Reducing Disparate Health Burdens of Full Supply Chains by Major PET and Polyester Consuming Corporations

Overview

The beverage and fashion industry's reliance on polyethylene terephthalate (PET) plastic for a significant portion of its packaging and polyester source material creates avoidable financial and business risks. Several known or possible carcinogens are associated with making PET plastic bottles, including antimony trioxide, cobalt, ethylene oxide (EtO), and 1,4-dioxane. Antimony and cobalt have been found in end products such as PET-based beverage bottles, and textiles made from recycled PET. This creates customer exposure risks. And dependency on ethylene oxide and 1,4-dioxane to make PET creates production risks, because of the high pollution levels and adverse human health impacts in industrial PET production communities where the proportion of nearby residents of color exceeds the national average. Evidence of environmental injustices[1] associated with this process creates supply chain risks, including unexpected costs related to litigation, fines and permits needed to operate.

Industry leaders, however, have invested in solutions including antimony and cobalt-free PET plastic. This represents an interim step beverage and fashion brands can take to invest in safer chemistries and reduce business risks associated with adverse human health and environmental impacts of PET products and production.

Key facts and industry trends

- The beverage industry worldwide purchases more than 500 billion plastic bottles yearly, or around one-quarter of all global PET plastic production.[2] Several known or possible carcinogens are associated with making PET plastic bottles, including antimony trioxide, cobalt, ethylene oxide, and 1,4-dioxane.[3]

- The apparel and footwear industry's reliance on polyester fiber derived from fossil-based polyethylene terephthalate (PET) plastic is rising. With this growing reliance we are seeing industry sector trends and voluntary industry standards that may work at cross-purposes to corporate sustainability goals. The textile industry has taken noticeable steps to reduce the discharge of hazardous chemicals from its wet polyester processing suppliers, historically major water polluters and hazardous waste generators. Yet, the

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1 Defend Our Health 2023. Hidden Hazards: The Chemical Footprint of a Plastic Bottle. Full text at https://defendourhealth.org/wp-content/uploads/2023/07/FINAL-DOH-PlasticBottles-Report_7.11.2023.pdf

2 Global Market Insights. (2020) *Polyester Fiber Market Size, By Grade (PET, PCDT), By Product (Solid, Hollow), By Application (Carpets & Rugs, Non-Woven Fiber, Fiberfill, Apparel, Home Textile, Others), Industry Analysis Report, Regional Outlook, Growth Potential, Price Trend, Competitive Landscape & Forecast, 2021 - 2027*. https://www.gminsights.com/industry-analysis/poly- ester-fiber-market; Grand View Research. (2019) P*olyethylene Terephthalate Market Size, Share & Trends Analysis Report, By Application (Packaging, Films & Sheets), By Packaging Application And Segment Forecasts, 2019 - 2025*. https://grandviewresearch.com/industry-analysis/polyethylene-tere- phthalate-market.

3 Defend Our Health 2023. Hidden Hazards: The Chemical Footprint of a Plastic Bottle. Full text at https://defendourhealth.org/wp-content/uploads/2023/07/FINAL-DOH-PlasticBottles-Report_7.11.2023.pdf

textile sector may be simultaneously contributing to the increased hazardous chemical content of polyester fiber. This is because of the increase in use of recycled PET or rPET in production. Studies show that recycled PET can contain toxic benzene and styrene that are produced in rPET due to contamination.[4] These chemicals can have health impacts as they can migrate out of the finished products.

- Safer alternatives to hazardous chemicals are widely available in the immediate-term, while the industry seeks longer term solutions to reduce its reliance on virgin PET. Companies like Herman Miller are already sourcing 100% antimony-free polyester for several of their textile products.[5] A portion of the Asian polyester market and Japanese plastic bottle market is antimony-free, thanks to use of titanium and germanium - both safer than antimony for making PET and polyester.[6, 7]

Consumer Risk

- Antimony trioxide is a commonly used catalyst to make PET and has been shown to migrate from PET bottles to beverages contained within,[8] thereby exposing consumers to the known carcinogen. Antimony can cause cancer[9] and is toxic to the liver, thyroid, and heart.[10]
- Antimony remains present in the final PET plastic at concentrations of 200 to 400 parts per million, and readily migrates from plastic bottles[11,12,13,14] and polyester fibers,[15]

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[4] Thoden van Velzen, E.U., Brouwer, M.T., Stärker, C. & Well, F. (2020). Effect of recycled content and rPET quality on the properties of PET bottles, part II: Migration. *Packaging Technology and Science*, 33(9), 359-371. https://onlinelibrary.wiley.com/doi/full/10.1002/pts.2528

[5] Herman Miller (2023) Earth Friendly Materials. https://www.hermanmiller.com/content/dam/hermanmiller/documents/materials/reference_info/Earth_Friendly_Materials.pdf

[6] Alan Cooper, Founder and CEO of Catalytic Technologies Ltd., personal communication (2022). https://ctl8.com/products/ctl-ti638-up/

[7] Kishi, E., Ozaki, A., Ooshima, T., Abe, Y., Mutsuga, M., Yamaguchi, Y., & Yamano, T. (2020). Determination of Various Constituent Elements of Polyethylene Terephthalate Bottles Used for Beverages in Japan. *Packaging Technology and Science*, 33 (4-5), 83–93. https://doi.org/10.1002/pts.2497

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[9] International Agency for Research on Cancer. (2022). *IARC Monographs evaluate the carcinogenicity of cobalt, antimony compounds, and weap- ons-grade tungsten alloy*. https://www.iarc.who.int/wp-content/up- loads/2022/04/Mono-131-QA.pdf

[10] Office of Environmental Health Hazard Assessment (OEHHA). (2016). *Public Health Goal for Antimony in Drinking Water*. https://oehha.ca.gov/media/ downloads/water/chemicals/phg/antimonyphg092316.pdf

[11] Westerhoff, P., Prapaipong, P., Shock, E. & Hillaireau, A. (2008) Antimony leaching from polyethylene terephthalate (PET) plastic used for bottled drinking water. *Water Research*, 42, 551–6. https://doi.org/10.1016/j.watres.2007.07.048

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[13] Chapa-Martínez, C.A., Hinojosa-Reyes, L., Hernández-Ramírez, A., Ruiz-Ruiz, E., Maya-Treviño, L. & Guzmán-Mar, J.L. (2016) An evaluation of the migration of antimony from polyethylene terephthalate (PET) plastic used for bottled drinking water. *Science of the Total Environment*, Elsevier B.V., 565, 511–8. https://doi.org/10.1016/j.scitotenv.2016.04.184

[14] Hansen, H.R. & Pergantis, S.A. (2006) Detection of antimony species in citrus juices and drinking water stored in PET containers. *Journal of Analytical Atomic Spectrometry*, 21, 731–3. https://doi.org/10.1039/b606367e

[15] Biver, M., Turner, A. & Filella, M. (2021) Antimony release from polyester textiles by artificial sweat solutions: A call for a standardized procedure. *Regulatory Toxicology and Pharmacology*, 119. https://doi.org/10.1016/j.yrtph.2020.104824

exposing consumers and polluting the environment. Americans who identify as Latinx or African-American are disproportionately exposed to antimony from all sources, as are children.[16]

- Cobalt is also used as a co-catalyst with antimony. Many cobalt compounds are known carcinogens.[17] Cobalt has also been found in beverage bottle plastics. The extraction, smelting, and refining of both metals put workers at risk[18, 19] and create environmental pollution in Asia, Africa, and Latin America.[20,21]

- PET resin production for plastic bottles in North America remains heavily dependent on antimony and cobalt. Therefore, the majority of rPET currently being used to meet recycled polyester goals in the apparel sector may be contributing to growing pollution. The Recycled Polyester Challenge, launched by the Textile Exchange as part of the Fashion Charter of the UN Framework Convention on Climate Change, aims to increase the fashion industry's use of rPET from 14% in 2019 to 45% by 2025 to reduce greenhouse gas emissions.[22] Meanwhile, the Zero Discharge of Hazardous Chemicals (ZDHC) Wastewater Guidelines establish a clear intent to limit antimony in wastewater discharges from wet polyester processing by 2025.[23] Additionally, the Apparel and Footwear International RSL Management (AFIRM) Group restricts the amount of extractable antimony present in a finished textile product.[24]

Production risk

- Ethylene oxide air emissions from chemical manufacturers that supply PET plastics expose more than 3 million people, primarily in the Gulf Coast, to serious cancer risks, far greater than any other hazardous air pollutant.[25] Around half of all ethylene oxide

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[16] U.S. Centers for Disease Control and Prevention (2022) National Report on Human Exposure to Environmental Chemicals. See creatinine-corrected urinary antimony concentrations. https://www.cdc.gov/exposurereport/index.html

[17] Agency for Toxic Substances and Disease Registry (ATSDR) (2004) Toxicological Profile for Cobalt. https://www.atsdr.cdc.gov/toxprofiles/tp33.pdf. https://doi.org/10.1111/j.1464-410X.1956.tb04795.x

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[22] Textile Exchange. 2025 Recycled Polyester Challenge. https://textileexchange.org/2025-recycled-polyester-challenge/

[23] Zero Discharge of Hazardous Chemicals (ZDHC), Wastewater Guidelines Version 2.1 (2022). https://downloads.roadmaptozero.com/output/ZDHC-Wastewater-Guidelines

[24] AFIRM Group (2023) Restricted Substances List. Version 08. https://afirm-group.com/wp-content/uploads/2023/03/2023_AFIRM_RSL_2023_0322.pdf

[25] Blau, M., Younes, L., & Flynn, K. (2021). The Dirty Secret of America's Clean Dishes—ProPublica. *ProPublica*. https://www.propublica.org/article/the-dirty-secret-of-americas-clean-dishes

produced in the U.S. is used as a building block chemical to make PET.[26] Ethylene oxide exposure is linked to leukemia, lymphoma, and breast cancer in humans.[27]

- Discharges to waterways of 1,4-dioxane are another significant source of pollution from the making of PET. In 2021, PET plastics manufacturers discharged 93,000 pounds of 1,4-dioxane to sewage plants and rivers in the Southeast U.S., more than any other industry in that year.[28] 1,4-dioxane is a byproduct of PET manufacturing and is a likely human carcinogen[29] and it is a very persistent pollutant in water.

- The health burden from these and other pollutants associated with PET production is not evenly spread among communities. Most PET supply chain chemical plants in the United States are in communities where the proportion of residents of color exceeds the national average. For example, Black and Brown residents face serious cancer risks from ethylene oxide emissions in greater numbers than white residents, making up 64% of the at-risk community.[30]

Path Forward

Fortunately, emergent tools can help beverage and apparel companies assess the risks associated with their plastic supply chain's chemical footprint, including the environmental justice impacts. The Chemical Footprint Project[31] is increasingly being utilized by forward-thinking companies to assess the chemical footprint of their own operations and manufacturing processes, as well as within their supply chains. The CFP Survey could be utilized by beverage and apparel companies to better understand the chemical footprint of plastics and recycled feedstocks. And the EPA's EJScreen is an environmental justice screening and mapping tool that can be used to identify disparate health impacts of a company's operations and supply chain.[32]

We urge companies to prioritize ensuring that all materials are made with inherently safer chemicals *before* considering them recyclable. Investing in cycles that use safer materials reduces risk and unlocks opportunities to improve environmental performance and a company's impacts on human health. Investing in antimony-free and cobalt-free polyester is a needed next step.

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[26] Defend Our Health 2022. Problem Plastic: How Polyester and PET Plastic Can be Unsafe, Unjust, and Unsustainable Materials. Full text at https://defendourhealth.org/campaigns/plastic-pollution/problem-plastic/

[27] National Cancer Institute. (2015). *Ethylene Oxide—Cancer-Causing Substances* (nci global, nci enterprise) [CgvArticle]. https://www.cancer.gov/about-cancer/causes-prevention/risk/substances/ethylene-oxide

[28] US EPA TRI reports (2021). https://www.epa.gov/toxics-release-inventory-tri-program

[29] Agency for Toxic Substances and Disease Registry (ATSDR). (2012). *Toxicological Profile for 1,4—Dioxane*. https://www.atsdr.cdc.gov/toxprofiles/tp187.pdf

[30] US EPA, HON, Proposed Rule, Table 31. https://www.epa.gov/station- ary-sources-air-pollution/synthetic-organic-chemical-manufacturing-in- dustry-organic-national

[31] https://chemicalfootprint.org

[32] https://www.epa.gov/ejscreen

We recognize responsible sourcing requires close attention to a variety of concerns. We urge companies to prioritize full supply chain chemical management and attention to racial disparities along the same supply chain. Investing in supply chains that use safer chemicals and materials and reduce environmental harm reduces financial and business risks and opens opportunities to improve environmental performance and impacts to human health.

Recommended Corporate Actions

- Source PET/polyester plastic, both virgin and recycled, that is antimony and cobalt-free and made with an inherently safer alternative catalyst.

- Utilize the Chemical Footprint Project Survey Tool across entire supply chains to assess the chemical footprint of plastics and recycled feedstocks.

- Employ the EPA's EJScreen mapping tool to identify disparate health impacts of entire supply chains.

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The views and analysis presented in this report do not necessarily represent the positions or perspectives of every member of Clean Production Action's Investor Environmental Health Network.

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