Supply Chain Chemical Footprints

CASE STUDY: The Chemical Footprint of a Plastic Bottle

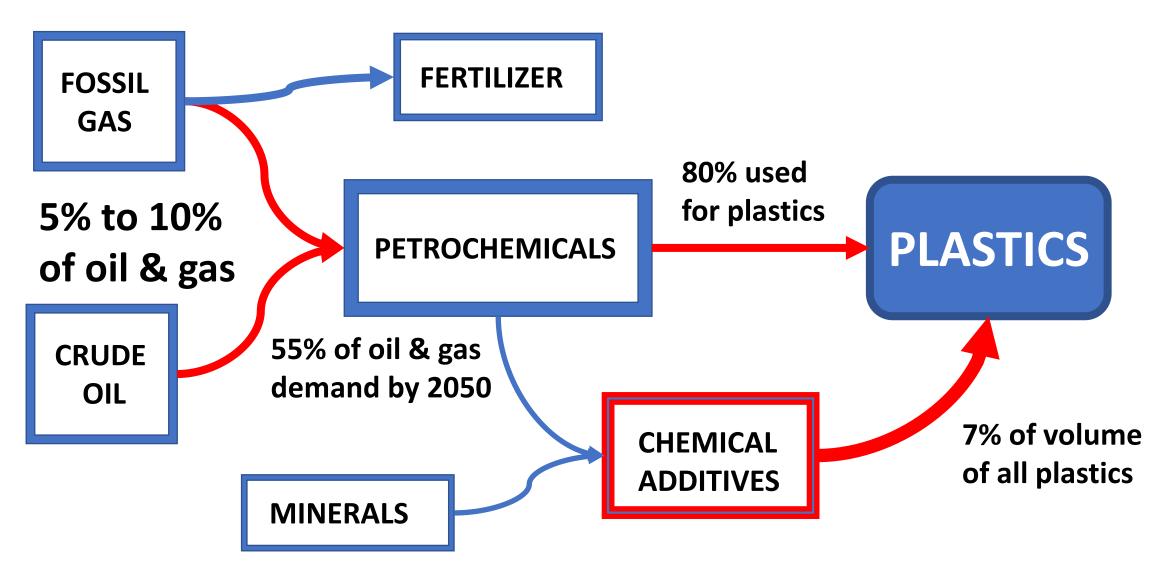
Measuring and Tracking Chemical Footprints panel,

BizNGO Annual Meeting, Oakland, California, 6 December 2023

Mike Belliveau, Founder, President & Executive Director



Petrochemical Plastics Drive Demand



Slashing Demand for Petrochemical Plastics

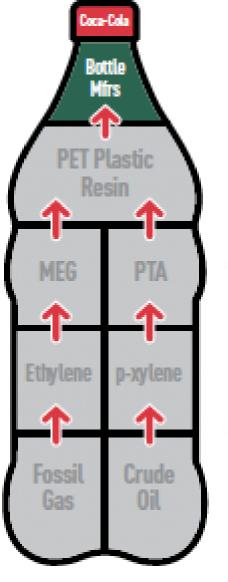
Unseating the Fossil Horsemen of the Apocalypse?



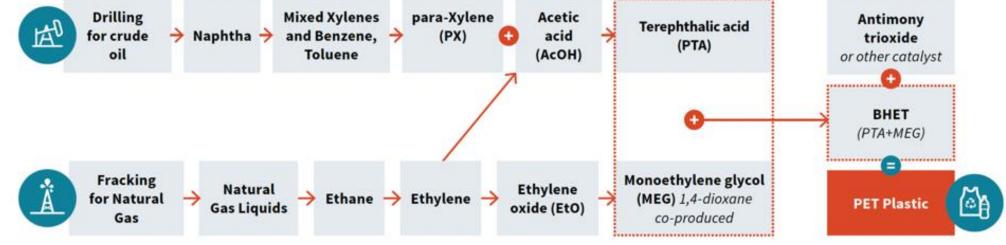
Four Horsemen of the Apocalypse, an 1887
painting by Viktor Vasnetsov. From left to right are
Death, Famine, War, and Conquest; the Lamb is at
the top.

• CLIMATE CRISIS

- ILL HEALTH
- INJUSTICE
- WASTEDRESOURCES



Know the Process Flow — What are the steps in making PET plastic?

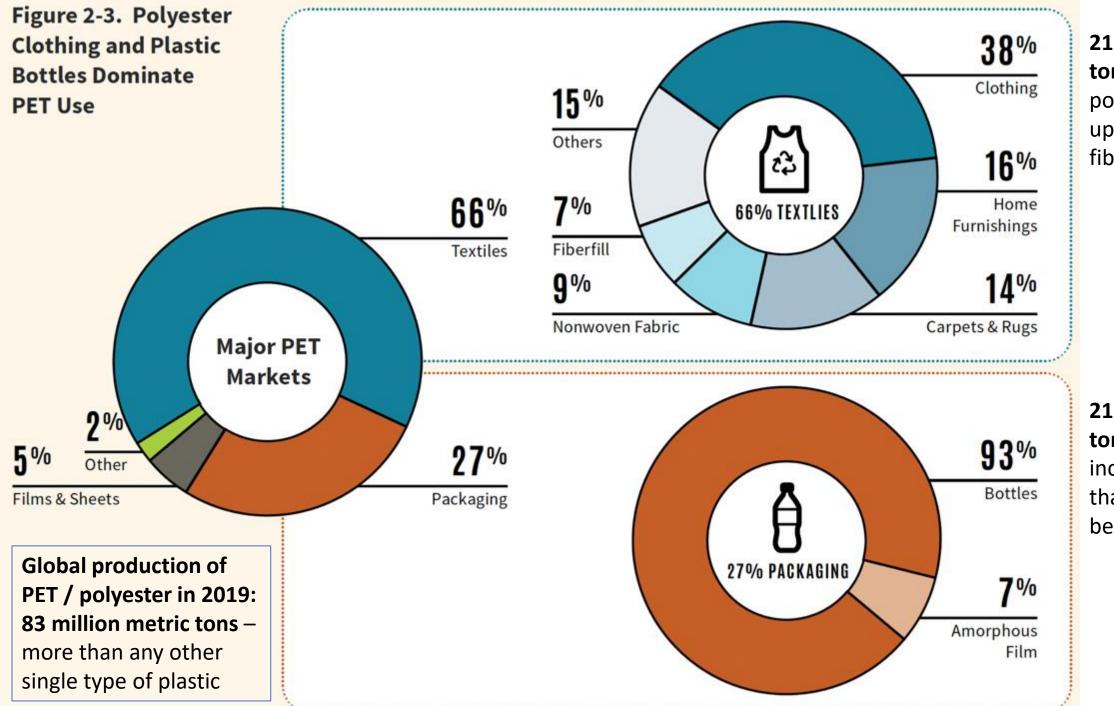


The North American PET manufacturing supply chain includes manufacturing at least 49 active and facilities are clustered proposed facilities in the Southeast See tables 2-2, 2-3, and 2-4 for names and details Most antimony produced in North America originates in Mexico Petrochemicals US production of PET Antimony "building block chemicals* is PET/Polyester concentrated in the Gulf Coast

Map the Chemical Supply Chain – PET Plastic in North America







21 million metric tons in 2019 – polyester makes up 54% of all fiber use globally

21 million metric tons in 2019 – including more than 500 billion beverage bottles!

UNSUSTAINABLE

Among most recyclable plastics

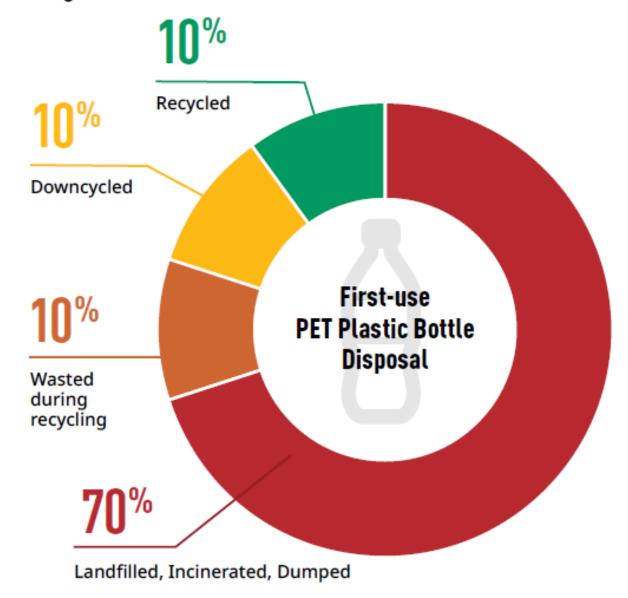
70% wasted; 30% collected

Only 10% of PET plastic bottles go back to bottles

NEW RESEARCH: Mechanical recycling of bottles produces **benzene** and **styrene** as byproducts. Non-detectable in virgin PET. Levels increase with recycled content. Migrates out from bottles. Probably due to PVC and PS contamination.

Source: Thoden van Velzen et al. (2020) *Packaging Technology and Science* https://doi.org/10.1002/pts.2528

Figure 2. Where Do PET Plastic Bottles Go After a Single Use?



| BRAND OWNER Beverage Brand | DRINK TYPE | ANTIMONY IN BEVERAGE (PPB) |
|-------------------------------|------------|-------------------------------|
| THE COCA-COLA COMPANY | | |
| Coca Cola | Soda | 2.20 |
| Diet Coke | Soda | 1.22 |
| Honest Tea (w/ lemonade) | Tea | 1.07 |
| Simply Lemonade | Juice | 0.96 |
| Powerade Fruit Punch | Energy | 0.88 |
| Dasani | Water | 0.17 |
| PEPSICO, INC. | | |
| Gatorade Blue Raspberry | Energy | 1.78 |
| Mountain Dew | Soda | 1.38 |
| Diet Pepsi | Soda | 1.10 |
| Pepsi | Soda | 0.98 |
| Tropicana Orange* | Juice | 0.56 |
| Aquafina | Water | 0.19 |

defendo

Consumer Health Hazard: Antimony

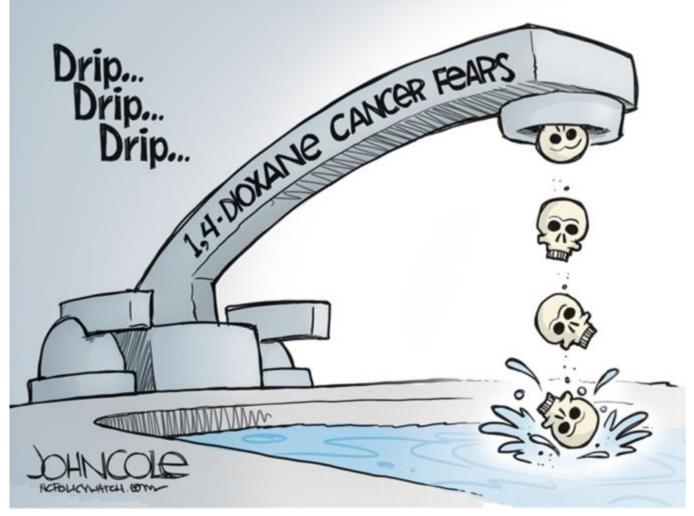
Antimony levels in 40% of the plastic-bottled beverages tested exceeded the California Public Health Goal for drinking water

| KEURIG DR PEPPER INC. | | |
|------------------------|---------|------|
| Motts Apple Juice | Juice | 0.98 |
| Dr Pepper | | 0.85 |
| 7up | Soda | 0.82 |
| Diet Dr Pepper | Soda | 0.79 |
| Snapple Peach tea | Tea | 0.50 |
| NESTLÉ S.A. | | |
| Perrier | Water | 1.58 |
| OCEAN SPRAY CRANBERRIE | S, INC. | |
| Ocean Spray 100% Juice | Juice | 0.46 |
| CAMPBELL SOUP COMPANY | P. | |
| V8 | Juice | 3.45 |

PET resin – Major Source of 1,4-Dioxane

- Probable human carcinogen
- Persistent in water

The PET plastics industry is the largest 1,4-dioxane polluter of any other industry in the United States.



https://pulse.ncpolicywatch.org/2022/04/08/chemical-facility-reports-its-the-source-of-latest-14-dioxane-spike-in-greensboro/#sthash.ww3GFenN.dpbs



PETROCHEMICAL BUILDING BLOCK:

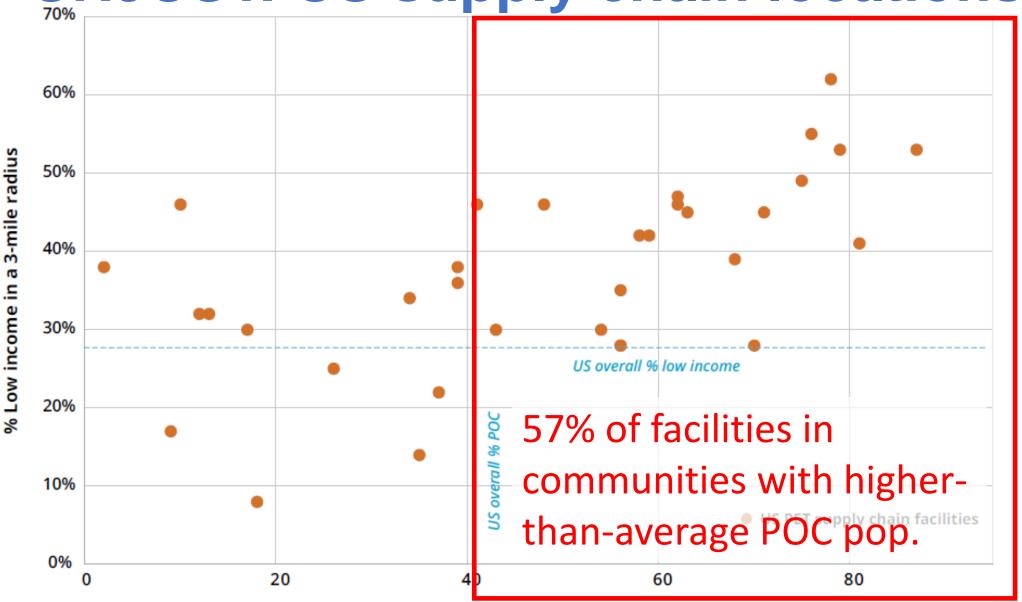
MONOETHYLENE GLYCOL



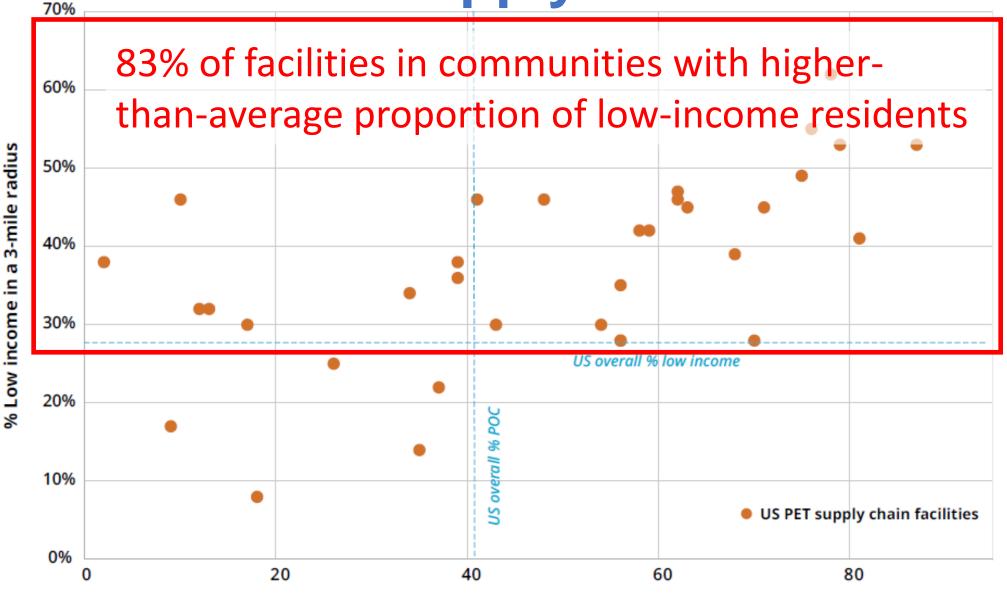
Ethylene Oxide (EtO) – Major Cancer Risk

- Known human carcinogen leukemia, lymphoma, breast cancer
- Responsible for 79% of U.S. cancer risk from hazardous air pollutants
- US EPA upheld its finding that EtO is sixty times more potent as a cancercausing substance than previously thought, in Dec. 2022
- EtO air emissions will be reduced by less than 70% if recently adopted rules (NESHAP) under the Clean Air Act are fully enforced
- EPA failed to require leakless valves at chemical manufacturing plants to eliminate so-called fugitive emissions from leaking equipment
- More than 3 million people will still face serious cancer risk from EtO exposure after rule adoption (at the one-in-one-million risk level)

UNJUST: US supply chain locations



UNJUST: US supply chain locations





HIDDEN HAZARDS:

FIGURE 1. THE CHEMICAL FOOTPRINT OF A PLASTIC BOTTLE

WASTE DISPOSAL

In the U.S., more than 70% of plastic bottles are landfilled, incinerated, or littered.

Plastic bottles, mostly PET, were the most common type of plastic litter found in North America in 2022.

1.4-DIOXANE in DRINKING WATER

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 2021.

1,4-dioxane, a byproduct of PET manufacture, is a probable human carcinogen and is a very persistent pollutant in water.

ANTIMONY in **FOOD and BEVERAGES**

Antimony, used as catalyst to make PET plastic, can cause cancer and is toxic to the liver, thyroid and heart.

GREENHOUSE GAS EMISSIONS

PET plastics demand results in 8.8 million tons of carbon-dioxideequivalent emissions annually in North America, about equal to 2 million cars.

WASTE RECYCLING

In the U.S., fewer than 30% of bottles are collected for recycling, but of those:

- 1/3rd are wasted in the process
- 1/3rd are down-cycled to fibers
- Only 1/3rd are recycled to bottles.

Recycling of PET can form toxic benzene and styrene due to waste contaminants.

PET PLASTIC

- + Plastic Additives + Processing Aids

150 chemicals have been shown to escape from plastic bottles and packaging into food and beverages; studies indicate that many are not authorized for food contact

PETROCHEMICALS

Manufacturers released an estimated 200 million pounds of toxic chemicals to the air. water, and land across the chemical supply chain of PET plastic in North America in 2021.

FOSSIL CARBON

Bottles are made from non-renewable fossil resources - natural gas and crude oil.

ETHYLENE OXIDE in the AIR

More than 3 million people, mostly in the **Gulf Coast, face serious** cancer risks from air emissions of ethylene oxide (EtO), more than from any other hazardous pollutant. About half of all EtO produced in the U.S. is used as a building block chemical to make PET. EtO exposure is linked to leukemia, lymphoma and breast cancer in humans

ENVIRONMENTAL RACISM

The majority of PET supply chain chemical plants in the U.S. are in communities where the proportion of residents of color exceeds the national average.

Black and Brown residents face serious cancer risks from EtO air emissions in greater numbers than white residents, making up 64% of the at-risk community.

FOSSIL FUEL EXTRACTION

Fracking and drilling for oil and gas results in serious air and water pollution, and greenhouse gas emissions.

Every plastic product has a chemical footprint

UNSAFE:

Six known or probable human carcinogens are uniquely associated with the production, use, or disposal of polyethylene terephthalate (PET) plastic

UNJUST:

The PET-plastics related health burden falls heaviest on Brown, Black, and lower income people who live and work near chemical and plastics plants, with similar population-wide disparities from exposures to consumers of color and young children

UNSUSTAINABLE:

More than 99% of PET plastic is derived from **fossil** carbon from oil and gas; only 11% of PET and polyester in U.S. is ever collected for **recycling**; and greenhouse gas emissions from PET are

ourhealth.orprojected to double in the next decade

Grist

by Joseph Winters 23 May 2023

US NGO calls for removal of cancer-causing chemicals from PET production

NEWS

23 May 2023

Group urges beverage industry, EPA to address metals, 1,4 dioxane and other substances



by Jodi Helm 7 June 2023



Plastic bottles harm human health at every stage of their life cycle

https://grist.org/accountability/plastic-bottles-harm-human-health-at-every-stage-of-their-life-cycle/

A new report says beverage companies like Coca-Cola must be "held accountable for the supply chain impacts of their plastics."



Soeren Stache / Picture Alliance via Getty Images

A New Report Details the Climate, Health and Human Rights Impacts of a Plastic Bottle

Petrochemicals
PEOPLE OVER POLLUTION

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