

[The World Has One Big Chance to Fix Plastics](#)

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Text is hyperlinked, where possible. Here are additional sources consulted during the writing of this essay.

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On **plastics' global fate and transport**, and planetary systems implications:

Steve Allen, Deonie Allen, Samaneh Karbalaei, Vittorio Maselli and Tony R. Walker. 2022. Micro(nano)plastics sources, fate and effects: What we know after ten years of research. *Journal of Hazardous Materials Advances*.

<https://doi.org/10.1016/j.hazadv.2022.100057>

Linn Perrson, Bethanie M. Carney Almroth, Christopher D. Collins, Sarah Cornell, Cynthia A. de Witt, Miriam L. Diamond, Peter Fantke, Marin Hassellöv, Matthew MacLeod, Morten W. Ryberg, Peter Søgaard Jørgensen, Patricia Villarrubia-Gómez, Zhanyun Wang, and Michael Zwicky Hauschild. 2022. Outside the Safe Operating Space of the Planetary Boundary for Novel Entities. *Environmental Science and Technology* 56(3): 1510-1521. DOI: [10.1021/acs.est.1c04158](https://doi.org/10.1021/acs.est.1c04158)

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Antonio ragus et al. 2021. Plasticenta: First evidence of microplastics in human placenta. *Environment International* 146: <https://doi.org/10.1016/j.envint.2020.106274>

On the **UNEA process** and **plastics treaty resolution**:

United Nations Environment Assembly of the United Nations Environment Programme. 2022. Draft Resolution: End Plastic Pollution: Towards an International Legally Binding Instrument.
https://wedocs.unep.org/bitstream/handle/20.500.11822/38522/k2200647_-_unep-ea-5-l-23-rev-1_-_advance.pdf?sequence=1&isAllowed=y

History of the prior UNEA Resolutions, which previously focused on Marine Litter:
<https://unea.marinelitter.no/>

Hiroko Muraki Gottlieb. 2021. Filling the gaps in the global governance of marine plastic pollution. *Natural Resources and Environment*, 35(4). Republished here:
<https://www.unep.org/news-and-stories/story/what-you-need-know-about-plastic-pollution-resolution>

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<https://www.unep.org/news-and-stories/story/what-you-need-know-about-plastic-pollution-resolution>

Hiroko Tabushi. 2022. The World Is Awash in Plastics. Nations Plant a Treaty to Fix That. *The New York Times*. 3/2/2022
<https://www.nytimes.com/2022/03/02/climate/global-plastics-recycling-treaty.html>

International Institute for Sustainable Development. 2022. Report on the main proceeding for 2 March 2022. UNEA5.2. *Earth Negotiations Bulletin*.
<https://enb.iisd.org/unea5-oecpr5-unep50-daily-report-2Mar2022>

See Governing Plastics Network at the University of Surrey in the UK:

<https://www.surrey.ac.uk/surrey-centre-international-and-environmental-law/governing-plastics-network>

On a **lifecycle approach**, lifecycle defined:

<https://pubs.acs.org/doi/full/10.1021/acs.est.0c05295>

On **public, civil society, scientific support for a plastics treaty**:

See www.plasticstreaty.org to see NGOs and scientific support leading into the Nairobi meetings.

Survey data (n=20,513 polled from 28 countries) compiled by IPSOS, details here:

<https://www.ipsos.com/en/attitudes-towards-single-use-plastics>

Stephanie B. Borelle, Chelsea M. Rochman, Max Liboiron and Jennifer Provencher. 2017. Why we need an international agreement on marine plastic pollution. *PNAS* 114(38): <https://doi.org/10.1073/pnas.1714450114>

Nils Simon, Karen Raubenheimer, Niko Urho, Sebastian Unger, David Azoulay, Trisia Farrelly, Joao Sousa, Harro Van Asselt, Giulia Carlini, Chrisian Sekomo, Maro Luisa Schulte, Per-Olof Busch, Nicole Wienrich and Laura Weiand. 2021. A Binding Global Agreement to Address the Life Cycle of Plastics. *Science*. 373 (6550): 43-47. [DOI: 10.1126/science.abi9010](https://doi.org/10.1126/science.abi9010)

For further information, see reports compiled by the following organizations: Basel Action Network (BAN), Alaska Community Action on Toxics (ACAT), the International Pollution Elimination Network (IPEN), the Center for International Environmental Law (CIEL), [the Global Alliance of Waste Pickers](https://www.globalallianceofwastepickers.org/), The Global Alliance for Incinerator Alternatives (GAIA), Break Free from Plastic, and the International Institute of Sustainable Development's [Earth Negotiations Bulletin](https://www.earthnegotiationsbulletin.org/).

On **international environmental governance**

See work of [Jen Allan](#) (Cardiff University and strategic advisor for the International Institute for Sustainable Development's [Earth Negotiations Bulletin](#), also generally a tremendous resource that has followed environmental international governance issues for something like 3 decades.) And specifically:

Jennifer Allan, Elsa Tsioumani, Natlie Jones and Bernard Soubry. 2022. The State of Global Environmental Governance 2021. International Institute for Sustainable Development. Report. Available at:

<https://www.iisd.org/publications/state-global-environmental-governance-2021>

Pia M. Kohler. 2019. *Science Advice and Global Environmental Governance: Expert Institutions and the Implementation of International Environmental Treaties* (Anthem).

On **global governance of plastics**, including gaps, analysis of resolution

<https://www.unep.org/news-and-stories/press-release/regulatory-landscape-single-use-plastics-shows-widespread-momentum>

Follow work of Governing Plastics Network at the University of Surrey in the UK:

<https://www.surrey.ac.uk/surrey-centre-international-and-environmental-law/governing-plastics-network>

On the **United Nations Stockholm Convention as it relates to plastics**:

When we say, some chemicals regulated under Stockholm are plastics-associated, we specifically are referring to PCBs, once used as a [plasticizer](#), PFOA, once deployed as a [processing aid](#) in the production of fluorinated plastics like Teflon, and Deca-BDE, added to plastics to impart [flame resistance](#). The plastic stabilizer [UV-328](#) may soon face global restrictions under the Stockholm Convention, too.

Stockholm Convention on Persistent Organic Pollutants (POPs) <http://www.pops.int/>

On the United States ratification status on [Stockholm](#) via US Department of State:

<https://www.state.gov/key-topics-office-of-environmental-quality-and-transboundary-issu>

[es/stockholm-convention-on-persistent-organic-pollutants/#:~:text=The%20United%20States%20signed%20the,and%20in%20technical%20working%20groups](https://www.unep.org/stockholm-convention-on-persistent-organic-pollutants/#:~:text=The%20United%20States%20signed%20the,and%20in%20technical%20working%20groups).

On Stockholm considering plastics as a mechanism for global transport
<http://chm.pops.int/Default.aspx?tabid=8747>

On artist **Ben Von Wong's** “**Turn off the Tap**” sculpture see:
<https://pandasnotplastic.com/>

See this Twitter thread re: its installation at UNEA Nairobi meetings (Feb 2, 2022):
<https://twitter.com/thevonwong/status/1496122485942718472>

On **worldwide plastics production, scale, rate, change over time**:

The National Academy of Sciences, Engineering and Medicine. 2021. Reckoning with the U.S. Role of Global Ocean Plastic Waste. Washington DC, The National Academies Press. <https://www.nap.edu/resource/other/dels/plastics-in-the-ocean/>

Geyer R, Jambeck JR, Law KL. 2017. Production, use, and fate of all plastics ever made. *Sci Adv.* 3(7):e1700782 [DOI: 10.1126/sciadv.1700782](https://doi.org/10.1126/sciadv.1700782)

Roland Geyer. 2020. A Brief History of Plastics. In: *Mare Plasticum—The Plastic Sea*. Marilena Streit-Bianchi, Margarita Cimadevila, and Wolfgang Tretnak, editors. Springer. https://link.springer.com/chapter/10.1007/978-3-030-38945-1_2

Plastics Europe. 2021. Plastics the Facts: An Analysis of European (and World) Plastics Production, Demand and Waste Data. Available at:
<https://plasticseurope.org/knowledgehub/plastics-the-facts-2021/>

Alice Mah. 2022 (forthcoming). *Plastics Unlimited: How Corporations Are Fueling the Ecological Crisis and What We Can Do About it*. Polity Press.

Jeffrey L. Meikle, Material Doubts: the Consequences of Plastic, *Environmental History*, Volume 2, Issue 3, July 1997, Pages 278–300, <https://doi.org/10.2307/3985351>

Jeffrey L. Meikle. 2007. American Plastic. Rutgers University Press.

Joel Tickner, Ken Geiser and Stephanie Baima. 2021. Transitioning the Chemical Industry: The Case for Addressing the Climate, Toxics and Plastics Crises.

Environment: Science and Policy for Sustainable Development. 63 (6):

<https://doi.org/10.1080/00139157.2021.1979857>

Joel Tickner, Ken Geiser and Stepahnie Baima. 2022. Transition the Chemical Industry: Elements of a Roadmap Toward Sustainable Chemicals and Materials. *Environmental: Science and Policy for Sustainable Development*. 64 (2): 22-36. DOI:

[10.1080/00139157.2022.2021793](https://doi.org/10.1080/00139157.2022.2021793)

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Joel Tickner and Peter Nieuwenhuizen. 2022. Reinventing the chemical industry to achieve a sustainable future. *C&EN*. 1 March 2022:

<https://cen.acs.org/environment/sustainability/Reinventing-chemical-industry-achieve-sustainable-future/100/web/2022/03>

On **percent annual plastics that go towards short-term, disposable uses**

See Geyer R, Jambeck JR, Law KL. 2017. Production, use, and fate of all plastics ever made. *Sci Adv*. 2017 Jul 19; 3(7):e1700782. DOI: [10.1126/sciadv.1700782](https://doi.org/10.1126/sciadv.1700782)

On **fossil fuel industry growth opportunity** in plastics:

IEA. 2018. The Future of Petrochemicals: Towards a More Sustainable Chemical Industry. <https://www.iea.org/reports/the-future-of-petrochemicals>

Alexander H. Tullo. 2019. Why the Future of Oil is in Chemicals, Not Fuels. *Chemical and Engineering News*. 97 (8):

<https://cen.acs.org/business/petrochemicals/future-oil-chemicals-fuels/97/i8>

Ahmad Ghaddar and Ron Bousso. 2018. Rising Use of Plastics to Drive Oil Demand by 2050. *Reuters*. October 4, 2018.

<https://www.reuters.com/article/us-petrochemicals-iea/rising-use-of-plastics-to-drive-oil-demand-to-2050-iea-idUSKCN1ME2QD>

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<https://theconversation.com/oil-companies-are-ploughing-money-into-fossil-fuelled-plastics-production-at-a-record-rate-new-research-169690>

On **plastics additives**:

Helene Wiesinger, Zhanyun Wang, and Stefanie Hellweg. 2021. Deep Dive into Plastic Monomers, Additives, and Processing Aids. *Environmental Science & Technology* 2021 55 (13), 9339-935. <https://pubs.acs.org/doi/full/10.1021/acs.est.1c00976>

From abstract: “In total, we identify more than 10,000 relevant substances and categorize them based on substance types, use patterns, and hazard classifications wherever possible. Over 2,400 substances are identified as substances of potential concern as they meet one or more of the 1 persistence, bioaccumulation, and toxicity criteria in the European Union.

Jane Muncke, Anna-Mara Andersson, et al. 2020. Impacts of food contact chemicals on human health: a consensus statement. *Environmental Health*.

<https://ehjournal.biomedcentral.com/articles/10.1186/s12940-020-0572-5>

Jane Muncke. 2021. Tackling the toxics in plastics packaging. *PLoS Biol.* 2021;[19\(3\):e3000961](https://doi.org/10.1371/journal.pbio.1008061).

International Pollutants Elimination Network. 2021. Plastics’ Toxic Chemical Problem: A Growing Public Health Crisis. Executive summaries:

<https://ipen.org/documents/plastics-toxic-chemical-problem-growing-public-health-crisis-executive-summary>

Kathrin Fenner and Martin Scheringer. 2021. The Need for Chemical Simplification as a Logical Consequence of Ever-Increasing Chemical Pollution. *Environmental Science and Technology* 55(21): 14470-14472. <https://doi.org/10.1021/acs.est.1c04903>

Joel Tickner, Ken Geiser and Stephanie Baima. 2021. Transitioning the Chemical Industry: The Case for Addressing the Climate, Toxics and Plastics Crises. *Environment: Science and Policy for Sustainable Development*. 63 (6): <https://doi.org/10.1080/00139157.2021.1979857>

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On scale of US contribution to plastic pollution:

See The National Academy of Sciences, Engineering and Medicine. 2021. Reckoning with the U.S. Role of Global Ocean Plastic Waste. Washington DC, The National Academies Press. <https://www.nap.edu/resource/other/dels/plastics-in-the-ocean/>

Matthew Savoca, Anna Robuck and Lauren Kashiwabara. 2021. Plastic Trash in the Ocean is a Global Problem, and the US is the Top Source – A New Report Urges Action. *The Conversation*. <https://theconversation.com/plastic-trash-in-the-ocean-is-a-global-problem-and-the-us-is-the-topsource-a-new-report-urges-action-172848>

On **plastic monomers that are known carcinogens**, we are referring to vinyl chloride monomer, used to make, vinyl, and styrene used to make polystyrene, for example.

After forty years of research, a working group of 23 scientists (from 12 countries) International Agency on Research and Cancer (IARC), based on the weight of the

evidence, in March 2018, upgraded the status of styrene from “possibly” to “probably carcinogenic,” a determination which, to the casual reader, can be confusing. Note: The designation of “possibly” or “probably” carcinogenic has strict meaning, and is a characterization of the strength of the scientific evidence NOT of the cancer-causing potential of the chemical itself.

A breakdown of the IARC carcinogen classification system is available here:

https://ec.europa.eu/health/scientific_committees/opinions_layman/en/electromagneticfields/glossary/ghi/iarc-classification.htm

IARC grouped styrene as a Group 2A “probably carcinogenic” based on the weight of the scientific evidence, meaning there is evidence to support that it is carcinogenic. The National Toxicology Program, in their review of the evidence, determined styrene was “a reasonably anticipated human carcinogen.” IARC. 2019. Styrene, Styrene-7,8-oxide, and Quinoline. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 121. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK551039/>

See also: National Research Council 2014. *Review of the Styrene Assessment in the National Toxicology Program 12th Report on Carcinogens*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/18725>

Mette Skovgaard Christensen, Jesper Medom Vestergaard, Francesco d’Amore, Jette Sønderskov Gørløv, Gunnar Toft, Cecilia Høst Ramlau-Hansen, Zara Ann Stokholm, Inge Brosbøl Iversen, Mette Schou Nissen, Henrik Albert Kolstad. Styrene Exposure and Risk of Lymphohematopoietic Malignancies in 73,036 Reinforced Plastics Workers. *Epidemiology*, 2018; 29 (3): 342

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<https://monographs.iarc.who.int/wp-content/uploads/2018/06/mono100F-31.pdf>

Grosse Y, Baan R, Straif K et al. WHO International Agency for Research on Cancer Monograph Working Group (2007). Carcinogenicity of 1,3-butadiene, ethylene oxide, vinyl chloride, vinyl fluoride, and vinyl bromide. *Lancet Oncol*, 8: 679–680.
doi:10.1016/S1470- 2045(07)70235-8 PMID:17726789

On plastics long-standing global nature, and on their environmental, human health, human rights legacy:

Some historians say plastics began with celluloid, and don't include gutta-percha and hard rubber. But most, like Morris Kauffman, Jeff Meikle and other major figures in the field, understand these, too, were important materials, industrially produced, and of consequence to the history and development of plastics in general.

Rebecca Altman. 2021. The Myth of Historical Bio-Based Plastics. *Science*. 373 (6550): 47049: [DOI: 10.1126/science.abj1003](https://doi.org/10.1126/science.abj1003) Available here: <https://www.science.org/stoken/author-tokens/ST-100/full>

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M. Kaufman (1963) *The First Century of Plastics: Celluloid and Its Sequel*. Published by the Plastics and Rubber Institute (London).

A. Hochschild, *King Leopold's Ghost: A Story of Greed, Terror and Heroism in Colonial Africa* (Houghton Mifflin, New York, 1998).

Jeffrey Meikle. 1997. *American Plastic: A Cultural History*. New Brunswick, NJ: Rutgers University Press.

Paul Blanc. 2016. *Fake Silk: The Lethal History of Viscose Rayon*. New Haven: Yale University Press.

The Forest Research Institute of Malaysia. 2018. Gutta Percha, The Untold Story. Published April 10, 2018. Available at: <https://www.frim.gov.my/gutta-percha-the-untold-story/> (Last accessed 11 March 2021).

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Mike Woshner. 1999. India-rubber and gutta-percha in the Civil War Era: An Illustrated History of Rubber and Pre-Plastic Antiques and Militaria.

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Susanne Grieve. 2013. The excavation, conservation, storage and display of rubber artifacts recovered from the USS Monitor (1862). *Journal of the American Institute for Conservation*. 47 (2): <https://doi.org/10.1179/019713608806112151>

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<https://eh.net/encyclopedia/the-international-natural-rubber-market-1870-1930/>

Gregg Mitman. 2021. *Empire of Rubber*. The New Press.

“Old camphor kingdom comes alive.” July 2, 2010. *Taiwan Today*. Available at: <https://taiwantoday.tw/news.php?unit=18,23,45,18&post=24403>

For images, video, other curated materials via the National Taiwan Museum, especially re: the Taiwan Provincial Camphor Refinery, e.g.,

https://www.ntm.gov.tw/en/content_174.html

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On carbon disulfide in the viscose process:

Paul Blanc. 2016. *Fake Silk: The Lethal History of Viscose Rayon*. New Haven: Yale University Press.

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On global plastics, industrial structure, unevenness and local specificity:

Tridibesh Dey. 2021. Plastic Mut(e)ability: Limited Promises of Plasticity. *Journal of Interdisciplinary Studies*. 4(1): <http://doi.org/10.5334/wwwj.63>

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On transboundary trade in plastics, waste-pickers, sorters, recyclers – expertise and mobilization for rights

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See work of the Global Alliance of Waste Pickers: <https://globalrec.org/>

On environmental racism in the **lower Mississippi Valley**, follow, for example, Rise St. James and the Louisiana Bucket Brigade, also

Marcos A. Orellana, Special Rapporteur to the United Nations on Toxics and Human Rights. 2021. The Stages of the Plastics Cycle and Their Impacts on Human Rights. July 22, 2021. Available at: <https://documents-dds-ny.un.org/doc/UNDOC/GEN/N21/201/78/PDF/N2120178.pdf?OpenElement>

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And see [Imani Jacqueline Brown's](#) work on forensic architecture: <https://forensic-architecture.org/investigation/environmental-racism-in-death-alley-louisiana>

Thom Davies. 2019. Slow Violence and Toxic Geographies: "Out of Sight" to Whom? *Environment and Planning C: Politics and Space*. <https://journals.sagepub.com/doi/full/10.1177/2399654419841063>

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