber complement on all natural fibers, regardless of whether treated or not. Both the French and the EU PEF are intended for use by brands making claims to be attached to specific items of apparel. Whether a treatment has been applied to the fabric or not will be known. To be remotely valid any PEF should reflect this with a Finishing option. The EU PEF offers one. The French PEF does not. If a microfiber complement is to be added to natural fibers to reflect the fact that treatments can be harmful this should automatically be related to whether a finishing option was or was not selected. It should not be slapped onto every natural fiber, willy-nilly in a haphazard and unscientific manner, as both the EU and French PEF currently propose.

5 Ecobalyse's contention:

We modified the default "expected wear" to match the PEFCR A&F assumptions. Original assumptions were the ones proposed by the French Ademe framework.
These default assumptions are not very important for us ("why 45 and not 44 wear for a t-shirt") as we calculate impacts at the product level. What is important regarding number of wears is the "durabilité multiplier" which differentiates the number of wear of specific garments depending on intrinsic (physical) and extrinsic (non-physical) criteria.
It's important to keep in mind that the ultimate goal of the French PEF Score (the French environmental display) is to provide estimates regarding the environmental cost of consumer goods (a t-shirt, a shoe, a chair, a pizza, etc.). That's why we calculate scores at the product level. This metric can easily be transposed at the PEF level (per day of wear).

Our response:

What Ecobalyse means by this, is that since our paper on the French PEF was published in March 2024, several entirely subjective variables have been added. (3)
These are intended to measure 'durability' both physical and non-physical. Ecobalyse is aware that the impact that matters is the impact per wear. (4)
Measuring physical durability is straightforward enough. Capturing why some clothes are worn a couple of times - or not at all - and thrown out, when others are kept for years and worn a hundred or several hundred times is another matter. Since the only person who knows how many times any given garment will be worn is the purchaser, the most obvious solution would be for the PEF to offer a small chart for each item: If worn 5, 10, 20,100 times the impact per wear of this garment is a,b,c, or d. Ecobalyse's solution is far more subjective. 'Durability' is supposedly determined by the type of enterprise, number of SKUs offered, purchase price when new, and whether traceability is or is not provided. (5)

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(1) https://www.sciencedirect.com/science/article/abs/pii/S0025326X21000643
(2) https://link.springer.com/article/10.1007/s11270-024-07093-6
(3) https://www.crdc.com.au/sites/default/files/pdf/French%20PEF.pdf
(4) https://www.veronicabateskassatly.com/read/sustainable-fashion-could-it-all-be-in-the-hands-of-the-consumer
(5) https://ecobalyse.beta.gouv.fr/#/textile/simulator

For example, as of 11/12/2024, all other variables held constant, a T-shirt costing €1-10 with an impact of 1,800 pts drops one point to 1,799 if the price increases €1 to €11. Jumps down to 1,753 pts at €12. It has an impact of 1,686 if it costs €15, falling progressively to 1591 pts if it costs €20. This drops to 1,503 pts if the item costs €25. And finally, reaches a low of 1,414 pts if the tee costs €30. And there it stays. We would agree that the more expensive the item, the less likely that it will be thrown out after a couple of wears. But where is the justification for these arbitrary values and cut-offs? We would argue that a €100 tee has an even better chance of being worn extensively due to the higher resale potential. So why does the impact not continue to fall?

Equally random cut-offs apply to the number of SKUs. The impact of a T-shirt costing €1-10 remains constant at 1,800 pts whether it's produced by an enterprise with 100,000 SKUs or only 15,712 SKUs. But at precisely 15,711 SKUs the purported impact of the tee drops to 1779 pts. It remains at 1779 pts until the number of SKUs falls to 15,134, at which point, the purported impact falls to 1,753 pts. The tee's purported impact continues to fall sporadically as the number of SKUs the enterprise offers falls, until it reaches 1,285 pts, if the enterprise only has 1,000 SKUs. And there it stays. However, if the enterprise offers repairs, the purported impact at 1,000 SKUs falls to 1,145 pts and the impact at 100,000 SKUs falls to 1,591 pts.

These arbitrary values have quite literally been pulled from a hat. The fact that the French public is being told that this is the best that French science can provide is concerning.

The underlying premise of the French PEF microfiber complement is as follows:
"reflète l'impact d'un vêtement proposant les pires caractéristiques d'un point de vue microfibres:

1. vêtement composé de fibres persistantes dans l'environnement,
2. vêtement relarguant une quantité élevée de microfibres sur l'ensemble de son cycle de vie."

Which, roughly translated, states that the metric:
"reflects the impact of a garment offering the worst characteristics from a microfiber point of view:

1. clothing made from fibers that are persistent in the environment,
2. clothing that releases significant microfibers over its life cycle."

This approach lacks scientific rigor. We are talking about micro and nanoplastics - particles that are barely visible or invisible to the human eye. That they exist does not prove that they are harmful. As already noted, contamination is not the same as pollution. There has to be evidence of the environmental impact, specifically harm to organisms in the environment of the contaminants. (1) Cellulose is the most abundant organic compound on earth. (2)
Cellulose is found in all plant cell walls in linear chains comprising 1,000-30,000 repeating glucose moieties.

Approximately 15 trillion (15,000,000,000,000) tons of cellulose are produced and decomposed annually. Cotton is a cellulose. There is no reason to believe that natural (untreated) cotton microfibers negatively impact the environment or human health. Indeed cellulose powder derived from purified, mechanically disintegrated cellulose from cotton pulp is a food-grade product. (3) It is commonly used as an emulsifier, film former, protective colloid, stabilizer, suspending agent, and thickener. (4)
It's also a cheap filler for grated parmesan cheese and a cheap way to boost the fiber content on food labels. (5)

(1) https://www.researchgate.net/publication/311093222_Some_problems_and_practicalities_in_design_and_interpretation_of_samples_of_microplastic_waste
(2) https://link.springer.com/chapter/10.1007/12_2015_319
(3) https://www.ingredion.com/content/dam/ingredion/technical-documents/na/Product%20Information%20File%20-%20Cellulose%20Powder.pdf
(4) https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=172.870
(5) https://www.cspinet.org/article/cellulose

We have found one recent study (November 2024) showing a harmful impact from cellulosic textiles. Published in Environmental Science & Technology, this study compared the impact of cellulosic viscose and lyocell microfibres on earthworm morbidity with that of polyester microfibres. The fibers used had no functionalisations applied. This analysis found that when earthworms were exposed to these microfibres the order of mortality was viscose>lyocell>polyester. The research also indicated that viscose and lyocell may also impact the adult and reproductive health of earthworms. (1)

We have been unable to find any studies demonstrating that microfibers of untreated cotton, or indeed, silk or wool are harmful in and of themselves. Critics will doubtless claim that since this is a paper funded by cotton, we probably didn't try very hard. But, as we shall see, the source of the French PEF's and indeed, the EU PEF's claims - despite considerable motivation to do so - has been unable to find any such studies either.

The French PEF cites 2 sources for its microfiber impact calculations: the aforementioned Microfiber Consortium, which we will come to shortly, and MariLCA.
MariLCA (2) is a project of the Lifecycle Initiative (3) and Plastics Europe. (4)

It focuses on microplastic and nanoplastic pollution (MNP), not fiber pollution in general, and only a single aspect of microplastic pollution - namely freshwater and marine pollution – by "Integrating potential environmental impacts of marine litter into LCA". It is, therefore, an inadequate tool from the get-go. Further, what kind of threat level are they assuming for the impact of micro and nanoplastics on marine biota? To what extent are potential downstream impacts on human health included? When these threats are themselves so uncertain, does complex, plastic-specific measurement even make sense? (5)

As to the partners behind MariLCA, the aim of one is to generate business for LCA providers, and the other, is to generate business for plastic producers. The goal of Lifecycle Initiative is: "advancing the understanding, adoption, and application of life cycle thinking by private and public decision-makers" (6)
Plastics Europe, on the other hand, is a trade association representing polymer-producing companies in the 27 member states of the European Union, plus Norway, Switzerland, Turkey, and the UK. (7)
As far as micro and nanoplastics are concerned, Plastics Europe has "a vision to transition the European plastics system by making plastics circular, helping drive lifecycle emissions to net zero (with circularity a key pathway to doing so), and fostering the sustainable use of plastics." (8)

Mitigating plastic consumption and phasing out non-essential usage is not part of this vision.

Plastics Europe has a microplastic research project - Brigid. Focusing on ingestion, Brigid's objective is to question studies suggesting that there are links between micro and nanoplastics and adverse health effects by demonstrating that such links are based on unrealistic conditions. (9)

It is just as naïve today to expect the plastics industry to regulate itself from the point of view of human health as it was to expect the tobacco industry to do the same in the fifties and sixties. The tobacco industry tried to fend off regulation by producing filter cigarettes to address consumer concerns and by churning out studies taking advantage of the inherent uncertainty in the scientific process to sow doubt about what was known: that smoking can be lethal.

(1) https://pubs.acs.org/doi/10.1021/acs.est.4c05856#
(2) https://marilca.org/
(3) https://www.lifecycleinitiative.org/about/our-mission-vision-and-approach/
(4) https://plasticseurope.org/about-us/
(5) https://www.sciencedirect.com/science/article/pii/S0959652623023557?via%3Dihub
(6) https://www.lifecycleinitiative.org/about/our-mission-vision-and-approach/
(7) https://plasticseurope.org/
(8) https://brigid-microplastics.com/about-us/#partners
(9) https://brigid-microplastics.com/about-us/#partners

We are not saying that the approach taken by Tobacco necessarily characterizes Plastics Europe's industry–science relationships, albeit the fact that Brigid's objective is to question studies is hardly reassuring. We are saying that Big Tobacco's steps have become a model used by some industries for the exertion of commercial interests over science ever since. (1)

The parlous state of peer-reviewed science publications adds a further wrinkle. Just one publisher - Wiley - had to retract 11,300 articles between 2022 and 2024, and in May 2024, shuttered 19 science publications infected by large-scale research fraud. (2)

There is variability in microfiber and nanofiber detection methodologies, and so potential for these differences to generate manipulative results aligned with specific agendas. Further, many studies fail to adhere to the fundamental scientific principle of controlling variables.

Different fiber lengths, yarn and fabric structures, and varying chemical and physical finishing treatments are often compared without standardization, raising significant concerns about data reliability.

Acknowledging all of this, automatically means that regulators cannot simply leave it to the plastics industry to evaluate the harmful impacts of plastics. Nor, for that matter, are LCA providers remotely qualified to assess the risks associated with microplastic pollution. Both the plastics industry and LCA providers are entitled to have their say on the treatment of microfibers in LCA and PEF applications. But to hand them carte blanche to determine the metrics underpinning green legislation and regulation - with global implications and ramifications - is neither scientific nor democratic.

THE MICROFIBER CONSORTIUM

The selection of the apparel industry initiative already mentioned in our section on Chemical Treatments - The Microfiber Consortium - as the second source for a French legislative measure is equally concerning on the grounds of both science and potential conflict of interest. Many people, including some of our reviewers, believe the Microfiber Consortium (TMC) to be an NGO. UK company records indicate that this is incorrect. The Outdoor Microfiber Consortium was incorporated in the UK in October 2018, as a Private company limited by guarantee without share capital, engaged in 'Other professional, scientific and technical activities' and filing as a micro-entity (3). (4)

Examination of recent filings shows that since inception, the company has averaged 4- 6 employees and no fixed assets. TMC has neither the staff nor the facilities to be a research institute. (5)

Not surprisingly, the organization has no peer-reviewed published research that we could identify (it has contributed funding to peer-reviewed research by one of its signatories, the University of Leeds). (6)

On what grounds TMC is qualified to act as one of only 2 sources to inform the microfiber complement of what is intended to be an obligatory environmental footprint label applicable to (7) all apparel and textiles sold in France is unclear and raises questions about scientific rigor.

TMC's recent paper "A position on fibre fragmentation as an integral part of biodiversity, environmental pollution and climate strategies. June 2024 begins: (8)

"Fibre fragmentation (also known as microfibre pollution) is the process of fibre loss from a textile product during its lifecycle and/or through its subsequent breakage in the natural environment. **All types of fibres have a propensity to shed** and **the issue is not isolated to plastics** [their bold].

(1) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3490543/

(2) https://www.wsj.com/science/academic-studies-research-paper-mills-journals-publishing-f5a3d4bc?st=b9hab3d5rvvmuo7&reflink=article_email_share

(3) Micro-entities are very small companies. A company will be a micro-entity if it has any 2 of the following: a turnover of £632,000 or less; £316,000 or less on its balance sheet; 10 employees or less https://www.gov.uk/annual-accounts/microentities-small-and-dormant-companies#:~:text=Micro%2Dentities%20are%20very%20small,10%20employees%20or%20less

(4) https://find-and-update.company-information.service.gov.uk/company/11647708

(5) https://www.microfibreconsortium.com/team

(6) https://www.microfibreconsortium.com/tmc-progress-report-22-24

(7) https://fabrique-numerique.gitbook.io/ecobalyse/textile/complements-hors-acv/microfibres

(8) https://www.microfibreconsortium.com/triple-planetary-impact

As we have repeatedly pointed out, fragmentation is not scientifically synonymous with pollution. For pollution to occur there has to be a biological response to the contaminant.

The TMC position paper goes on to discuss fiber fragmentation in the context of Biodiversity loss, Environmental pollution, and Climate change. But in every case the research that the position paper links to refers only to the harmful impact of microplastics. No evidence is provided to demonstrate that natural fibers "have the potential to harm the environment, wildlife and people, with research continuing to emerge on the negative effects of their physical and/or toxicological presence in our ecosystems," as the paper claims.

Specifically, the sole sources provided to substantiate TMC's claims are:

Rebelein et al. (2021) '**Microplastic** fibers — An underestimated threat to aquatic organisms?'①

Corradini et al.(2019) 'Evidence of **microplastic** accumulation in agricultural soils from sewage sludge disposal.'②

Napper et al. (2023) 'Examining the release of **synthetic microfibres** to the environment via two major pathways: Atmospheric deposition and treated wastewater effluent',③

Laqa Kakar et al. (2023) 'Climate change interaction with **microplastics** and **nanoplastics** pollution'.④

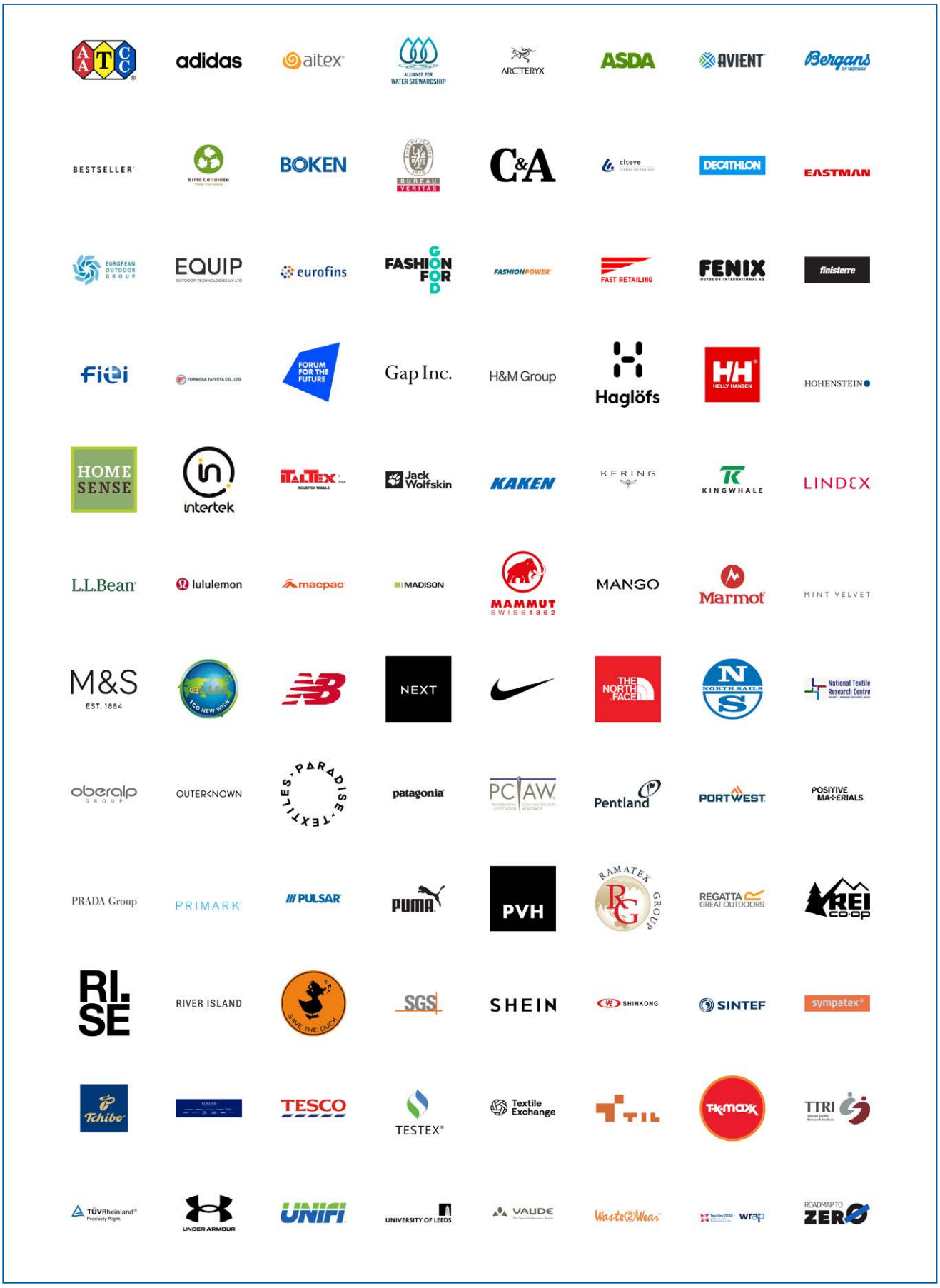
Conti et al. (2024) 'Relationship between climate change and environmental **microplastics**: a one health vision for the platysphere health'.⑤
[our bold]

This is not science.

As to who is supporting TMC's endeavors, the screenshot below shows TMC's signatories⑥ >>

① https://www.sciencedirect.com/science/article/abs/pii/S0048969721011128?via%3Dihub
② https://www.sciencedirect.com/science/article/pii/S004896971931366X?via%3Dihub
③ https://www.sciencedirect.com/science/article/abs/pii/S0048969722064166?via%3Dihub
④ https://www.sciencedirect.com/science/article/abs/pii/B9780323999083000038?via%3Dihub
⑤ https://onehealthadv.biomedcentral.com/articles/10.1186/s44280-024-00049-9
⑥ https://www.microfibreconsortium.com/signatories

The Microfiber Consortium 'Signatories' as of 03/09/2024



https://www.microfibreconsortium.com/signatories

The list includes some of the richest and most successful fashion and athleisure brands and retail platforms on the planet. It seems extraordinary that these global corporations would entrust research and analysis on a topic of such importance, to an entity with limited staff and funding, and no independent research capacity. Polyester is the cheapest mainstream fiber by a significant margin. Many of these brands market competitively priced apparel with a high synthetic fiber content. It is in their business interest to continue to sell this to sustain and build market share and operate profitably. (1) This raises serious concerns of potential conflict of interest.

The one piece of published research undertaken by TMC "Report: Biodegradability within the context of Fibre Fragmentation", December 2021, (2) was led by Patagonia with input from Adidas, Gap, Pangaia, Inditex, and others.

The report concerned was a desk study of published research. It correctly points out that "the bio-degradability of textiles is affected by additives, such as dyes, finishes, and coatings". But then, unscientifically, conflates this with the underlying fibers to suggest that natural fibers don't biodegrade. The report further compounds this error by suggesting that the rate of degradation is all that matters when the real concern is the impact that the fibers may have on human health and the environment. As noted earlier, TMC has been unable to find evidence that untreated cellulosic or proteinaceous fibers negatively impact the ecology of organisms. While some treatments slow the process, even treated natural fibers still biodegrade. Consequently, this approach is seriously misleading.

All of this is most unhelpful. If TMC is convinced that functionalizations pose a serious toxicity threat to which nobody is paying sufficient attention, we would agree. For instance, a 2023 laboratory study of oysters found that ingesting fibers and leachate from treated fabrics negatively impacted the mollusks. The wool used in that study was particularly problematic because it had been treated with high levels of persistent organic pollutants (POPs) - polychlorinated biphenyls (PCBs), and polyaromatic hydrocarbons (PAHs). Specifically, 10 PAHs and 5 PCBs were identified. We don't want such fibers in our oysters, and we don't want them on our bodies. (3)

We would urge TMC and its members to focus their research on this area. Fiber issues are solved with fiber solutions. Chemistry issues are solved with chemistry solutions. In other words, microfiber concerns will only be eliminated if brands and consumers choose

a) Fibers that pose no measurable threat.
b) Functionalizations that pose no measurable threat in relevant exposures. Indeed, functionalizations that may be toxic should be eradicated.

For this to happen, PEFs and LCAs must reflect the distinction between Fibers and Functionalizations. Many LCAs include measures of both human and environmental toxicity. Indeed, the Glimpact tool - about which, more in the next section (4) - indicates that these are included in the EU PEF. Purported product impact increases markedly with the addition of waterproofing or anti-stain functionalization. To suggest we should then assume that all natural fiber products are functionalized when it comes to the microfiber complement is inconsistent. At the very least the two should be related. The PEF scores for products will be completed by the brands who made the products concerned. They will know whether toxic treatments have or have not been applied. Only if the functionalization is toxic should natural microfibers incur any microfiber penalization. This approach would, of course, markedly increase the microfiber score for treated plastics, to reflect the materials' propensity to adsorb and sorb substances onto their surfaces. We would also submit that it is likely unrepresentative to use the same shedding rates for virgin and recycled polyester. Initial research suggests that due to structural changes in the fibers, recycled polyester generates increased microfiber emissions, with fibers breaking into smaller particles. (5)

(1) https://changingmarkets.org/report/fossil-fashion-todays-fashion-industry-has-become-synonymous-with-overconsumption-a-snowballing-waste-crisis-widespread-pollution-and-the-exploitation-of-workers-in-global-supply-chains-w/
(2) https://www.microfibreconsortium.com/biodegradability-report
(3) https://archimer.ifremer.fr/doc/00839/95128/102812.pdf
(4) https://tool.glimpact.com/ecodesign/6873/11393
(5) https://www.tandfonline.com/doi/full/10.1080/00405000.2020.1741760

THE EU PEF

As of December 2024, there is no official website showing how the EU PEF will work or what its scores will be. Given that it is supposed to launch imminently, that seems an extraordinary omission. The available information tells us that the Technical Secretariat of the PEF for Apparel and Footwear is chaired by Cascale - formerly the Sustainable Apparel Coalition - a not-for-profit alliance founded by leading apparel brands such as Patagonia, Walmart, Nike, and H&M. (1) Their representative, and the committee chair, is Baptiste Carriere-Pradal. He is also a Boston Consulting Group (BCG) senior advisor. (2) The technical lead is Quantis - an LCA provider owned by BCG. (3) Voting rights cost Euro 50K per year, and most associations, such as Euratex and the International Wool Textile Organization (IWTO), have observer status only. Voting members include heavily plastic-dependent brands such as Nike, Decathlon, and Inditex. (4) The EU defends this model by claiming, not inaccurately, that legislation is most effective when supported by the corporations involved. The interests of the general public are supposedly preserved by consultation with NGOs.

An increasing number of voices are questioning this model - not just in apparel and in the EU, but globally - because many not-for-profit organizations represent quite narrow interests, not those of the general population, least of all, the population of the Global South. Moreover, in many instances, the not-for-profit organizations consulted by the EU are created, funded, and directed by the same organizations as the entities the EU claims the NGOs are counterbalancing. A lead member of the Policy Hub, for instance, is Cascale (5) and from May 2019 - Sep 2024 the Policy Hub Chair was Baptiste Carriere-Pradal. (6) This raises serious concerns regarding conflict of interest as well as the science and the justice of allowing such a narrow set of interests to determine legislation. (7)

As already mentioned, unlike the French PEF, there is no EU website concerned citizens can visit to evaluate what the EU PEF will look like. The closest we have found is a private service provider, Glimpact (8) which offers a PEF-based tool "selon le PEFCR Apparel & Footwear 2.0 utilisant la base de données EF 3.1". We ran some simulations on 18/10/24, "Based on template: T-shirt Classique en Coton - 150g - Monde" and then again, with no changes apart from swapping the raw material to polyester. The outcomes are shown in the charts below.

The first surprise for us was that the scores are shown per day of wear. There are no studies of how many days the average t-shirt or any other item of clothing is worn (rather than years kept), consequently, this metric is an unscientific guesstimate. For example, in February 2024, the French PEF for a t-shirt was based on 45 wears and 45 washes. As of 11/11/2024 that had been modified to 30 wears and 30 washes. No explanation is provided for this change, and the underlying data sheet still shows 45 wears for a t-shirt and indeed, 70 wears for a pair of jeans. (9) The product page for jeans however now shows only 47 wears. (10) What accounts for these dramatic reductions in expected wear is not explained. Again We reached out to Ecobalyse who offered the following explanation: "We modified the default "expected wear" to match the PEFCR A&F assumptions. Original assumptions were the ones proposed by the French Ademe framework." (11) In other words, there is no science behind this. It is a question of preference for one guestimate over another.

The second issue to note is that according to the EU PEF, with a purported impact of 38.0 µPt per day of wear, a cotton tee is 74% more environmentally damaging than a polyester one which has an impact rated at only 21.9µPt per day of wear. Further, the 'Human toxicity cancer' of a

(1) https://pefapparelandfootwear.eu/who-is-involved/
(2) https://www.consultor.fr/articles/durabilite-en-europe-le-bcg-peaufine-son-droit-avec-un-nouveau-senior-advisor
(3) https://quantis.com/
(4) https://cascale.org/about-us/our-advocacy/pef/
(5) https://www.policyhub.org/partners
(6) https://www.linkedin.com/in/baptiste-carriere-pradal/?originalSubdomain=nl
(7) https://www.linkedin.com/posts/baptiste-carriere-pradal_pef-days-activity-7142831152096034819-Hq-s?utm_source=share&utm_medium=member_desktop
(8) https://www.glimpact.com/european-global-impact-score
(9) https://ecobalyse.beta.gouv.fr/#/explore/textile/products
(10) https://ecobalyse.beta.gouv.fr/#/textile/simulator
(11) Ecobalyse email of 09/12/2024

cotton tee is 50% greater (2.2128e-10 CTUh vs 1.4905e-10 CTUh [1]) and non-cancer, 3 times greater (4.1103e-9 CTUh vs 1.2940e-9 CTUh), than that of a polyester tee. In light of recent research, some of which we have touched upon in this paper, this comparative evaluation appears seriously out of touch and inconsistent with current scientific thinking.

Finally, Only 16 variables are shown. A microfiber index has not yet been included. That is about to change. Specifically, the March 2023 proposed EU Green Claims Directive states the following: [2]
"As regards textiles, the PEFCR should for example reflect the microplastics release, before the adoption of PEFCR could be considered"
NB. PEFCR= Product Environmental Footprint Category Rules)
This requirement was reiterated in the position adopted by the EU Parliament in March: [3]
And again in the June 2024 EU Council General Approach to the proposal. [4]

The F&A Technical Secretariat is obliged to include a microfiber metric and so intends to do so.
Concerningly, the intent of the secretariat appears to be to follow this admonition in letter but not in spirit. We quote:

"The TS voted in December 2023 at the PEF Days in Düsseldorf to overturn its previous decision regarding the scope of the pursued assessment. Instead, the PEFCR's approach **should consider all fibre types, including natural fibres**."(our bold)

The PEF Technical Secretariat in Lille, on 26 November 2024, was expected to vote on a further agenda that distills to 2 points. Only yes or no votes are allowed:

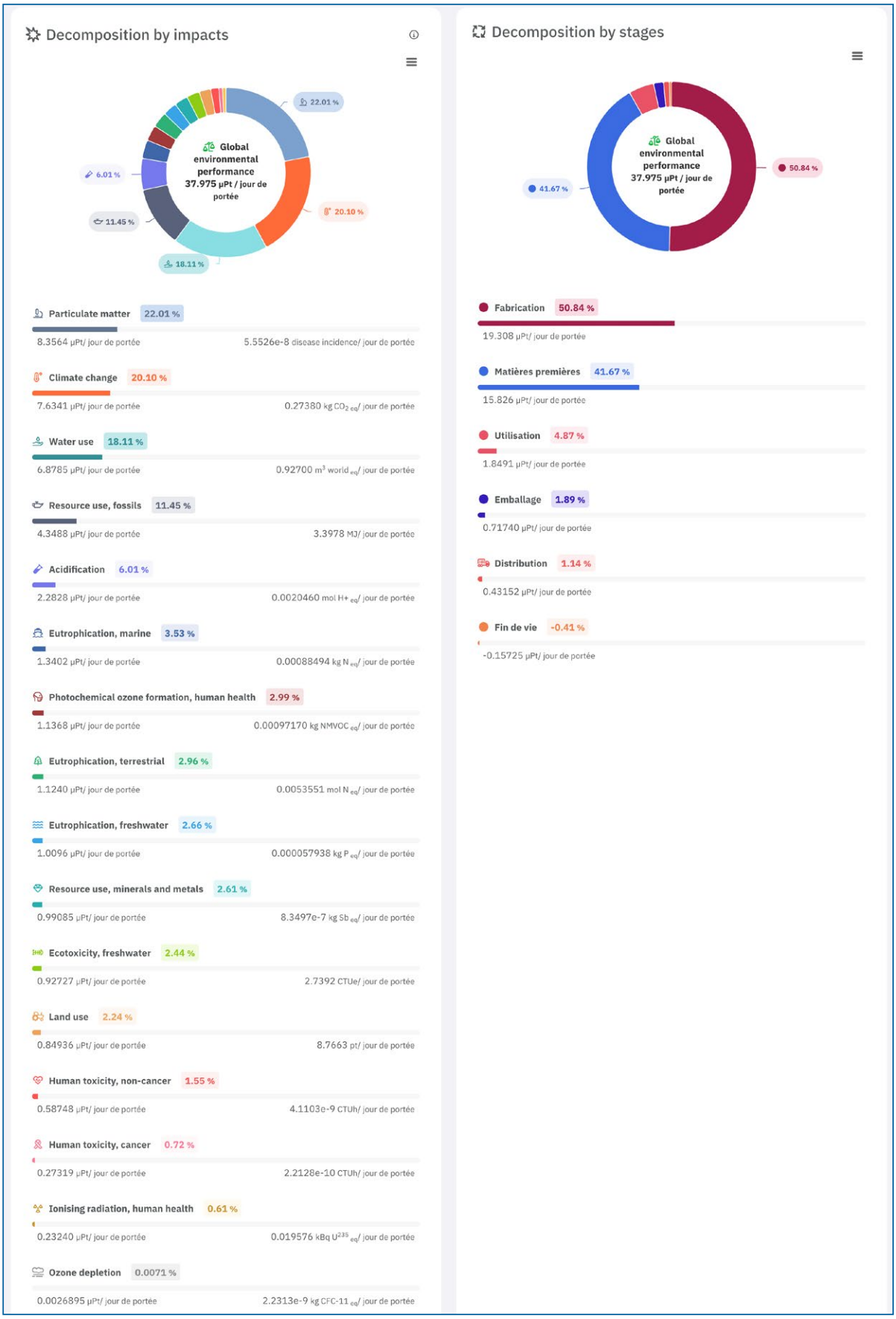
a) TMC data will either be obligatory or optional with the former recommended: "to mitigate TMC's intellectual property risks."
b) The use of primary data will or will not be permitted

Source: "Voting Materials for the Consideration of the Members of the Technical Secretariat for the PEFCR A&F: The Integration of Fibre Fragments into the PEFCR for A&F. PEF Days in Lille, 26 November 2024

There is no evidence that the secretariat intends to inform the EU Commission, Parliament, the scientific community, or indeed, anyone else, of its unilateral decision to transition the term "microplastics" to "fiber fragments" including all fiber types, natural as well as plastic. Indeed, the documentation states that the decision should be presented as adhering "to the Commission's requirements in the Green Claims Directive, incorporating a **microplastics assessment** method in its final version." (our bold). This is inconsistent with the EU's publicly declared stance on plastics. Specifically, the EU is a member of the High Ambition Coalition (HAC) to End Plastic Pollution (as is France). The HAC Member States Ministerial Joint Statement INC-3 [5] refers specifically to the 15 global policy interventions commissioned by the Nordic Council of Ministers and developed by Systemiq. Number 3 of the 15 interventions is: "Application-specific levers to **reduce plastic consumption**." [6] [our bold]
A reduction is believed necessary because, to quote the Executive Vice-President for the European Green Deal, Maroš Šefčwovič: "Plastics are choking our oceans, polluting the environment and harming people's health and livelihoods." [7]

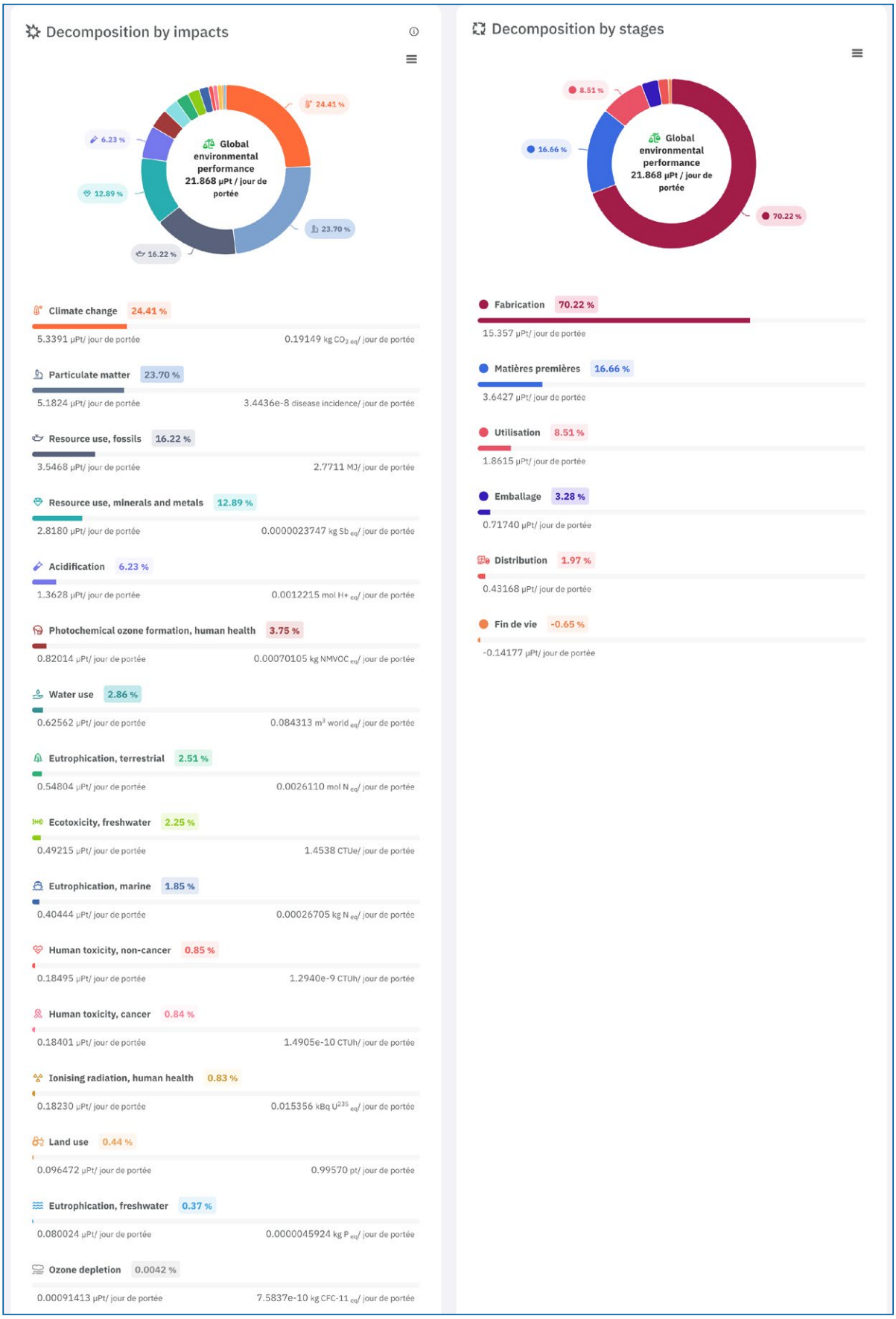
1 Comparative Toxic Unit, humans
2 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2023%3A0166%3AFIN
3 https://www.europarl.europa.eu/doceo/document/TA-9-2024-0131_EN.htm
4 https://data.consilium.europa.eu/doc/document/ST-11312-2024-INIT/en/pdf
5 https://hactoendplasticpollution.org/hac-ministerial-joint-statement-inc3/#
6 https://www.systemiq.earth/towards-ending-plastic-pollution-by-2040/#fastfacts
7 https://environment.ec.europa.eu/news/eu-calls-agreement-conclude-global-plastics-treaty-2024-11-25_en

EU PEF: Glimpact Simulation Impacts Analysis Classic Cotton Tee



https://tool.glimpact.com/ecodesign/6479/10819/results

EU PEF: Glimpact Simulation Impacts Analysis Classic Polyester Tee



https://tool.glimpact.com/ecodesign/6478/10818/results

CONCLUSION

HOW SHOULD MICROFIBERS BE TREATED IN LCA AND PEF APPLICATIONS?

Here, we would repeat the observation made earlier, and it is a vital one. Decisions on the treatment of microfibers in LCA and PEF applications must be made with broad consultation. In 2013 the European Environment Agency, an official organisation of the European Union (1), published advice on the application of the precautionary principle in legislation and regulation. This advice points out that: "There are many value judgments involved in hazard and risk analysis, from the framing of the issue and the questions to be addressed to the ethical choice of the appropriate strength of evidence that should justify action to reduce hazards in a particular case. As several authoritative bodies have highlighted in recent years, the public should be involved in decisions about serious hazards and their avoidance, and at all stages of the risk analysis process". (2)
With this in mind, the assessment of apparel microplastic and nanoplastic pollution cannot ethically or scientifically be left to a handful of LCA providers, fashion brands, and not-for-profit organizations to decide. Moreover, unlike smoking for example, my decision to consume plastic clothing may impact the health and welfare of someone living on the other side of the earth. Millions of tonnes of synthetic fibers are exported from the Global North to the Global South in the form of waste used-clothing each year. Much of it becomes contamination in the environments of recipient countries which lack adequate waste management systems. It is, therefore, not just the European or US public who should be involved in the decision-making. This must be a global consultation.

What follows are our suggestions for how the topic could be approached.

1. All macro plastic leakage will eventually become micro and nano plastics. Above all the potential impact of macro plastic release/leakage must be included in textile and apparel LCAs and PEFs along with microplastic release.

2. We see a distinction between assessments intended to inform internal business decisions and those directed at consumers. There are end-uses where plastics are not easily replaced. In the interim, for these uses, a fabric that sheds fewer fibers is preferable. Some measure of shedding rates is an appropriate indicator in business-to-business LCAs.

3. Measures of shedding are not appropriate for inclusion in LCAs or PEFs intended for consumers. Telling consumers that an item of clothing will release a specific number of fibers per wash or wear is meaningless. How many is too many? Is the number in the thousands or is it any number greater than zero? The appropriate solution here is a warning. In the late fifties, the US tobacco industry tried to fend off consumer concerns and potential regulation with promises of filters to reduce tar and 'improve taste'. By the mid-sixties, the warning "Caution: Cigarette Smoking May Be Hazardous to Your Health" had to be placed on one side panel of every package. (3) Unlike cigarette smoke, microfibers do not just impact those in the users' vicinity. Unlike cigarette smoke, the danger does not end when the purchaser is finished with the item. By extension, the argument that any use whatsoever is potentially harmful is stronger for plastic clothing than for cigarettes. Logically, the most appropriate information to transmit to consumers would be a warning along the lines of:

"Caution: Plastic Clothing May Be Hazardous to Your Health, that of your Family, and that of every other living creature."

(1) https://www.eea.europa.eu/en/about/who-we-are/governance
(2) https://backend.orbit.dtu.dk/ws/portalfiles/portal/52992783/Gee%20et%20al.%202013%20Late%20lessons%20from%20early%20warnings%20II%20-%20Full%20report-2.pdf
(3) https://famri.org/history-of-cigarette-warning-labels/

VERONICA BATES KASSATLY AND TERRY TOWNSEND

The Treatment of Microfibers in Life Cycle Analysis and Product Environmental Footprint Applications

Plastic microfibres are microscopic particles generated by the physical and chemical degradation of consumer and industrial plastic products including apparel. They are commonly categorized as microplastics - particles less than 5 millimeters (about 0.2 in or 5,000 microns) across – and nanoplastics - particles between 1-1,000 nanometers (1 micron = 1,000 nanometers) across. Plastic microfibres are found in every ecosystem on Earth even in the remotest locations - from the Mariana Trench to Everest, and from Antarctica to Tibet. Microplastics affect everyone and everything, everywhere.

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