

A Few Highlights of the ELI Report

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Why are we here?

- Historically, US environmental legislation focused on the inventory of US industry products and byproducts generated during the 1960's and 1970's, specifically ignitable, corrosive, reactive and toxic solid waste, with implementation relying on this known chemical inventory, developing sampling and analytical methods to regulate that inventory.
- Many pollutants didn't fit our perception of risk, e.g., PFAS, and we're playing catch up. Plastic didn't fit either, due to its inert nature by design that allows it to be so useful, resulting in its regulatory waste classification as solid, not hazardous waste.
- As we now know, this same inert nature results in previously unrecognized environmental persistence, bioaccumulation, and other unique risks not yet completely characterized or integrated into US environmental policy.
- Plastic and its degradation products, micro and nanoplastic pollution, the inevitable result of unrestrained production, use, waste management and leakage into the environment, pose their own unique risks:
 - Plastic particle exposure, bioaccumulation and biological interference from particle ingestion, inhalation, and dermal absorption;
 - Chemical exposure to plastic additives, and adsorbed chemicals, through releases from the plastic particle surface, at increasing rates with decreasing particle size, to the environment and into organisms when particles act as chemical delivery devices through ingestion/inhalation/absorption;
 - Pathogenic exposure to microorganisms that thrive on micro and nanoplastic surfaces.

OSHA, Section IV.P, page 176

- OSHA General Duty Clause
 - Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees
- OSHA specific standards
 - Recall OSHA rules for particles, carbon nanotubes/fibers, silica, asbestos, talc and fumes
- OSHA recognition of risk to employees from:
 - Isocyanate exposure during manufacture of some plastic products such as insulation materials and polyurethane products
- NIOSH's Nanotechnology Research Center
 - Studying exposure from releases of airborne nano and microplastics (NMPPs) into the workplace, where thermal degradation products of polytetrafluoroethylene can lead to polymer fume fever and potentially fatal pulmonary edema.
 - Developing approaches to measurement, assessment and mitigation of NMPP exposure in the workplace, recommending voluntary control measures.

Clean Air Act, Section IV.B., page 53 and fn. 140

Particulate Matter, 2.5 microns (PM2.5)

- Based on the list of its PM sources reviewed EPA for PM2.5 implementation, EPA does not consider the unique toxicity of micro and nanoplastic particles in its regulation of PM2.5.
- PM2.5 is regulated as mass per cubic meter ($\mu\text{g}/\text{m}^3$), not by micro and nanoparticle count, sampled with methods limited to minimum 1 micron size.
- EPA's Clean Air Act National Ambient Air Quality Standards mitigation methods are not implemented to reach to known sources of micro and nanoplastic point source and area source emissions such as:
 - Municipal waste incinerators burning plastic are allowed to emit PM2.5 at a rate of $25 \text{ mg}/\text{m}^3$, up to 100 tons per year, and more as permitted, without speciating for microplastic in stack emissions, fugitive emissions, ash content or wastewater discharges. No plastic destruction efficiency is required to be demonstrated;
 - Fugitive ground level emissions of micro and nanoplastic particles from solid waste management and plastic recycling facilities;
 - Microplastic fibers preferentially concentrated in wastewater treatment plant sludge and land applied as biosolids to be emitted as fugitive ground level emissions through wind erosion;
 - Tire wear particles, despite EPA CAA authority to review with new sampling and analytical methods in the context of newly recognized risk pursuant to 42 USC 7548.

Impact of *Loper Bright Enterprises v. Raimondo* (06/28/2024)

- Recall that *Chevron U.S.A., Inc. v. NRDC*, 467 U.S. 837 (1984) is about EPA's adaptation of CAA "source" after the 1977 CAA amendments (plant wide v. bubble):
 - Recognizing that "Judges are not experts in the field," the Court found EPA entitled to deference in its detailed and reasoned fashion reconciling conflicting policies responsive to separate interests not accommodated by Congress, that of reducing air pollution with economic growth.
- But with *Massachusetts v. EPA*, 549 US 497 (2007), the Court chose against Chevron deference in favor of the **CAA's broad and unambiguous definition of "air pollutant."**
 - **"any pollutant agent or combination of such agents, including any physical, chemical, biological, radioactive...substance or matter which is emitted into or otherwise enters the ambient air.** Such term includes any precursors to the formation of any air pollutant, ...*** 42 USC 7602(g).
- In this context, consider *Loper Bright* given EPA's failure to include micro and nanoplastic in implementing CAA to regulate emissions and ambient air concentrations of these uniquely hazardous particles, where Congress directed EPA "to protect public health and welfare from any actual or potential adverse effect..." from PM10, which CAA definition EPA relies on to regulate PM2.5:
 - **"PM-10" means particulate matter within an aerodynamic diameter less than or equal to a nominal ten micrometers, as measured by method as the Administrator may determine.**

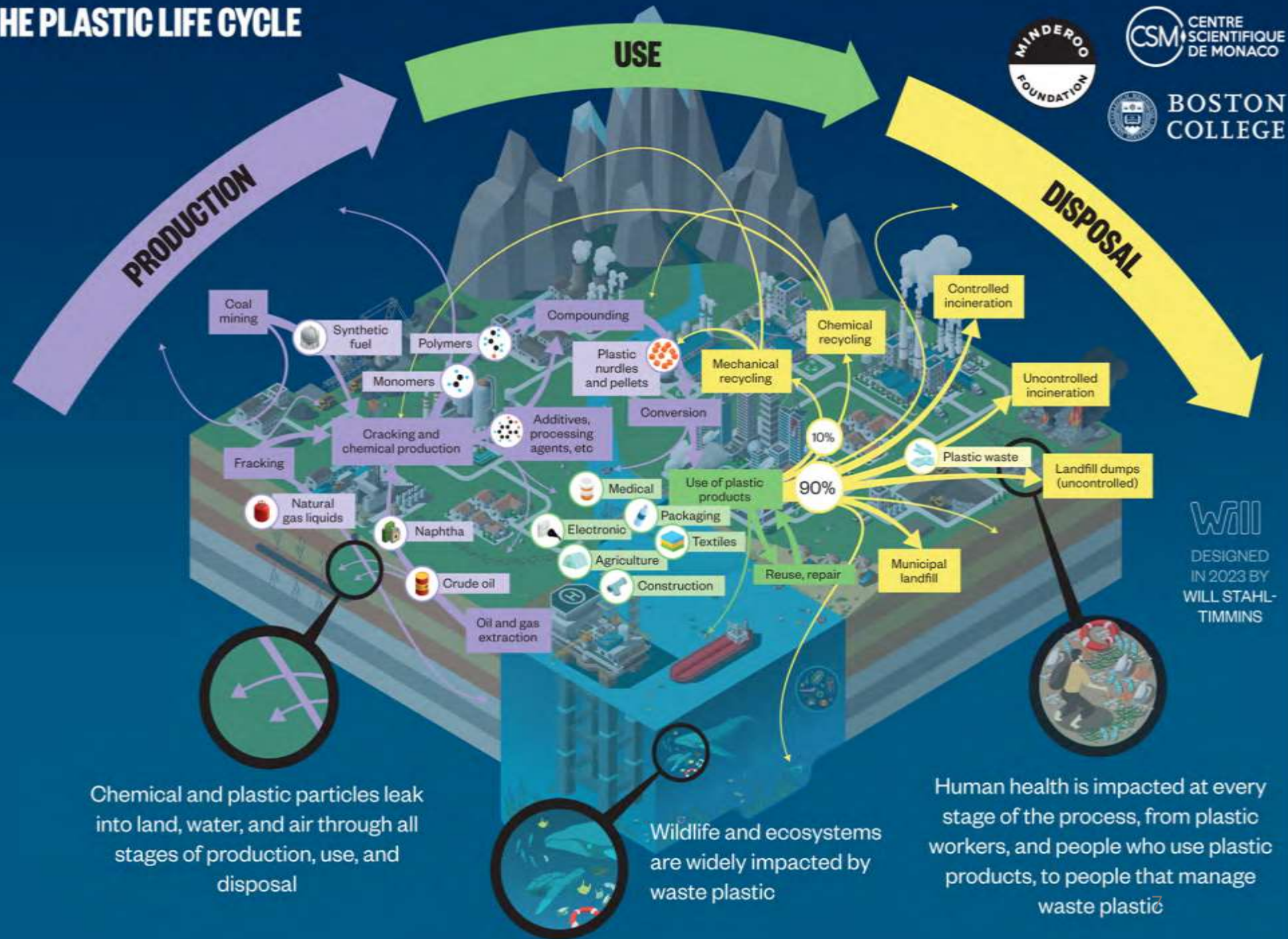
Solid Waste Disposal Act and RCRA Amendments, Section IV.B.5 and fn 355

- Open dumping and plastic hotspots
 - “Open dump” means “any facility or site where solid waste is disposed of which is not a sanitary landfill which meets the criteria promulgated under and which is not a facility for disposal of hazardous waste.” 42 USC 6903(14);
 - Open dumps are prohibited pursuant to 42 USC 6943(a)(2) which requires each State to provide a solid waste management plan that shall:
 - in accordance with sections 6944(b) and 6945(a) of this title, prohibit the establishment of new open dumps within the State,...
- As an example of similar treatment, see EPA’s 2015 coal ash regulations that clarify that new open dumps are prohibited,
 - Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 80 Fed. Reg. 21302, 21431 (final rule) (April 17, 2015) (superseded after Congress amended the law to give EPA authority over coal ash even though it is solid, not hazardous, waste). EPA could adopt regulations and issue guidelines for plastics as EPA did for coal ash. Alternatively, Congress could give EPA authority over plastic waste under RCRA Subtitle D, as it did for coal ash.

Consider the entire cycle of plastic production, product use, post-use plastic and MP fate and transport, and its failure to meaningfully degrade, in the context of US environmental law as both particle and chemical.

Landrigan, P. et al.,
 The Minderoo-
 Monaco Comm. on
 Plastics and Human
 Health. *Annals of
 Global Health*. 2023;
 89(1): 23, 1–215.
 DOI: <https://doi.org/10.5334/aogh.4056>, Figure 2.3

THE PLASTIC LIFE CYCLE



If we cannot just read the label, forensic experts are eager to identify, i.e., fingerprint, both microplastic particles and their unique and proprietary chemical additives with developing analytical and evidentiary approaches.

New microplastic detection and characterization methods

- Particle pollution has been regulated as mass per volume, not by particle count as asbestos is regulated.
- But see new microplastic methods:
 - ECOS/ERIS ITRC microplastic project website: <https://itrcweb.org>
 - Rapid single-particle chemical imaging of nanoplastics by SRS microscopy, Naixin Qian et al., January 8, 2024, PNAS 121 (3) e2300582121, <https://doi.org/10.1073/pnas.2300582121>

Unique fingerprint of each product's polymer/additive profile

- Chemical identification has been difficult given over 16,000 different unique and proprietary additives.
- But see new analytical methods:
 - *GCMSFormer: A Fully Automatic Method for the Resolution of Overlapping Peaks in Gas Chromatography–Mass Spectrometry*, Ziquan Guo et al., Anal. Chem. 2024, 96, 15, 5878–5886, April 1, 2024, <https://doi.org/10.1021/acs.analchem.3c05772>

PFAS as microplastic surrogate

Apart from exposures to pure PFAS through e.g., manufacturing and AFFF, PFAS is also a plastic additive and accumulates on secondary micro and nano plastic in the environment.

Adsorption of PFAS onto secondary microplastics: A mechanistic study, Salawu, O., et al., J. of Haz. Mat., Vol. 470, May 15, 2024, 134185, <https://doi.org/10.1016/j.jhazmat.2024.134185>

“Microplastics play a role as carriers of harmful chemicals which can be absorbed into our bloodstream through the skin.”

Assessment of human dermal absorption of flame retardant additives in polyethylene and polypropylene microplastics using 3D human skin equivalent models, Ovokeroye, A., et al., Env. Int., Vol. 186, April 2024, 108635, <https://doi.org/10.1016/j.envint.2024.108635>

“Nanoplastics are absorbed by living organisms in the food and water they eat, through the air they breathe and even through contact with their skin.”

The physiological effect of polystyrene nanoplastic particles on fish and human fibroblasts, Peng, M., et al., Sci. of the Total Env., Vol. 914, 1 March 2024, 169979, <https://doi.org/10.1016/j.scitotenv.2024.169979>