HIDDEN HAZARDS:

THE CHEMICAL FOOTPRINT OF A PLASTIC BOTTLE

How the Beverage Industry's Addiction to Plastic Bottles May Prolong the Climate Crisis, Threaten Human Health, and Promote Environmental Racism

DEFEND OUR HEALTH

Solutions for a Toxic-Free Tomorrow

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CASE STUDY: The Coca-Cola Company and Its Plastic Bottle Chemical Supply Chain | MAY 2023

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CASE STUDY: The Coca-Cola Company and Its Plastic Bottle Chemical Supply Chain | MAY 2023

Defend Our Health is a nonprofit environmental public health and social justice organization that works to create a world where all people are thriving with equal access to safe food and drinking water, healthy homes, and products that are toxic-free and climate-friendly.

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BEYOND Petrochemicals PEOPLE OVER POLLUTION

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List of Abbreviations

BTX – benzene, toluene, and xylenes
CDC – Centers for Disease Control and Prevention, United States Department of Health and Human Services
CFP – Chemical Footprint Project
CO_2 – carbon dioxide
EJScreen – Environmental Justice Screening and Mapping Tool
EtO – ethylene oxide
FLIGHT – Facility Level Information on GreenHouse gases Tool
HAP – hazardous air pollutant
MEG – monoethylene glycol; ethylene glycol
NASA – National Aeronautics and Space Administration
NESHAP – National Emission Standards for Hazardous Air Pollutants
NGLs – natural gas liquids
PET – polyethylene terephthalate
PFAS – per- and polyfluoroalkyl substances
PM10 – particulate matter with a diameter of 10 microns or less
ppb – parts per billion
PTA – purified terephthalic acid (also known as TPA)
PVC – polyvinyl chloride
PX – para-xylene
RSEI – Risk-Screening Environmental Indicators model
TRI – Toxic Release Inventory
µg/L – micrograms per liter
UK – United Kingdom
US – United States
US EPA – United States Environmental Protection Agency
VOCs – volatile organic compounds

Unless otherwise noted, *all photos of facilities and infrastructure are stock photos showing petrochemical production, pollution, and effluent releases, and do not reflect any specific facility or type of production discussed in the report.*

EXECUTIVE SUMMARY

Most people barely give a thought to an empty plastic bottle before they toss it. But what they don't know is that behind that bottle lurk hidden hazards, from the bottle's origins as fossil fuel to its disposal as waste or litter.

A first-ever study, *Hidden Hazards: The Chemical Footprint of a Plastic Bottle*, reveals the potential threats to human health, environmental justice, and climate change created by the chemical manufacturing and plastics production processes required to turn crude oil and fossil gas into plastic bottles, as well as from consumption of plastic-bottled beverages and final disposal of the bottles.

Worldwide, the beverage industry buys more than 500 billion plastic bottles every year to package its products. This insatiable demand for plastic bottles drives the production of a common plastic known as **polyethylene terephthalate or PET**. Plastic bottles consume a quarter of all PET plastic production worldwide.

The report finds that, all along its chemical supply chain, PET plastic pollutes air, water, and food with cancer-causing chemicals. **PET plastic is the top polluter** among all industries across the United States for three carcinogens:

ETHYLENE OXIDE IN THE AIR. Air emissions from chemical manufacturers that supply PET plastics expose more than 3 million people in the Gulf Coast to serious cancer risks, far greater than any other hazardous air pollutant.

1,4-DIOXANE IN DRINKING WATER. Discharges from PET plastic production pollute drinking water sources in the Southeast US with this persistent cancer-causing chemical that may pose an unreasonable human health risk.

ANTIMONY IN FOOD & BEVERAGES. Antimony, used to speed up plastic production, migrates out of PET plastic bottles and packaging and is a major source of antimony in food and drinks.

The report also shows that **demand for plastic bottles promotes environmental racism**. The health burden of PET plastic production falls disproportionately on communities of color and low-income people, largely in the Gulf Coast and Southeast US. For example, 64% percent of the residents facing serious cancer risk from ethylene oxide emissions are people of color, while the US population at large is 41% people of color.

Finally, the report demonstrates that the beverage industry's **addiction to plastic bottles worsens the climate crisis**. The PET plastic supply chain emits nearly nine million metric tons of greenhouse gases in North America every year, about the same amount as the annual emissions of two million cars. With PET production projected to double in the next decade, so will its climate impacts.

Hidden Hazards uses **The Coca-Cola Company** as a case study to illustrate corporate responsibility for supply chain impacts from over-reliance on PET plastic. Coca-Cola has been named the number one plastic polluter for five years running by BreakFreeFromPlastic for its name-brand litter, and the company buys and sells more than 125 billion plastic bottles every year, consuming about 6% of all PET plastic produced worldwide.

The report urges Coca-Cola and other beverage companies to take immediate action to require suppliers to replace antimony and cobalt in plastic bottles with safer alternatives and to achieve zero discharge of cancer-causing chemicals to the air and water along its supply chain. By 2030, these companies should replace 50% of plastic bottles with reusable and refillable container systems and end the use of virgin fossil-based PET plastic by 2040 to help solve the climate crisis.

THE REPORT FINDS THAT, all along its chemical supply chain, PET plastic pollutes air, water, and food with cancer-causing chemicals. PET plastic is the top polluter among all industries across the United States for three carcinogens: ethylene oxide in the air, 1,4-dioxane in drinking water, and antimony in food and beverages.

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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.

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.

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.

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

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.

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.

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.**

FOSSIL CARBON

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

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.

GREENHOUSE GAS EMISSIONS

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

FOSSIL FUEL EXTRACTION

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

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INTRODUCTION

PLASTIC BEVERAGE BOTTLES

A case study in petrochemical plastic pollution associated with one major consumer, The Coca-Cola Company

Indorama's supply chain in Decatur, AL, include this facility that produces Xylenes and PTA, which are building-block chemicals for PET plastics.

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INTRODUCTION

Petrochemical plastics and the thousands of chemicals involved in making them are creating growing impacts on human health, social justice, the climate, and the environment. Driven by concerns around litter and disposal, many companies are seeking ways to reduce plastic waste. But waste reduction is not enough to meaningfully address the impacts of the ever-increasing production of plastics. That's why it's important to benchmark the hazards of plastics across their entire lifecycle.

This report tells the story of a single major use of one commodity plastic, the plastic bottle made of polyethylene terephthalate (PET) plastic (often marked with its #1 resin identification code). More PET plastic, known in its fiber form as polyester, is produced than any other single type of plastic.[1] About 25% of all PET is used to make plastic bottles, with another quarter going into polyester clothing.[2] Throughout this report, "PET plastic" refers to resin, polyester fiber, and other applications of PET, while more specific designations such as "PET resin" or "PET plastic bottle" refer to those applications only.

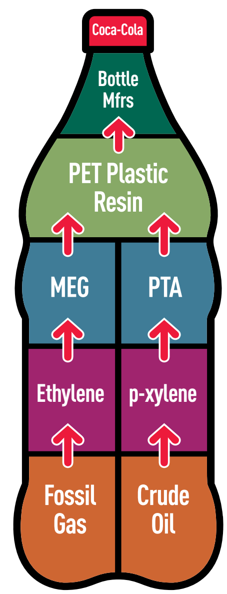
The scope and methods used to tell the story of a PET plastic bottle in this report should be applied to other major products and packaging materials made from other types of plastic. After establishing a baseline of chemical hazards for a specific plastic use, corporations and other institutional users can act to reduce its impacts across their entire supply chain.

The PET plastic bottle was developed in 1973 by DuPont as a cheaper alternative to glass.[3] Fifty years later, the **beverage industry worldwide buys and sells more than 500 billion PET plastic bottles per year,[4]** or nearly a million per minute. More PET packaging is produced and consumed in the US than in any other country.[5]

The use of PET plastic resin for bottling beverages drives fossil fuel extraction, petrochemical manufacturing, and plastics production. In turn, **this reliance on PET plastic triggers potential hazards to human health, local communities, and the climate at every major step in a bottle's production, use, and disposal.**

A lot of the focus on plastic bottles as a problem has been around the issue of waste, with good reason. In the US, most PET plastic bottles are not recycled at the end of their life and instead end up as waste in landfills or incinerators or as litter on the land and in oceans and waterways.

But there are many steps in the production of a PET plastic bottle that lead up to its being filled with a beverage and sold in the market. Together, these steps—from extraction of nonrenewable resources to the manufacture of bottles from plastic resin—are known as the **chemical supply chain**. At every major step in the chemical supply chain of a PET plastic bottle, as well as after the bottle is discarded as waste, toxic chemicals are released into the air, water, soil, and, potentially, our bodies, greenhouse gases are emitted, and disproportionate environmental health burdens are often placed on vulnerable communities.



This report takes a deep dive into the **chemical footprint** *(see Box 1)* of the PET plastic beverage bottle. It follows the life cycle of these bottles, starting with plastic waste and working backward through the many stages in the petrochemical manufacturing process, from chemicals contained in the beverage bottle to its source as fossil fuel. The following pages show step-by-step what it takes to make a plastic bottle. At each point along the way, this report shows how local communities can be affected by pollution from the petrochemical industry and how they're fighting to protect their air, water, and health.

For each step of the bottle production process analyzed, this report includes boxes that summarize a particular chemical manufacturing facility or fossil fuel extraction region's **production capacity, reported toxic chemical releases, potential racial and economic disparities, and greenhouse gas emissions**. Additional boxes delve into particular chemicals of concern involved in or emitted by the PET plastic production process.

All of the pollutant emissions numbers used in this report, unless otherwise specified, are from research conducted by Defend Our Health (Defend) with Materials Research, L3C, using toxics emission data from US EPA's Toxic Release Inventory (TRI) reports and greenhouse gas emission data from US EPA's Facility Level Information on GreenHouse gases Tool (FLIGHT). Data on population, percent people of color, and percent people who are low income in a 3-mile radius of emission sources come from the US EPA's Environmental Justice Screening and Mapping Tool (EJScreen). Interviews with community organizers were conducted by Defend staff. Data sources and key definitions can be found in the Appendix A.

WHY FOCUS ON THE CONSUMPTION OF PLASTIC BOTTLES BY THE COCA-COLA COMPANY?

To illustrate the chemical footprint of plastic bottles, this report examines the supply chain of one major corporate consumer of PET plastic bottles. This narrowed focus allows the use of PET plastic in the form of polyester fiber for textiles to be set outside the scope of the report. It also simplifies the presentation of complex data to focus on a single corporate supply chain for plastic bottles.

Coca-Cola is an informed choice for an illustrative case study, given the scope of the company's plastic use. As further detailed in the sections that follow, The Coca Cola Company has:

- » **Been reported as the planet's biggest plastic polluter five years in a row,** with its name on more pieces of plastic litter collected around the world than any other company, according to one survey;[6]
- » **Consumed more than 125 billion plastic bottles in 2021,** accounting for just over 20% of global consumption of PET plastic bottles;[7]
- » **Sold more beverages globally in 2021 than any other company with US sales except** for Anheuser-Busch InBev and Nestlé SA;[8] and
- » **Sold more carbonated soft drinks in the US** than any other company in 2021.[9]

For this report, the connections among steps in Coca-Cola's bottle supply chain were established by starting with a list of facilities in North America associated with the PET plastics supply chain. The flow of resources through this supply chain, in addition to reported linkages among manufacturing facilities, resource extraction sites, and end users, was analyzed using reports and data from plastics and petrochemical industry sources as well as US EPA and other government agency databases and reports *(see Figure 4: "The Coca-Cola Company's US Chemical Supply Chain," page 43)*.

This report serves as an illustration of the ways in which a single consumer product, the PET plastic beverage bottle, presents wide-ranging potential hazards to health, environmental justice, the climate, and waste streams. However, **every plastic product leaves behind its own footprint, with a cascade of effects from resource extraction to waste disposal. Chemical footprint analyses should be conducted for a wider range of products going forward.**

Major beverage brands that market and create demand for their products should take responsibility for eliminating greenhouse gas emissions, toxic releases, health effects, waste, and impacts on communities up and down the PET plastic bottle chemical supply chain.

Box 1. What Is a Chemical Footprint?

Similar to a carbon footprint, which estimates greenhouse gas emissions, or an ecological footprint that tracks resource consumption, a chemical footprint assesses the use of chemicals of high concern.

The Chemical Footprint Project (CFP)[10] provides tools to help businesses move away from chemicals of high concern toward safer alternatives. CFP defines chemicals of high concern as those that are known, based on scientific evidence, to cause cancer, reproductive harm, or other serious adverse effects on human health and the environment.[11]

CFP defines a chemical footprint for a commercial enterprise as the total mass of chemicals of high concern in products sold by a company, used in its manufacturing operations and facilities, used by its suppliers in its supply chain, and contained in its packaging.[12]

This report follows CFP's lead in assessing certain chemicals of high concern associated with the supply chain of the PET plastic bottle based on lists of chemicals of high concern identified from authoritative sources using the GreenScreen List TranslatorTM [13] and the Pharos Chemical & Material Library.[14] This report **supplements this chemical of high concern evaluation with measures of environmental injustice and greenhouse gas emissions.**

Work remains to more fully incorporate measures of environmental injustice into the chemical footprint of companies, including their products, packaging, and supply chain. Some uses of chemicals disproportionately impact vulnerable groups including people of color, low-income people, infants and children, or workers. Such unjust disparities should be assessed and reduced.

This report's intent is to establish a baseline of the chemical impact of a PET plastic bottle for future measurement of progress away from hazardous chemicals and plastics of environmental health concern and toward solutions that are safer, more just, and more sustainable.

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END OF LIFE:

PLASTIC BOTTLE WASTE

Most plastic beverage bottles end up as garbage or litter

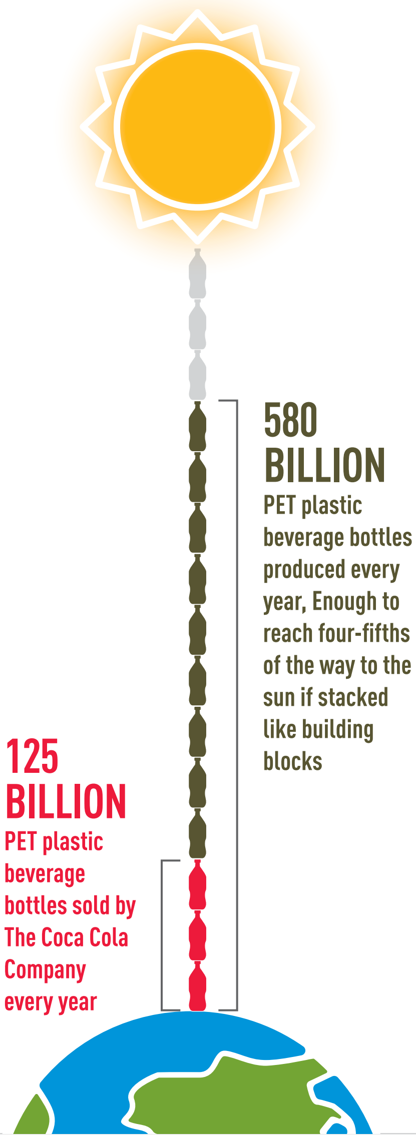
© iStockphoto

END OF LIFE: PLASTIC BOTTLE WASTE

COCA-COLA CONNECTION:
Coke products are consistently the top source of plastic litter in annual brand audits.[15]

Worldwide, more than 580 billion PET plastic beverage bottles are produced every year.[16] That's enough bottles to reach four-fifths of the way to the sun, if you stacked them like building blocks, and The Coca-Cola Company is responsible for the sales of 125 billion, or over 20%, of these bottles.[17]

DISTANCE FROM THE EARTH TO THE SUN



While some beverage companies tout the recyclability of their products,[18] most plastic bottle waste ends up in landfills or incinerators or as litter on land and in the ocean and other waterways.

The BreakFreeFromPlastic network organizes annual brand audits in which community volunteers from around the world collect plastic waste at community cleanups and identify the source corporations from names and logos on the waste. For five years running, The Coca-Cola Company has been found by these audits to be the biggest source of plastic litter worldwide, with more than 31,000 Coca-Cola branded pieces of product packaging found in the 2022 audit, triple the amount found in 2018.[19] The most common type of plastic waste found in North America as part of the 2022 audit was plastic bottles, with over 16,000 collected, making up nearly 40% of all items collected.[20]

Plastic waste isn't just an unsightly blight on our land and water; it poses real hazards to human health and the planet. Municipal solid waste incinerators, where household trash is burned as a method of disposal and to generate electricity, are disproportionately located in communities that are predominantly home to people of color or low-income residents.[21] The burning of PET and other plastic waste releases toxic chemicals such as polyaromatic hydrocarbons and polychlorinated biphenyls, several of which are cancer-causing,[22] as well as heavy metals into the environment.[23] [24] Moreover, plastic waste in the environment concentrates toxic organic pollutants[25] and breaks down into microplastics that enter the food chain and have been found in nearly every corner of the world, including in whales,[26] lobsters,[27] and even newborn babies' feces.[28]

RECYCLING ALONE CANNOT SOLVE THE PLASTIC WASTE PROBLEM

Manufacturers appear to be trying hard to convince consumers that recycling will solve the negative effects of ever-increasing sales of plastic-bottled beverages. Recycling does have the potential to reduce reliance on finite resources and greenhouse gas emissions. Life cycle analysis of recycled PET plastic resin has found that recycled stock uses up to 79% less energy than virgin stock and has up to 67% less global warming potential.[29]

However, in general, too little plastic is recycled at the end of its useful life. A US EPA analysis found that less than 9% of total plastics generated in the municipal waste stream in 2018 were recycled.[30] Furthermore, any improvements in recycling rates and capacities will likely be outpaced by continued rapid growth in plastics production, which is projected to double by 2040.[31] Recycling also often results in the production of a lower-quality material[32] that typically cannot be recycled again.[33] Finally, recycled plastic often picks up toxic contaminants or forms toxic chemical byproducts during the recycling process, increasing its hazards.[34]

Although PET plastic bottles are considered to be one of the most recyclable plastic products, less than 30% of post-consumer PET bottle waste was recycled in the US in 2021,[35] and only about 30% of that was made back into new food-grade bottles,[36] meaning only 10% of all PET bottles are recycled into new bottles. Rather, most PET bottle recycling is "downcycling," or turning bottles into other kinds of items, like polyester filling for clothing and carpets, that usually won't be recycled again.[37]

Traditionally, plastic recycling has been done through mechanical processes that involve sorting plastic waste by type, then shredding, melting, and forming it into new plastic products. Mechanical recycling of PET usually results in a lower-quality product that may be contaminated with toxic PVC plastic[38] as well as brominated flame retardants, rare earth metals, and other toxic chemicals carried over from electronics waste[39] like old phones and computers. Mechanical recycling of PET plastic bottles can also form **cancer-causing toxic chemicals such as benzene and styrene that can migrate into beverages in amounts that increase with recycled content.[40]**

As an answer to the problems inherent in mechanical recycling, the plastics industry is promoting the development of new "chemical recycling" technologies, which in theory involve breaking down waste plastics at a chemical level and putting them back together to make new plastics. But reporting by the International Pollutants Elimination Network,[41] the Natural Resources Defense Council,[42] ProPublica,[43] and others shows that these technologies often entail turning plastic into fuel for combustion. Even in the

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Box 2. The Footprint of PET Plastic Waste

Disposal Rate

- More than 70% of PET plastic waste in the US is landfilled, incinerated, or dumped in the environment.[46]
- Less than 30% of PET plastic bottle waste in the US is recycled.[47]
- Only 30% of those recycled bottles are used to make new bottles.[48]

Toxic Chemical Releases

- Plastic incineration (including so-called waste-to-energy recycling) can release toxic chemicals, such as chlorinated dioxins and furans, into the environment.[49]
- Mechanical recycling of PET plastic bottles can form cancer-causing chemicals like benzene and styrene that can migrate into beverages in amounts that increase with recycled content.[50]

Disparities

- 79% of the 73 municipal solid waste incinerators in the US are located in communities where residents are predominantly people of color or low-income.[51]

Greenhouse Gas Emissions

- Incineration of plastics in municipal waste incinerators contributed 16 million metric tons of CO2 equivalents in 2015,[52] about the same emissions as 1 million cars in a year.
- Plastic waste also releases greenhouse gases when it breaks down in landfills and in the environment.[53]

LESS THAN

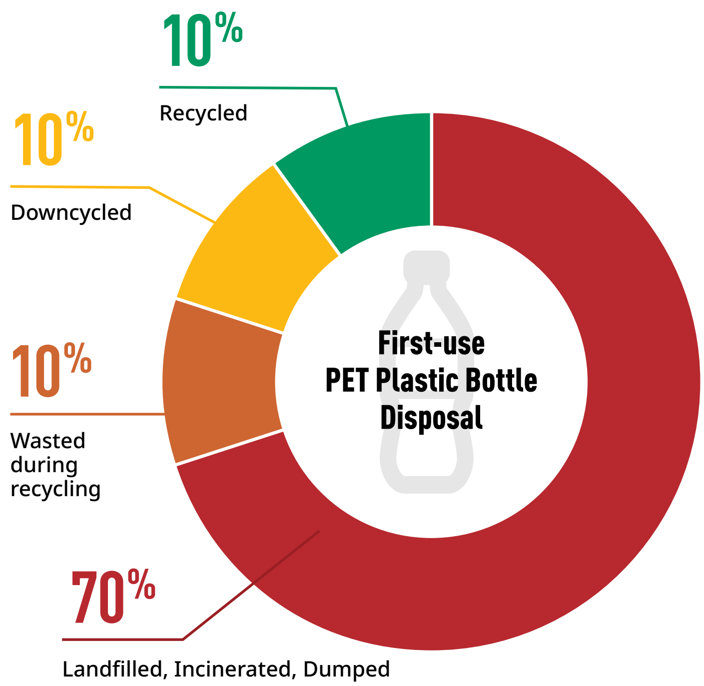
30%

of PET plastic bottle waste in the US enters the recycling stream.[47]

best-case scenarios, chemical recycling is energy-intensive and can produce persistent toxic byproducts that may put workers, surrounding communities, and consumers at risk of cancer and other health effects from exposure.[44]

To combat the growing epidemic of plastic waste, the US needs to implement, and the beverage industry needs to comply with, a reuse and refill system that uses less problematic materials for packaging and is universal, accessible, and affordable.[45] Plastic waste is a problem that needs to be stopped at its source.

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



Data for the United States only. Percentages are approximate. See Appendix B for details.

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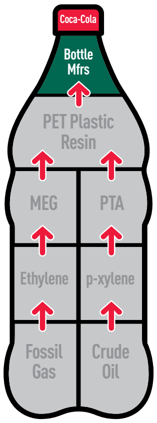
ON THE SHELF:

PLASTIC-BOTTLED BEVERAGES

Studies show at least 150 chemicals can escape from plastic bottles and into beverages

Photo by Tim Samuel from Pexels: https://www.pexels.com/photo/cheerful-woman-sitting-on-floor-with-refreshment-and-laughing-6696897/



ON THE SHELF: PLASTIC-BOTTLED BEVERAGES

COCA-COLA CONNECTION:
Ten out of eleven bottle samples from beverage products manufactured by The Coca-Cola Company were found in independent laboratory testing to contain antimony (see Table 1).

A soda bottle may look clean, clear, and benign, but the PET plastic resin it is made of contains hundreds of chemical compounds. Some of those chemicals are added by manufacturers to achieve certain properties in the plastic or to facilitate the processing of the material, while others are introduced as impurities or degradation products during the production process.

According to a recently published scientific review evaluating 300 different chemicals found in PET bottles, previous studies found that at least half of these chemicals migrate from packaging into food and beverages.[54] There may be hundreds of additional chemicals in PET that have been inadequately studied or are not approved for use in food-contact plastics in some jurisdictions.[55]

Nse Witherspoon, Executive Director of the Children's Environmental Health Network, says of toxic chemicals in foods and consumer products, **"What we need to be fighting for is primary prevention, which means not having the exposure in the first place."**

Antimony is one of the toxic chemicals that can make its way into beverages from bottles. Antimony trioxide is the dominant catalyst used to speed up the final chemical reaction that makes PET plastic resin *(page 13)*.[56] Several forms of antimony are known to cause cancer[57] and to have toxic effects on target organs, such as the liver.[58] The National Biomonitoring Program found that Black and Latinx communities face greater exposures to antimony than white populations, with nearly double the exposure in some cases.[59] Safer alternatives exist that can perform the same function as antimony with fewer toxic hazards.[60]

Independent laboratory testing has found antimony in both PET plastic bottles and their contents from several brands owned by The Coca-Cola Company and other major beverage brand-owners.[61] In 40% of the beverage samples tested, antimony levels exceeded California's drinking water goal of 1 part per billion (ppb). In 90% of the beverage samples tested, antimony in the beverages exceeded 0.25 ppb, a more health-protective goal that better takes into account children's exposure from other sources, such as plastic additives that contaminate household dust.[62]

"We collectively need to have one voice. We have to insist that the onus should be on the polluters. The onus should be on the production team."

NSE WITHERSPOON, Executive Director
Children's Environmental Health Network

Nse is a leader in the field of children's environmental health, serving on the External Science Board for the Environmental Influences on Child Health Outcomes (ECHO) NIH Research work. She is a Co-Leader the Health/Science initiative of the Cancer Free Economy Network and Co-Chair of the National Environmental Health Partnership Council. Ms. Witherspoon is appointed by the Governor to serve on the Maryland Children's Environmental Health Advisory Council.

Box 3. The Footprint of Plastic-Bottled Beverages[66]

Production Capacity

- Beverage companies in the US make 100 billion bottled beverages every year.[67]

Toxic Chemical Releases

- Consumers may be exposed to toxic chemicals used to make PET that remain in plastic bottles, including antimony[68] *(see Box 4)* and cobalt[69] compounds.

Disparities

- Biomonitoring data from the CDC[70] has indicated that Black and Latinx communities are disproportionately exposed to antimony.[71]
- The total exposure to antimony for infants and children experiencing median exposures exceeds the maximum daily dose established by the State of California to protect against chronic organ toxicity.[72] PET bottles may compound this exposure burden.

Greenhouse Gas Emissions

- North American PET bottle production contributes the equivalent of 2.2 million metric tons of CO_2 a year.[73]

Box 4. Chemical Spotlight: Antimony

Role in PET Life Cycle

- Antimony, primarily in the form of antimony trioxide, is used as a catalyst in PET manufacturing.
- Antimony compounds are the most common PET catalysts.[74]
- Some antimony is retained in PET beverage bottles, which can then expose consumers to antimony.[75]

Why It's a Problem

- California's Office of Environmental Health Hazard Assessment lists antimony trioxide as a carcinogen.[76]
- The US Department of Health and Human Services lists antimony trioxide as "reasonably anticipated to be a human carcinogen."[77]
- The International Agency for Research on Cancer has concluded that antimony trioxide is "probably carcinogenic to humans." [78]
- Analyses suggest Black and Latinx communities, as well as infants and children, are disproportionately exposed to antimony.[79] PET bottles may contribute to this exposure.[80]

Solutions

- Alternative PET catalysts exist[81] and have been adopted in some markets for PET bottles (e.g., Japan)[82] and textiles (e.g., Herman Miller).[83]

The concentration of antimony measured in the Coca-Cola products' plastic bottles appears consistent with the reported use of an antimony trioxide catalyst in the manufacture of PET beverage bottles.[63] Follow-up analysis found antimony in all seven Coca-Cola products tested, suggesting the company likely uses bottles manufactured with antimony trioxide *(see Table 1)*.

Photo by Ketut Subiyanto from Pexels: https://www.pexels.com/photo/man-in-gray-crew-neck-t-shirt-drinking-water-4719919/

Scientists have shown that antimony migrates into beverage products from plastic bottles.[64] Safer, antimony-free catalysts for PET plastic production are widely available.[65] The Coca-Cola Company and other major beverage brand-owners have the power to make change by requiring suppliers upstream in their chemical supply chain to use safer alternatives to antimony in the PET plastic resin manufacturing process.

Table 1. Antimony in Coca-Cola Brand Plastic Bottles

Antimony was detected in the sampled plastic bottles of several beverage brands of The Coca-Cola Company.

BRAND OF PET BOTTLE SAMPLED	BEVERAGE TYPE	ANTIMONY IN BOTTLE (PARTS PER MILLION)
INITIAL TESTING		
Diet Coke	soda	**238**
Simply Lemonade	juice	**<2.8**
Honest Tea (w/lemonade)	tea	**255**
Dasani	water	**265**
FOLLOW-UP TESTING		
Coke	soda	**232**
Diet Coke	soda	**246**
Simply Lemonade	juice	**284**
Powerade Lemon Lime	energy	**257**
Honest Tea (w/lemonade)	tea	**228**
vitaminwater Lemonade flavor	water	**229**
Dasani	water	**266**

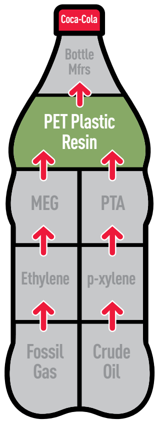
Notes: Based on testing done in 2022 and 2023. See Appendix C for details.

Indorama's Xylenes and PTA facility in Decatur, AL.

PLASTIC RESIN

POLYETHYLENE TEREPHTHALATE

Production of PET plastic resin and polyester releases more cancer-causing 1,4-dioxane to water and air than any other US industry



PLASTIC RESIN: POLYETHYLENE TEREPHTHALATE

COCA-COLA CONNECTION:

Companies that manufacture the PET resin that may be made into bottles used by Coke are located in at least three US cities (see page 43).

The type of plastic used in most single-use plastic bottles is called polyethylene terephthalate, or PET. Making PET requires a reaction between two building-block chemicals: monoethylene glycol (MEG) and purified terephthalic acid (PTA). Analysis of Toxic Release Inventory reports submitted by PET manufacturers to the US EPA shows that companies that manufacture PET plastic release dozens of toxic chemicals into the air and into municipal wastewater treatment and solid waste processing facilities, which can affect local communities.

One of the major suppliers of PET resin used in manufacturing bottles likely purchased by The Coca-Cola Company is Indorama Ventures. This international petrochemical conglomerate, headquartered in Bangkok, Thailand, specializes in PET plastics and polyester fibers. Indorama is the world's largest PET producer.[84] The company owns facilities all over the world that manufacture chemicals and products in many steps along the PET bottle supply chain, including ethylene cracking *(page 28)*; manufacturing of PX *(page 31)*, PTA *(page 25)*, and MEG *(page 20)*; production of PET plastic resin; and recycling[85] of PET.

Indorama has three PET plastic resin facilities in the US, located in Decatur, Alabama, Spartanburg, South Carolina, and Asheboro, North Carolina.

Asheboro is located in the Piedmont region of North Carolina, along the Deep River, a major tributary of the Cape Fear River watershed. Indorama purchased the Asheboro PET facility known as StarPet in 2003. Indorama StarPet has the capacity to manufacture 266,000 tons of PET per year. The facility reported releasing 2.9 million pounds of toxic chemicals into the environment in 2021, including 353,000 pounds to publicly owned wastewater treatment systems.[86]

One hazardous byproduct of PET plastic production is 1,4-dioxane, a persistent chemical that the US EPA designates as likely to be carcinogenic in humans.[87] **In 2021, the manufacture of PET plastic was the largest source of 1,4-dioxane pollution in the US.[88]**

One hazardous byproduct of PET plastic production is 1,4-dioxane, a persistent chemical that the US EPA designates as likely to be carcinogenic in humans. In 2021, the manufacture of PET plastic was the largest source of 1,4-dioxane pollution in the US.

In nation-wide testing of water utility systems in 2013-2015, US EPA found some of the highest concentrations of 1,4-dioxane in the country in the Cape Fear River watershed,[89] where Indorama's StarPet facility and other industrial plants are located. Monitoring of water in the Cape Fear basin by the North Carolina Department of Environmental Quality between October 2014 and September 2015 found ambient levels of 1,4-dioxane far in excess of US EPA's health assessment guideline, with concentrations nearly 18 times higher than agency's health advisory of 35 ppb in some locations.[90]

Three of the four 1,4-dioxane hotspots found in this testing were located downstream of municipal wastewater treatment facilities in Asheboro, Reidsville, and Greensboro.[91] The director of the The City of Asheboro Water Resources Division has publicly acknowledged that the city believes that 1,4-dioxane is coming from the StarPet facility.[92]

Emily Sutton, Haw Riverkeeper, holding water samples. © Emily Sutton

The discharge of wastewater to municipal treatment systems by industrial facilities passes on the problem of dealing with chemicals like 1,4-dioxane to the public utilities. The chemical is difficult to remove with standard water treatment processes[93] and is more widespread in drinking water than most other synthetic chemicals.[94]

Emily Sutton is the Haw Riverkeeper with the Haw River Assembly, a nonprofit that works to protect Jordan Lake Reservoir and the Haw River, another major tributary of the Cape Fear River watershed. She believes that the State of North Carolina should do more to regulate releases from Indorama StarPet.

"Until the state starts using its existing authority to set those protective limits on dischargers, facilities like StarPet will continue to discharge high levels of 1,4-dioxane," according to Sutton. She notes that in Asheboro, the facility's discharge may be contaminating downstream users in Sanford, which supplies drinking water to its own residents and communities in Pittsboro, Chatham County, and Fuquay-Varina. She also believes that Fayetteville, Wilmington, and Brunswick County may be impacted by discharges from this facility.

Box 5. The Footprint of Indorama StarPet[97]

Asheboro, NC

Production Capacity

- 266,000 metric tons PET per year,[98] enough to make 1.4 billion beverage containers.

Toxic Chemical Releases (2021)

- 2.9 million pounds of toxic releases, including lead compounds and 101,647 pounds of 1,4-dioxane *(see Box 8)*.
- 353,000 pounds of those toxic releases were discharged to public water systems that discharge into the Cape Fear River, which provides drinking water to over a million people.
- 1,4- dioxane was measured in wastewater discharged by the Asheboro sewage treatment facility at 1,011 ppb in February 2018, a level 29 times higher than US EPA's current health advisory level for drinking water, and which may contribute to 1,4-dioxane levels downstream in the Cape Fear watershed.[99]

Disparities

Within a 3-mile radius, residents are disproportionately lower-income:

- Nearly 15,000 residents.
- 41% people of color (nation-wide: 41%).
- 46% low income (nation-wide: 27.5%).

Greenhouse Gas Emissions (2021)

- Nearly 36,000 metric tons of CO2 equivalents, roughly the same emissions as 8,000 passenger cars in a year.

Box 6. The Footprint of Indorama Auriga Polymers[100]

Spartanburg, SC

Production Capacity

- 286,000 metric tons PET per year,[101] enough to make 1.6 billion beverage containers.

Toxic Chemical Releases (2021)

- 1.3 million pounds of toxic releases, including over 53,000 pounds 1,4-dioxane, 1,000 pounds antimony compounds, and 550 pounds of cobalt.
- 63,000 pounds of toxic releases to air and 4,300 pounds to surface water.

Disparities

Within a 3-mile radius, residents are disproportionately people of color and lower income:

- 545 residents.
- 68% people of color (nation-wide: 41%).
- 39% low income (nation-wide: 27.5%).

Greenhouse Gas Emissions (2021)

- Over 100,000 metric tons of CO_2 equivalents, similar to the annual greenhouse gas emissions of 22,000 passenger cars.

© iStockphoto

Box 7. The Footprint of Formosa Plastics, Nan-Ya Corporation[102]

Lake City, SC

Production Capacity

- 450,000 metric tons PET per year,[103] enough to make 2.4 billion beverage containers.

Toxic Chemical Emissions (2021)

- Over 106 million pounds of toxic releases, including 222,000 pounds 1,4-dioxane and 490 pounds antimony compounds.
- 69,000 pounds toxic releases to air and nearly 2,000 pounds to surface water.

Disparities

Within a 3-mile radius, residents are disproportionately people of color and lower income:

- 7,822 residents.
- 79% people of color (nation-wide: 41%).
- 53% low income (nation-wide: 27.5%).

Greenhouse Gas Emissions (2021)

Over 178,500 metric tons of CO_2 equivalents, or about equal to the annual emissions of 40,000 passenger cars.

Ultimately, local communities, like those in the Cape Fear River watershed, bear the costs of exposure to carcinogens like 1,4-dioxane released from facilities that make PET plastic for the manufacture of bottles for beverage companies and other purposes.

PET resin manufactured by Indorama's Asheboro, NC, and Spartanburg, SC, and Nan Ya's Lake City, SC, facilities is purchased by packaging companies such as Amcor[95] and CKS.[96] These companies form PET resin into bottles, which are then purchased by The Coca-Cola Company and other beverage brands. *(For the full picture of Coke's chemical supply chain, see page 43.)*

Box 8. Chemical Spotlight: 1,4-dioxane

Role in the PET Life Cycle

- 1,4-dioxane is a byproduct[104] of MEG production and is released at facilities that manufacture or process MEG (especially at PET facilities,[105] where MEG is combined with PTA to make PET resin).
- The biggest 1,4-dioxane water polluting facilities in the US make PET resin.[106]

Why It's a Problem

- The US EPA lists 1,4-dioxane as a likely carcinogen.[107]
- 1,4-dioxane is called a "forever chemical" because of its persistence in the environment.
- It is highly soluble in water, doesn't break down in most wastewater treatment facilities, and makes its way into groundwater and drinking water,[108] where it is very difficult to break down.[109]
- Unlike in water, 1,4-dioxane breaks down quickly when released into air,[110] but it presents a cancer risk when inhaled.[111]

Solutions

- Update 1,4-dioxane regulations in the US to sufficiently protect people by establishing a federal limit for 1,4-dioxane in drinking water. US EPA's unenforceable recommended limit is in the range of 0.35[112] to 35 µg/L (ppb)[113] for a 1 x 10^{-6} to 1 x 10^{-4} cancer risk level.[114] New Jersey has adopted an enforceable maximum contaminant level for 1,4-dioxane of 0.33 µg/L.[115]
- Establish health-protective 1,4-dioxane regulations limiting 1,4-dioxane as industrial waste to protect communities that live at the fence lines of MEG and PET facilities.

Table 2. The PET Plastic Industry Is a Top Industrial Polluter of 1,4-Dioxane in the US

Releases of 1,4-dioxane to water and air in 2021 by PET plastic resin manufacturers, with rank among more than 20,000 industrial facilities reporting to the US EPA.

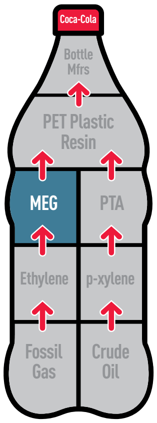
OWNER	PET PLANT NAME	LOCATION	WASTEWATER DISCHARGES		AIR EMISSIONS	
			POUNDS	US RANK	POUNDS	US RANK
Far Eastern	APG Polytech	Apple Grove, WV	**36,667**	**1**	**716**	**14**
Indorama	Indorama	Decatur, AL	**28,233**	**2**	**8,329**	**2**
Alpek	DAK Americas	Moncks Corner, SC	**14,775**	**3**	**1,731**	**8**
Indorama	StarPet	Asheboro, NC	**9,406**	**4**	**154**	**23**
Alpek	DAK Americas	Fayetteville, NC	**2,611**	**7**	**885**	**11**
Formosa	Nan Ya Plastics	Lake City, SC	**764**	**10**	**1,712**	**9**
Indorama	Auriga Polymers	Spartanburg, SC	**230**	**11**	**809**	**13**
Alpek	DAK Americas	Bay St. Louis, MS	**50**	**12**	**1,447**	**10**
Alpek	DAK Americas	Gaston, SC	**0**	**-**	**7,740**	**3**

NOTES: Based on TRI data submitted by industry to the US EPA. Wastewater discharges include direct discharge to water bodies plus transfers to publicly owned treatment works. Air emissions include both stack and fugitive emissions. Ownership details: Far Eastern New Century Corporation is part of the Far Eastern Group based in Taiwan; Indorama Ventures Public Company, Ltd., is based in Thailand; Alpek S.A. de C.V. is part of Alpha S.A.B. de C.V. based in Mexico; and Formosa Plastics Group is based in Taiwan.

Point Comfort, TX, 2023

PETROCHEMICAL BUILDING BLOCK:
MONOETHYLENE GLYCOL

The use of PET plastic is a major driver for the production and air emissions of cancer-causing ethylene oxide



PETROCHEMICAL BUILDING BLOCK: MONOETHYLENE GLYCOL

COCA-COLA CONNECTION:

MEG manufactured in Texas's Gulf Coast region is made into PET resin, which may be used in Coke's plastic bottles (see page 43).

Monoethylene glycol, also known as ethylene glycol or MEG, is combined with PTA *(page 25)* to make PET plastic. MEG is manufactured from ethylene oxide (EtO), the most potent cancer-causing chemical emitted in large amounts into the air from chemical manufacturing.[116] EtO is formed in a chemical reactor from a mixture of ethylene *(page 28)* and oxygen.

About half of all EtO produced in the US is used to make MEG for PET plastic production.[117] Significant quantities of EtO—more than 68,000 pounds—were released into the air in 2021 during the production of MEG for the PET plastic industry.[118]

The top air polluters of EtO in the US serve the chemical supply chain for PET plastic. Among the industrial facilities that emit this hazardous air pollutant, three of the top five, six of the top ten, and nine of the top fifteen polluters, by pounds of EtO air emissions in 2021, are PET plastics suppliers *(see Table 3)*.

Hazardous air emissions of EtO expose local communities and add to the cancer burden on Texas's Gulf Coast, a region known as "The Cancer Belt."[119] A ProPublica report found that, as of **2021, EtO "contributes to more cancer risk than any other toxic air pollutant emitted by American industry."**[120] EtO exposure is linked to breast cancer, lymphoma, and leukemia.[121] Cancer risk is driven by exposure to EtO emitted from storage tanks, process vents, and equipment leaks.[122]

Three companies that manufacture EtO and MEG in Texas's Gulf Coast region as part of the chemical supply chain for PET plastic bottles are Indorama Ventures Oxide & Glycols, in Clear Lake, Indorama Ventures Oxides (formerly Huntsman) in Port Neches, and Formosa Plastics in Point Comfort.

The Formosa chemical plant in Point Comfort, a small community of fishers and ranchers located southwest of Houston on Lavaca Bay, produces a variety of plastics and building-block chemicals, including EtO and MEG used for PET plastic production. The plant is one among many owned by the Taiwan-based conglomerate Formosa Plastics Group, which is one of the largest plastics and petrochemical producers in the world.

A 2021 Center for International Environmental Law report documents that Formosa paid $560 million in worldwide safety and environmental fines between 1999 and 2021.[123] Formosa's US facilities have been routinely out of compliance with US EPA's air quality regulations, and the Point Comfort facility racked up 269 air-related enforcement cases between 2013 and 2018.[124] In 2019 Formosa paid a settlement of

A PROPUBLICA REPORT FOUND THAT, as of 2021, EtO "contributes to more cancer risk than any other toxic air pollutant emitted by American industry." EtO exposure is linked to breast cancer, lymphoma, and leukemia.

Point Comfort, TX, 2023. © Diane Wilson

Diane Wilson, shrimping around Formosa. © Diane Wilson

$50 million, the largest citizen-led Clean Water Act settlement in history,[125] after local residents sued the company for dumping plastic pellets and other pollutants into Lavaca Bay near Point Comfort. As of 2020, activists reported finding evidence that Formosa was continuing to release plastic waste into local waterways, despite agreeing to halt the dumping.[126]

Diane Wilson, a local fourth-generation fisherperson, anti-war activist, and community organizer, has worked for 35 years to hold Formosa accountable. She helped form an injured workers' group for Formosa employees, was a plaintiff in the lawsuit over plastic pollution in Lavaca Bay, and has led the charge against expansion of the Point Comfort Formosa facility.

"There is a constant move to expand." Wilson says of the facility, noting that emissions have increased over time.[127] "It's been this constant not enough, not enough. They buy out the ranchers, the cattlemen. In the town of Point Comfort, Formosa owns almost all of the houses because the people have left. They own the school. It's no longer a school, it's Formosa's training facility. They gobble up everything: the houses, the land, the air. They like to have their own downstream plants where they can send their rail cars day and night and make this plastic."

Two clean air rules[128] advanced by the US EPA would reduce ethylene oxide emissions from chemical manufacturers that supply PET plastic (including polyester) production and from other smaller sources.[129] [130]

However, the rules would only reduce by 20% the number of people facing serious[131] cancer risk from ethylene oxide.[132] **More than 3 million people who live within 30 miles of these chemical plants will still face serious cancer risks from ethylene oxide exposure,** even if such rules become fully effective.[133]

"There is a constant move to expand. It's been this constant not enough, not enough. They (Formosa) buy out the ranchers, the cattlemen. In the town of Point Comfort, Formosa owns almost all of the houses because the people have left."

DIANE WILSON, a local fourth-generation fisherperson, anti-war activist, and community organizer

US EPA took a more health-protective stance when they restricted cancer-causing benzene emissions, protecting 99% of the surrounding population, in 1989.[134] The agency has also recently proposed a 93% reduction in the number of people facing similar cancer risks from chloroprene, another cancer-causing substance.[135] More stringent EtO regulations than those proposed are necessary to further reduce population cancer risk from this hazardous air pollutant.

Box 9. The Footprint of Indorama Ventures Oxides International (formerly Huntsman)[139]

Port Neches, TX

Production Capacity

- 1.3 million metric tons of EtO and 964,000 metric tons of MEG per year.[140]

Toxic Chemical Releases (2021)

- Over 156 million pounds toxic releases.
- Over 217,000 pounds of carcinogenic EtO *(see Box 12)* released overall.
- Some reports suggest the facility may have intentionally underreported releases.[141]
- Largest or second-largest polluter of EtO in the US since at least 2017.[142]

Disparities

Within a 3-mile radius, residents are disproportionately lower income:

- 36,000 residents.
- 39% people of color (nation-wide: 41%).
- 36% low income (nation-wide: 27.5%).

Greenhouse Gas Emissions (2021)

- 1.35 million metric tons of CO_2 equivalents, roughly equivalent to six months' worth of energy-related greenhouse gas emissions for the city of Washington, DC.[143]

Box 10. The Footprint of Indorama (Oxide & Glycols)[144]

Clear Lake, TX

Production Capacity

» 385,000 metric tons of MEG per year.[145]

Toxic Chemical Releases (2021)

» Over 27.7 million pounds of toxic chemicals released.
» Over 108,000 pounds of toxic releases into air.
» Nearly 7.8 million pounds of toxic releases into municipal water treatment systems.
» Over 129,000 pounds toxic EtO (see Box 12) released overall.

Demographics

Within a 3-mile radius:

» 24,000 residents.
» 35% people of color (national-wide: 41%).
» 14% low income (nation-wide: 27.5%).

Greenhouse Gas Emissions (2021)

» Over 771,000 metric tons CO_2 equivalents.

Box 11. The Footprint of Formosa Plastics[146]

Point Comfort, TX

Production Capacity

» 620,000 metric tons of EtO.
» 740,000 metric tons of MEG.[147]
» Also produces three other plastic resins: polyethylene, polypropylene, and polyvinyl chloride.

Toxic Chemical Releases (2021)

» Over 187 million pounds toxic releases.
» 1.2 million pounds into air.
» 5,409 pounds to surface water.
» Paid $50 million to fund cleanup of plastic pellets dumped into Lavaca Bay.[148]

Disparities

Within a 3-mile radius, residents are disproportionately lower income:

» 785 residents (the city is mostly occupied by the Formosa facility).
» 43% people of color (nation-wide: 41%).
» 30% low income(nation-wide: 27.5%).

Greenhouse Gas Emissions (2021)

» Over 4.9 million metric tons CO2 equivalents, or a little more than the total annual emissions produced by Boston's buildings and transportation.

Ethylene oxide emissions from chemical manufacturers continue to perpetuate environmental racism, primarily to supply PET plastic production. Even if the proposed rules become fully effective, Black and Brown communities will remain heavily overburdened. People of color represent 64% of all who face serious cancer risk from living within 6 miles of EtO emissions from chemical manufacturing plants, while 41% of the US population as a whole are people of color.[136] Further, 18% of the at-risk population live in poverty and 20% have not graduated from high school, higher than the national rates of 13% and 12%, respectively.[137]

Further reductions in emissions and cancer risk could be achieved if facilities were required to also retrofit with available technology that can eliminate so-called fugitive air emissions of EtO, such as leakless valves and pumps.[138]


© iStockphoto

People of color represent 64% of all who face serious cancer risk from living within 6 miles of EtO emissions from chemical manufacturing plants, while 41% of the US population as a whole are people of color. Further, 18% of the at-risk population live in poverty and 20% have not graduated from high school, higher than the national rates of 13% and 12%, respectively.

MEG manufactured at Indorama's Port Neches, TX, and Clear Lake, TX, facilities and Formosa's Point Comfort, TX, facility is supplied to Indorama's Asheboro, NC, and Spartanburg, SC, facilities and Nan Ya's Lake City, SC, facility, respectively, for manufacture into PET plastic resin (page 15), which is made into beverage bottles, some of which may be used by The Coca-Cola Company. (For the full picture of Coke's chemical supply chain, see page 43.)

Box 12. Chemical Spotlight: Ethylene Oxide

Role in PET Life Cycle

- Ethylene oxide (EtO) is the precursor to monoethylene glycol (MEG).
- It's released as waste to the environment during the manufacture of both MEG and PET.
- About 50% of all EtO production in the US is connected to the PET supply chain.[149]

Why It's a Problem

- The US EPA lists EtO as carcinogenic to humans. Exposure to EtO is linked with breast cancer, leukemia, and lymphomas.[150]

Solutions

- EtO is a key building block in PET manufacture. Requiring leakless equipment and reducing the production of PET plastic is necessary to drive down EtO pollution.

Photo by Cindy Shebley from Pexels: https://www.pexels.com/photo/smog-coming-out-of-the-factory-15279487/

Table 3. Chemical Suppliers for PET Plastic Are Top Polluters of Ethylene Oxide in the US

Total releases to air in 2021, in pounds, reported by manufacturers of ethylene oxide (EtO) used to make MEG for production of PET plastic including polyester, with national rank among more than 20,000 industrial facilities reporting to the US EPA.

OWNER	CHEMICAL PLANT NAME	LOCATION	AIR EMISSIONS (LBS.)	US RANK
Indorama Ventures	(Huntsman Petrochemical)	Port Neches, TX	18,980	1
Lotte / Westlake	LACC / Lotte Chemical	Westlake, LA	10,525	4
Formosa Plastics	Formosa Plastics	Point Comfort, TX	7,717	5
Dow Chemical	Union Carbide	Hahnville (Taft), LA	7,449	6
Eastman Chemical	Eastman Chemical	Longview, TX	6,219	7
Shell Oil	Shell Chemical	Geismar, LA	4,981	10
Dow Chemical	Union Carbide	Seadrift, TX	4,612	11
Sasol	Sasol Chemicals	Westlake, LA	3,500	12
Dow Chemical	Dow Chemical	Plaquemine, LA	2,849	15
Indorama	Celanese – Clear Lake	Pasadena, TX	1,569	25
TOTAL:	**10 chemical plants out of top 25 EtO polluters**		**68,401**	

NOTES: Based on TRI data submitted by industry to the US EPA. Air emissions include both stack and fugitive emissions.
The Huntsman Petrochemical plant in Port Neches, Texas was acquired by Indorama Ventures in 2020. LACC is a joint venture between Lotte Chemical and Westlake Chemical. Two other ethylene oxide producers, ranked #2 and #3 in EtO air emissions in 2021, mostly serve end-markets for surfactants and brake fluid, not PET plastic. They are BASF in Geismar, LA, (15,541 pounds of EtO air emissions) and LyondellBassell (Equistar Chemicals) in Baytown/Pasadena, TX, (10,623 pounds emitted)

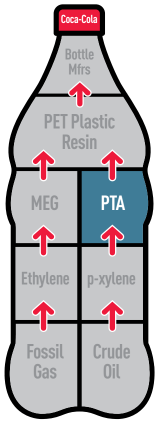
(Left) Brenda Hampton at the Tennessee River. © Maya Rommwatt
(Right) Brenda Hampton and Marcus Echols at local food pantry in Moulton, AL
© Maya Rommwatt

PETROCHEMICAL BUILDING BLOCK:

TEREPHTHALIC ACID

Demand for PET plastic and polyester results in air emissions of carcinogenic cobalt

Indorama's Xylenes and PTA facility in Decatur, AL.
© Maya Rommwatt



PETROCHEMICAL BUILDING BLOCK: TEREPHTHALIC ACID

COCA-COLA CONNECTION:

PTA manufactured in Decatur, AL, is used to produce PET plastic, which in turn may be used in Coke's plastic bottles (see page 43).

Purified terephthalic acid, or PTA, is one of two key ingredients in the manufacture of PET plastic. One of North America's biggest PTA production facilities is located in Decatur, Alabama.

Decatur is located on the Tennessee River about 85 miles north of Birmingham. There are 27 industrial plants located in Decatur and the surrounding metropolitan area.[151] One of the most toxic polluters among these is Indorama Ventures Xylenes & PTA, LLC, which releases more toxic air and water pollutants than almost any other facility in the area.[152] The plant manufactures up to 745,000 metric tons of PTA annually for use in the production of PET plastic within Indorama's own industrial processes[153] as well as for sale to other major PET manufacturers such as the Nan Ya Plastics Corporation. Both Indorama[154] and Nan Ya[155] supply plastic for the production of bottles for The Coca-Cola Company and other beverage corporations.

Brenda Hampton at the Tennessee River.
© Maya Rommwatt

Brenda Hampton was born and raised in Lawrence County, downstream from Decatur on the Tennessee River. She lived and worked in Boston for 25 years before returning home in 2015 to care for her mother, who was grappling with kidney failure. After her mother's death, Hampton became active in the local community, distributing food and supplies to the growing number of sick people in need. Through her group, Concerned Citizens of West Morgan-East Lawrence Water Authority, she educates residents about potential chemical exposures from the region's many industrial plants, and she was instrumental in getting her local water treatment facility upgraded to a reverse osmosis system to remove the "forever chemicals" PFAS from drinking water, some of which may originate from facilities in the region, such as 3M and Daikin's fluorochemical factories.[156] She's now working on getting air quality in the area tested.

"My family comes from on the Tennessee River," says Hampton. "Our residency is 19 miles away from Indorama, but our drinking water intake valve is only 13 miles downstream, and it's on the left-hand side of the Tennessee River, the same side that all 27 industrial plants are located on." **Indorama's operations add thousands of pounds of other toxic chemicals to water and air burdened by other plants in the area.**

Toxic chemicals released into air and water through the manufacture of PTA include cobalt, a cancer-causing metal which is also associated with respiratory and cardiac effects.[157] Cobalt is used as a catalyst in the production of PTA, and, as a result, the carcinogenic metal is released in the manufacturers' wastewater and solid waste. EPA's RSEI (Risk-Screening Environmental Indicators) model shows that **cobalt releases from this Indorama facility make up the greatest source of modeled toxic hazards in the Decatur**

> "My family comes from on the Tennessee River. Our residency is 19 miles away from Indorama, but our drinking water intake valve is only 13 miles downstream, and it's on the left-hand side of the Tennessee River, the same side that all 27 industrial plants are located on."
>
> **BRENDA HAMPTON,** Concerned Tennessee River Resident, Environmental Activist and Educator

"**Sometimes I find myself crying.** That's why I have to come to the Tennessee River and sit on the river to go back to my roots, because we came from the Tennessee River—being Cherokee Indians—we were along the river. I feel my ancestors when I'm here along the river. If some of these people who owned these plants could just walk in my shoes, [I think] they would say 'Hold up!'"

BRENDA HAMPTON, Concerned Tennessee River Resident, Environmental Activist and Educator

Brenda Hampton, activist

area over the past decade and constitute approximately one third of the modeled hazard produced by the top five polluting facilities in Decatur.[158]

The Decatur Indorama chemical plant, which includes both PTA and PET resin manufacturing, reports releasing 28 different toxic chemicals into the environment and is responsible for a known 8.3 million pounds of toxic releases in 2022, including 677,000 pounds to air and 550,000 pounds to surface water. In that time, it also generated greenhouse gas emissions equivalent to 339,000 metric tons of CO_2, or as much as nearly 74,000 passenger cars.[159]

"Sometimes I find myself crying," says Hampton. "That's why I have to come to the Tennessee River and sit on the river to go back to my roots, because we came from the Tennessee River—being Cherokee Indians—we were along the river. I feel my ancestors when I'm here along the river. If some of these people who owned these plants could just walk in my shoes, [I think] they would say 'Hold up!' "

PTA manufactured at Indorama's Decatur, AL, facility is supplied to Indorama's PET plastic resin facilities *(page 15)**, which use it to make PET bottles, some of which Coca-Cola may purchase.* *(For the full picture of Coke's chemical supply chain, see page 43.)*

Box 13. The Footprint of Indorama Ventures Xylenes & PTA and AlphaPET[160]

Decatur, AL

Production Capacity

- 720,000 tons of para-xylene, 745,000 tons of PTA, and 450,000 tons of PET resin.[161]

Toxic Chemical Releases (2021)

- 8.3 million pounds of toxic chemicals, including 253,000 pounds of 1,4-dioxane, 534,000 pounds of benzene, 955,000 pounds of xylenes, and 30,000 pounds of cobalt compounds.
- 677,000 pounds of toxic releases to air.
- Over 1 million pounds of toxic releases to surface water and the municipal sewage system, which discharges toxic substances, like 1,4-dioxane, into the Tennessee River watershed.[162]

Disparities

Within a 3-mile radius, residents are disproportionately people of color and lower income:

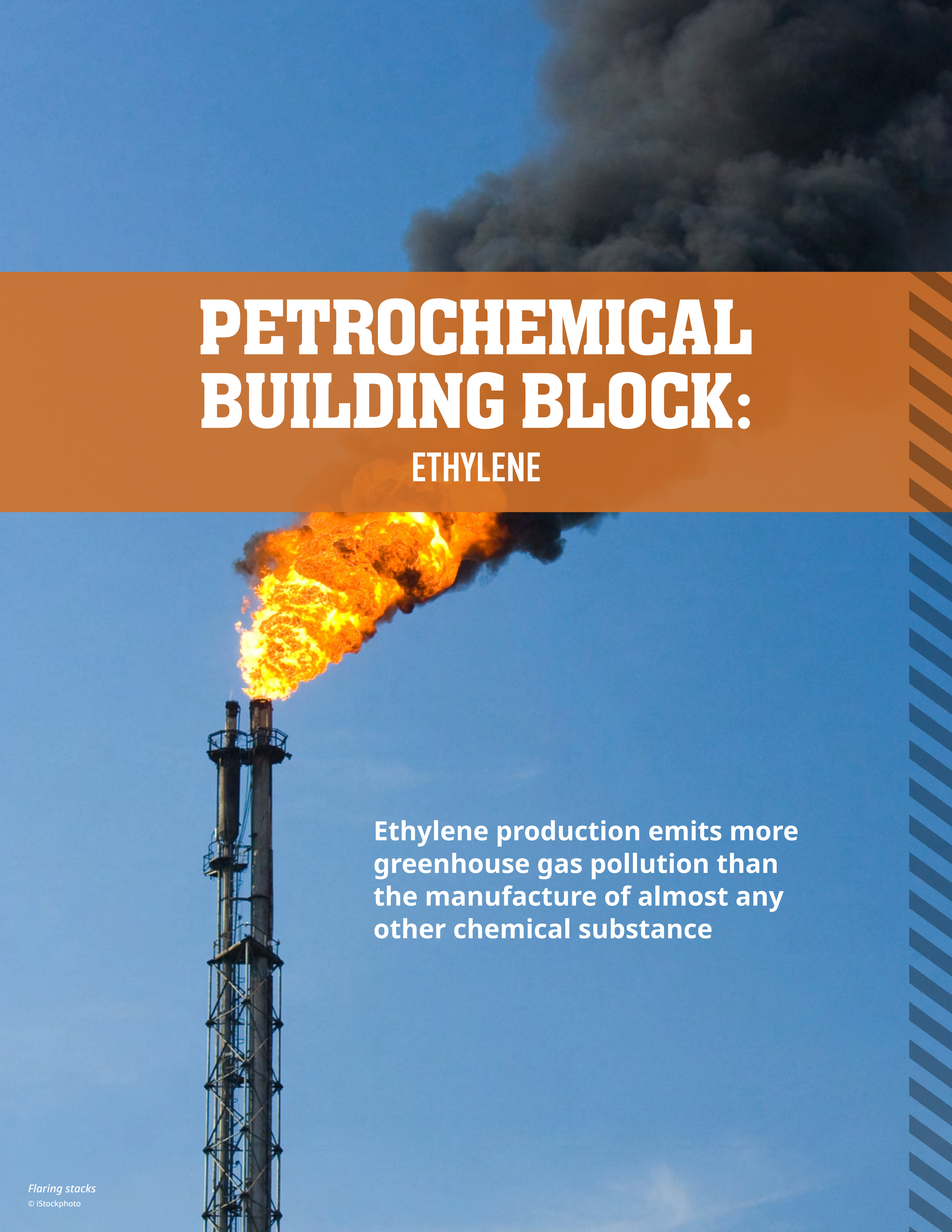
- 54% people of color (nation-wide: 41%).
- 30% low income (nation-wide: 27.5%).

Greenhouse Gas Emissions (2021)

- 339,000 metric tons of CO_2 equivalents.

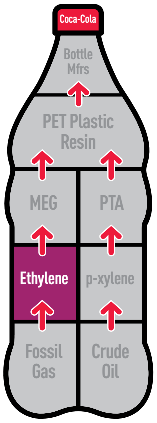
PETROCHEMICAL BUILDING BLOCK:

ETHYLENE



Ethylene production emits more greenhouse gas pollution than the manufacture of almost any other chemical substance

Flaring stacks



PRIMARY PETROCHEMICAL: ETHYLENE

COCA-COLA CONNECTION:

Ethylene manufactured in Louisiana feeds into the production of PET plastic for plastic bottles that Coke may purchase (see page 43).

Ethylene is a light hydrocarbon gas that is an essential ingredient in the processes that generate many plastics. **About 90% of all ethylene produced worldwide is used to make plastics, including PET, polyethylene, polyvinyl chloride, and polystyrene.**[163] PET plastic manufacturing alone requires about 10% of all ethylene production.[164]

Ethylene manufacture illustrates how society's over-reliance on petrochemical plastics compounds the growing threat of climate change from ever-increasing greenhouse gas emissions from the plastics industry. Chemical manufacturing as a whole consumes more energy than any other industry and emits more greenhouse gases than any other industrial sector except for steel and cement,[165] and eighty percent of all petrochemicals are used to make plastics.[166]

Ethylene is most commonly produced in the US through the steam cracking of ethane extracted from natural gas. Climate-changing pollution from ethylene production exceeds that of the production of every other chemical substance except for ammonia.[167] Conventional cracking emits 1 to 2 tons of CO_2 for every ton of ethylene produced.[168] Only propylene, another plastics building-block chemical, approaches ethylene in its climate impact intensity.

The chemical hazards of ethylene, other than its extreme flammability, are low, moderate, or unknown.[169] However, due to high production volumes and large amounts of fossil fuel combustion, ethylene crackers can create significant local impacts, including emissions of health-threatening hazardous air pollutants, fine particles (soot), and smog-producing volatile organic compounds and nitrogen oxides.[170]

Due to high production volumes and large amounts of fossil fuel combustion, ethylene crackers can create significant local impacts, including emissions of health-threatening hazardous air pollutants, fine particles (soot), and smog-producing volatile organic compounds and nitrogen oxides.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In 2015, Indorama Ventures purchased a shuttered cracker facility located near Lake Charles, Louisiana,[171] and headquartered in nearby Westlake. The company restarted operations under the name Indorama Ventures Olefins in 2018 to process ethane into ethylene.[172] The ethylene, in turn, is used in the manufacture of EtO for the production of MEG *(page 20)* at Indorama's Clear Lake and Port Neches, TX, facilities.[173]

Indorama's Lake Charles cracker facility produces approximately 430,000 metric tons of ethylene a year. The facility reports having released 2.8 million pounds of toxic chemicals into the environment in 2021, of which 95,000 pounds were emitted into the air.

The site has come under scrutiny for excessive flaring, or burning off of waste gases and excess chemicals. A report from local television news station KPLC quoted residents expressing anger about the noise and plumes of black smoke coming from the plant at a public hearing in late 2021 and requesting that the company's air pollution permit not be renewed until the flaring issues were resolved. One resident, Charlie Atherton, said that he believes "Indorama has not been a good neighbor to the community."[174]

Ethylene manufactured at Indorama's Lake Charles, LA, facility, is supplied to Indorama's Port Neches, TX, and Clear Lake, TX, facilities to make MEG *(page 20)**, which makes its way into bottles used by The Coca-Cola Company.* *(For the full picture of Coke's chemical supply chain, see page 43.)*

Box 14. The Footprint of Indorama Ventures Olefins[175]

Lake Charles (Westlake), LA

Production Capacity

- 440,000 tons of ethylene per year.176

Toxic Chemical Releases (2021)

- Over 2.8 million pounds of toxic chemical releases, including 12,000 pounds of benzene and 3,000 pounds of xylenes.
- Over 95,000 pounds toxic releases to air.

Disparities

Within a 3-mile radius, residents are disproportionately lower income:

- 12,455 residents.
- 12% people of color (nation-wide: 41%).
- 32% low income (nation-wide: 27.5%).

Greenhouse Gas Emissions (2021)

- 162,172 metric tons of CO_2 equivalents, or about the equivalent of 35,000 passenger cars.

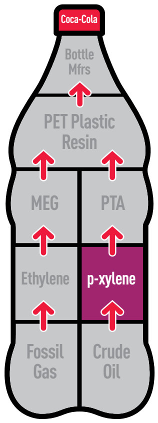
© iStockphoto

PRIMARY PETROCHEMICAL:

PARA-XYLENE

Crude oil provides 97% of the highly toxic aromatic chemicals used to make plastics [177]

Kirsten Vallee, community organizer, pictured in front of the BP refinery in Whiting, IN. © Kirsten Vallee



PRIMARY PETROCHEMICAL: PARA-XYLENE

COCA-COLA CONNECTION:

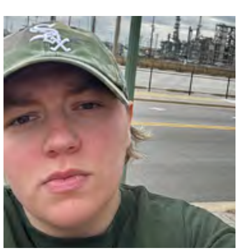
Xylenes manufactured at a refinery on Lake Michigan are essential in the production of PET resin for Coke's plastic bottles (see page 43).

The aromatic hydrocarbon para-xylene (PX) is a crucial ingredient in the manufacture of PTA, which is one of the two building block chemicals that go into forming PET plastic. About 90% of PX manufactured in the US supplies the production of PET plastic[178] by way of PTA.[179]

PX is a product of crude oil refining, which involves a series of processes that generate various liquid fuels, primarily gasoline, as well as other chemicals and end-products, including the toxic aromatic hydrocarbons benzene, toluene, and xylenes (BTX). PX is one component of mixed xylenes and is a highly hazardous chemical.[180] Long-term exposure to xylenes is associated with nervous system, respiratory, kidney, and cardiovascular effects.[181]

In addition to being a major source of emissions of BTX compounds into the air, petroleum refining emits a range of other air pollutants, such as particulate matter, nitrogen oxides, carbon monoxide, hydrogen sulfides, and sulfur dioxide.[182]

The BP Refinery located in Whiting, Indiana, on the south shore of Lake Michigan in the Chicago Metropolitan Area is the largest refinery in the Midwest, processing 440,000 barrels of crude oil per day, including oil piped from Alberta's tar sands *(page 37)*.[183] Mixed xylenes manufactured at BP's Whiting facility are piped[184] directly to the Indorama facility in Decatur, Alabama,[185] where they're manufactured into PX for use in the production of PTA at that same facility *(page 25)*.



Kirsten Vallee, a resident of Whiting and a community organizer working to hold BP accountable for the air pollution affecting the local community, has personally experienced health effects air pollution. "I've been dealing with respiratory issues since I was around three or four years old," she says. "Now 27, I still take an inhaler and often find myself coughing for no explainable reason other than the air quality."

"I've been dealing with respiratory issues since I was around three or four years old. Now 27, I still take an inhaler and often find myself coughing for no explainable reason other than the air quality."

KIRSTEN VALLEE, Concerned Whiting Resident

The BP Whiting facility produces 787,000 metric tons of mixed xylenes and reported releasing over 4 million pounds of toxic chemicals in 2021, including over 479,000 pounds into the air and over 1 million pounds into surface water, mostly Lake Michigan.[186]

A report from the Environmental Integrity Project's assessment of refineries in the US found that BP Whiting was the second-worst refinery polluter of nickel, the third-biggest polluter of selenium, and the fifth-biggest polluter of nitrogen into waterways.[187] Nickel refinery dust is classified by the US EPA as a human carcinogen.[188] Selenium is toxic at high concentrations and bioaccumulates in aquatic food chains.[189] Nitrogen can cause an overgrowth of algae in water bodies that may lead to reduced oxygen levels and dead zones.[190] BP Whiting also produced over 5 million metric tons of CO_2 equivalents in 2021, or about as much as the 1.1 million passenger cars in nearby Chicago emit in a year.[191]

Vallee describes a troubling incident that happened in August 2022: "On one of our community Facebook pages, citizens kept bringing up that the flame burning from BP was much larger than usual. My dad, who currently works at BP, told me that a large flame on one of the smokestacks means that the refinery is trying to burn chemical off. I've seen this happen for short periods of time in the past, but this instance was the most alarming. It wasn't just one smokestack; it was all of them. The flames burned for 48 hours. The area smelled like a barbecue and you could feel the heat from the boulevard," she says, referring to the area where the plant is located. She adds, "As far as I'm aware, the city has still not commented on how much the air quality was affected by those 48 hours despite numerous requests from concerned citizens."

The process Vallee describes is "flaring," a method of burning off waste and excess chemicals that releases toxic pollutants into the air. **In 2008, BP Whiting paid an $8 million settlement for allegedly violating conditions of their air emissions license due to pollutants released in association with flaring.**[192]

It wasn't the only time the facility has been accused of violating air quality regulations. Last year, BP agreed to pay $2.75 million to settle a lawsuit filed by environmental organizations over alleged repeated excess emissions of particulate matter (PM10).[193] Exposure to PM10 is associated with both respiratory and heart problems including asthma and heart attacks.[194] On the day of the settlement, the Indiana Department of Environmental Quality modified BP's permit, removing the limits on PM10.[195]

"What was most striking to me," Vallee says about a period when the plant was shut down for repairs, "was how quiet the city went. There was no longer a low hum hanging over the city as usual. It was silent. And the air quality seemed much clearer; the sky was not as smoggy. I recall my breathing becoming a bit clearer. When the plant restarted, I remember coughing a bit more."

Mixed xylenes manufactured at the BP refinery in Whiting, IN, are supplied to Indorama's Decatur, AL, facility, where PX is separated out and then converted into PTA *(page 25)**. Indorama's PET facilities use that PTA to make PET resin which may be used in some of The Coca-Cola Company's PET bottles.* *(For the full picture of Coke's chemical supply chain, see page 43.)*

Box 15. The Footprint of BP Refinery[196]

Whiting, IN

Production Capacity

- 787,000 metric tons of mixed xylenes.[197]
- It also produces other petrochemicals, gasoline, and other fossil fuels.

Toxic Chemical Releases (2021)

- Over 4.2 million pounds toxic releases, including 48,000 pounds of 1,4-dioxane, 121,000 pounds of benzene and 283,000 pounds of mixed xylenes.
- Over 479,000 pounds toxic releases to air, including 48,300 pounds of mixed xylenes.
- Over 1 million pounds toxic releases discharged to surface waters, primarily Lake Michigan, making it "one of the worst water polluters in the nation."[198]

Disparities

Within a 3-mile radius, residents are disproportionately people of color and lower income:

- 44,000 residents (primarily in the cities of Whiting and majority-Hispanic and Black East Chicago).
- 75% people of color (nation-wide: 41%).
- 49% low income (nation-wide: 27.5%).

Greenhouse Gas Emissions (2021)

- Over 5 million metric tons of CO_2 equivalents, nearly totaling the energy-related emissions of Vermont.[199]

Box 16. Chemical Spotlight: Benzene

Role in PET life cycle

- The process of refining oil and producing *para*-xylene (PX) for PET plastic generates a mix of aromatic hydrocarbons called BTX (benzene, toluene, xylene) at refineries like BP Whiting.
- Benzene is also released at facilities using PX as an intermediate, including facilities that produce PTA and PET.[200]
- Additionally, benzene has been found in plastic bottles made from recycled PET.[201]

Why it's a problem

- Long-term exposure to benzene is linked with toxic impacts on blood and with cancer, including leukemia.[202]
- The CDC estimates that as many as 238,000 people may be occupationally exposed to benzene,[203] with the petrochemical industry being a major contributor. Workers with jobs inside refineries are particularly at risk.[204]
- Fenceline communities living near refineries may be at increased risk; communities closer to refineries were found to have an increased risk of multiple types of cancers that may be linked with exposure to BTX.[205]
- Benzene in recycled PET could result in exposure for consumers of beverages from recycled PET bottles.[206]

Solutions

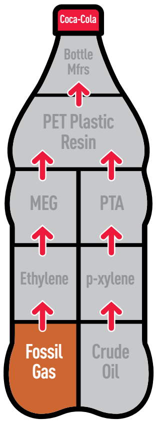
Reducing reliance on fossil-fuel-based plastics including PET is important to safeguarding workers, fenceline communities, and consumers from exposure to benzene and other harmful aromatic hydrocarbons.

A Permian Basin oil rig, where frack drilling is in process.
© iStockphoto

NONRENEWABLE RESOURCE:
NATURAL GAS

Fossil gas supplies 20% of the carbon that goes into making PET plastic

Kaylee Shoup, activist, in front of drilling equipment in the Permian Basin. © Kaylee Shoup



NONRENEWABLE RESOURCE: NATURAL GAS

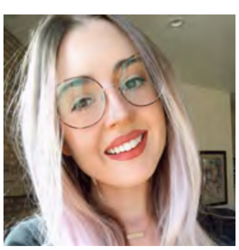
COCA-COLA CONNECTION:

The nonrenewable resources that go into making PET resin for Coke's plastic bottles likely include gas extracted from the Permian Basin (see page 43).

Almost all plastic gets its start as fossil carbon, such as that found in natural gas extracted from the Permian Basin, an 86,000-square-mile bowl-shaped area encompassing 52 counties in western Texas and southeastern New Mexico.[207] Within the bedrock in this region lie reservoirs of fossil fuels that include crude oil and natural gas.

After extraction, natural gas is processed to separate the hydrocarbon mixture known as natural gas liquids (NGLs) from methane. NGLs are then fractionated into ethane, propane, butanes, and natural gasoline.[208] Most of the ethane is chemically "cracked" to manufacture ethylene *(page 28)*. More than 20% of this ethylene is used to produce EtO[209] for conversion to MEG *(page 20)*, which is used to make PET plastic *(page 15)*.

Oil has been extracted from the Permian Basin since 1920, with production declining after a peak in the 1970s. The development of horizontal drilling and hydraulic fracturing, or "fracking," led to a resurgence in well production.[210] By 2022, more than 5 million barrels of oil a day were being extracted from the basin,[211] and today it's the country's largest producer of crude oil and second-largest producer of gas.[212] About 60% of the nation's crude oil[213] and 23% of its natural gas[214] production comes from the approximately 45,000 wells located in the basin.[215]



Kayley Shoup was born and raised in Carlsbad, New Mexico, in the Permian Basin. After moving away in 2010 and returning in 2018, she found her small town had been transformed by the Permian oil boom, with heavy traffic, fatal car accidents, failing infrastructure, a skyrocketing cost of living, out-of-reach housing costs, earthquakes, and widespread illness.

"Within a year of being back I had a lot of people in my personal life getting diagnosed with rare and aggressive cancers," Shoup says. "I started to think maybe it was environmental factors and I started looking for answers."

Shoup eventually became a community organizer with Citizens Caring for the Future, an organization focused on protecting air, water, and public health in the Permian Basin in New Mexico.

Fracking involves pumping pressurized fluid deep into drilled wells to fracture the surrounding bedrock and allow oil and gas to be pumped to the surface. Fracking fluid is made up of water, sand, and chemicals, the identities of which are often considered proprietary information and not disclosed to local communities or regulators.[216] More than 1,000 different chemicals have been **reported as constituents of fracking fluid. Many of these have known toxic effects, while others have not been adequately studied.**[217]

"Within a year of being back I had a lot of people in my personal life getting diagnosed with rare and aggressive cancers. I started to think maybe it was environmental factors and I started looking for answers."

KAYLEY SHOUP, Concerned Carlsbad, NM Resident
Community Organizer, Citizens Caring for the Future

"There's not a great picture of the amount of pollution we're facing and not much documentation of health impacts we're seeing in this community," says Shoup. "But we do know the associated health issues that come with this kind of pollution: benzene, toluene, ethylbenzene, xylene, nitrous oxides." Shoup notes that used fracking fluid, known as produced

Drilling and fracking inside a Texas, Permian Basin well. @Stockphoto

"A lot of what's produced here is going to the Gulf to make plastic. You see the connections with people in the Gulf; they're really dealing with very similar issues to what we're dealing with. We're essentially sacrifice zones. There's really no regard for the communities. We're having to defend ourselves from these corporations that are some of the most powerful, richest corporations in the world. And the only people speaking out about them and trying to stand up to them are the community members. It's David and Goliath everywhere you look. How can we protect ourselves when we have this system that doesn't prioritize the people, doesn't prioritize the planet?"

water, can contain a wide range of chemicals, including the forever chemicals PFAS,[218] and may be radioactive.[219]

Fracking also releases massive quantities of greenhouse gases into the atmosphere. Last year, a NASA instrument detected a two-mile long plume of methane—a greenhouse gas 25 times as potent as carbon dioxide[220]—over the Permian Basin near Carlsbad from gas leaking or being vented directly to the atmosphere from oil and gas operations.[221] New scientific reports detail how methane emissions from fracking in the Permian Basin have been severely underreported, and that the region releases more greenhouse gas pollution than previously known.[222]

Targa Resources Corporation is a leading supplier of NGLs, including ethane used to make ethylene for the production of PET plastic.[223] Targa stores massive amounts of NGLs extracted from the Permian Basin in caverns in Mont Belvieu, near Houston.[224] The company supplies Indorama with its ethane and propane feedstock and manages storage of these gases in Lake Charles, Louisiana.[225]

"A lot of what's produced here is going to the Gulf to make plastic," says Shoup. "You see the connections with people in the Gulf; they're really dealing with very similar issues to what we're dealing with. We're essentially sacrifice zones. There's really no regard for the communities. We're having to defend ourselves from these corporations that are some of the most powerful, richest corporations in the world. And the only people speaking out about them and trying to stand up to them are the community members. It's David and Goliath everywhere you look. How can we protect ourselves when we have this system that doesn't prioritize the people, doesn't prioritize the planet?"

NGL extracted from the Permian Basin is supplied to Indorama's Lake Charles, LA, facility, where it is processed into ethylene *(page 28)**. From there, it's used by Indorama's supply chain to make MEG* *(page 20)* *and PET resin* *(page 15)**, which is used in plastic bottles that may be purchased by Coca-Cola.* *(For the full picture of Coke's chemical supply chain, see page 43.)*

Box 17. The Footprint of the Permian Basin[226]

Texas and New Mexico

Production Capacity

- 23% of US gas production comes from the approximately 45,000 wells located in the region.

Toxic Chemical Releases

- Fracking operations emit sulfur dioxide, methane, nitrogen oxides, and VOCs.
- Used fracking fluid can contain radioactive chemicals,[227] toxic PFAS,[228] and many other chemicals that are not disclosed by industry[229] or have never been evaluated for health impacts.[230]

Disparities

- Around 2 million residents in the Permian Basin.
- Population concentrated in the majority-Hispanic cities of Midland (58% people of color, 23% low income), Odessa (70% people of color, 31% low income), and San Angelo (52% people of color, 32% low income). (Nation-wide: 41% people of color, 27.5% low income.)

Greenhouse Gas Emissions

- Methane emissions from New Mexico's oil and gas wells amount to 194 metric tons an hour,[231] equivalent to 1.8 million metric tons CO_2 in a year.

© Jean L'Hommecourt

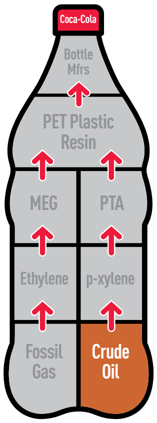
NONRENEWABLE RESOURCE:

CRUDE OIL

Crude oil supplies 80% of the fossil carbon that goes into making PET plastic

Jean L'Hommecourt, activist

© Jean L'Hommecourt



NONRENEWABLE RESOURCE: CRUDE OIL

COCA-COLA CONNECTION:

Crude oil is one of two nonrenewable resources essential for making the PET resin that forms Coke's plastic bottles (see page 43).

Plastic is made up of long chains of carbon, and the primary source of carbon for most PET plastic is crude oil.

One of the largest reservoirs of crude oil in North America is Canada's Athabasca tar sands in northeastern Alberta, where a mixture of sand, clay, water, and a viscous form of crude oil called bitumen underlies the boreal forest in a layer up to 200 feet thick.[232] Extraction of tar sands requires clearcutting ancient forests and strip-mining the bitumen-laden soil, which is then "washed" using hot water and fossil gas. Bitumen is heavier than typical crude oil, and of a lower quality, necessitating considerable processing to "upgrade" it for use as a fuel and a raw material for plastics production.[233]

Fort McKay is a small First Nation community in the midst of the Athabasca tar sands region, home to Dene, Cree, and Métis First Nation peoples. **Jean L'Hommecourt, an Indigenous Denesulinè, Registered Member of Treaty 8 with the Fort McKay First Nation, has worked in many capacities to advocate for Denesulinè traditional territory and protection of the environment.** L'Hommecourt lives on the banks of the Athabasca River in Fort McKay, which, she says, sits within 10 to 15 miles of multiple industrial sites related to tar sands extraction and processing.[234]

"I can stand on the shoreline and look towards the south and see the stacks with steam coming out and the big flare stacks with the flames which burn off the gases into the air," she says. "If I turn around and face the north, I can see all the man-made hills that they call overburden, which is the leftover sand from processing the tar sands. The sand is a really fine dust where if we get a little wind, it lifts all the sand and it flows in the air."

After bitumen is washed, the leftover water, silt, and chemicals are dumped into human-made lakes called tailings ponds.

> **"I can stand on the shoreline and look towards the south and see the stacks with steam coming out and the big flare stacks with the flames which burn off the gases into the air. If I turn around and face the north, I can see all the man-made hills that they call overburden, which is the leftover sand from processing the tar sands."**
>
> **JEAN L'HOMMECOURT,** Indigenous Denesulinè, Registered Member of Treaty 8 with the Fort McKay First Nation

There are 19 tailings ponds along the Athabasca River, and together they cover an area of 99 square miles and hold 528 billion gallons of tailings and wastewater. This waste is contaminated with heavy metals and toxic chemicals including selenium, cadmium, mercury, arsenic, polycyclic aromatic hydrocarbons, naphthenic acids, and salts.[235]

"The tailings ponds surround our community," says L'Hommecourt. "Water has no boundaries. You can't stop it from flowing—it finds its way." In 2020, the Canada-US-Mexico Commission for Environmental Cooperation confirmed that toxic chemicals from the tailings are leaching into groundwater. [236]

L'Hommecourt worries about the effects leachate from the ponds may be having on her community and those downstream. She adds that Fort McKay is experiencing high rates of cancer as well as skin issues and other health problems. Her own grandchild was born with an underdeveloped heart and had to have three corrective surgeries. She says that health studies have been minimal and that the government has resisted taking responsibility.

Crude oil from the tar sands is transported to refineries in the US, such as the BP refinery in Whiting, Indiana (page XX), through a network of pipelines that have a documented history of leakage, spreading impacts all along the tar sands oil's route.[237]

The effects of tar sands extraction on local communities extend beyond direct exposure to toxic chemicals. L'Hommecourt's people were removed from their traditional lands to make room for the extraction of the resource in the 1960s, and L'Hommecourt worries that today the influx of tar sands workers poses a danger to Indigenous women. "It is scary," L'Hommecourt says. "There's like 3,000-man camps. You never know when you're going to run into someone out on the land by yourself. We have such a high rate of missing or murdered Indigenous women in our area." Across Canada, Indigenous women and girls are 12 times more likely to be missing or murdered than non-Indigenous women.[238]

L'Hommecourt notes that tar sands development has transformed her family's reliance on traditional foods. They no longer eat fish from the area, and, when they hunt for moose, they assess the health of the animal and examine its liver in an attempt to avoid eating contaminated meat.

"We're in a situation right now where we don't have any access to our traditional lands. It's all been uprooted. Our special spiritual places and our places our families used to gather are no more," says L'Hommecourt. "Our connection to the land and our special places has been severed. It's a daily life of knowing what we have lost, and what we are still losing today, because encroachment of the oil industry is never-ending."

Crude oil mined in Alberta's tar sands is piped to BP's Whiting, IN, refinery, where it is processed into mixed xylenes *(page 31)*. This is piped to Indorama's Decatur, AL, facility, where it is manufactured into the PTA *(page 25)* that is used by Indorama facilities to make PET plastic resin *(page 15)*. PET resin is then made into beverage bottles, some of which may be purchased by The Coca-Cola Company. *(For the full picture of Coke's chemical supply chain, see page 43.)*

Box 18. The Footprint of Athabasca Tar Sands[239]

Alberta, Canada

Production Capacity

Produces 3 million barrels of oil per day,[240] making it the top exporter of crude to the US. It's also been called the "world's most destructive oil operation."[241]

Toxic Chemical Releases[242]

- Toxic and carcinogenic chemicals in tailings ponds include ammonia, benzene, cyanide, phenols, toluene, polycyclic aromatic hydrocarbons, arsenic, copper, and sulfates.[243]
- Refining of tar sands crude releases higher levels of nitrogen oxides, VOCs, and heavy metals to the air than conventional crude. These air pollutants are linked with asthma, emphysema, other lung diseases, and birth defects.
- Communities downstream from tar sands mines have higher-than-anticipated cancer rates.[244]
- Leaks have been detected in pipelines connecting Alberta's tar sands to refineries like BP in Whiting, IN, contaminating water and soil along the pipeline corridor.[245]

Disparities

- Activists and members of Indigenous communities argue that Alberta's tar sands oil development is in violation of the treaty[246] and inherent rights[247] of the Denesulinè (Chipewyan), Woodland Cree, Métis, and other Indigenous peoples of the Athabasca watershed.

Alberta Tar Sands, © iStockphoto

Greenhouse Gas Emissions

- Per barrel, tar sands extraction and processing results in 14% more greenhouse gas emissions than other crude oils used in the US.[248]
- Overall, the emissions of the Alberta tar sands industry exceeds the total greenhouse gas emissions of New Zealand and Kenya combined.[249]

Accounting for the Chemical Footprint of a Plastic Bottle

The **chemical footprint** of a plastic beverage bottle starts with fossil carbon extraction, grows through the several stages of petrochemical refining and manufacturing that go into producing PET plastic resin, and continues after the bottle's use and disposal. The **chemical supply chain** portion of this footprint begins with resource extraction and culminates with a beverage bottle ready for filling. The pollution, environmental justice, and climate change impacts of the PET plastic bottle chemical supply chain in North America are summarized below.

Plastic bottles drive about 25% of global demand for PET plastic.[250] The **Coca-Cola Company, one of the world's largest consumers of PET plastic bottles, buys more than 125 billion PET bottles per year globally.**[251] That's more than 20% of the worldwide demand for PET plastic beverage bottles.[252]

Through its reliance on plastic bottles, Coca-Cola alone consumes almost 6% of all PET plastic produced in the world (see Appendix H for calculations). This market share means that Coca-Cola should bear responsibility for about 6% of the known hazards of PET plastic across its chemical supply chain. Some of the hazards of the PET supply chain in the US are summarized in Table 4.

These hazards and Coke's market share are the reason that The Coca-Cola Company should lead the market in reducing the chemical footprint of its PET plastic bottles.

Table 4. Impacts of PET Plastic Across the US Chemical Supply Chain[253]

HEALTH	
Toxic Releases	211.5 million total pounds of toxic chemicals are released to air, water and land across the PET plastics supply chain in North America.[254]
Ethylene oxide	More than 50% of production of EtO is driven by PET plastic demand.[255] 6 of the top 10 industrial air emitters of EtO in the US are PET supply chain facilities.
1,4-Dioxane	4 of the top 5 industrial dischargers of 1,4-dioxane to water and sewage plants in the US are PET resin plants (and 8 of the top 12).[256] 4 of the top 10 industrial air emitters of 1,4-dioxane in the US are PET resin plants (and 8 of the top 14).[257]
Cobalt	Major source of cancer risk from chemical plants that produce PTA for PET. [258]
Antimony	Independent testing found 40% of PET-plastic-bottled beverage samples tested in the US exceeded the California Public Health Goal for antimony in drinking water. [259]
Benzene	Co-produced and released during production of mixed xylenes including PX for PET.
JUSTICE	
Environmental Racism	57% of PET supply-chain chemical plants in the US are in communities where the proportion of residents of color exceeds the national average.
Income inequality	83% of PET supply-chain chemical plants in the US are located in communities where the proportion of residents who are low income exceeds the national average.
Population Wide	79% of municipal waste incinerators in the US are located in communities where at least 25% of the population are people of color or at least 25% of people live below the federal poverty rate.[260] One study found 50% higher exposure to antimony experienced by Latinx and Black consumers compared to white consumers in the US.[261]
CLIMATE	
Fossil Resource Use	More than 99% of PET plastic is made from fossil carbon from oil and gas, both nonrenewable
Greenhouse Gas Emissions	8.8 million metric tons annual emissions from the North American PET supply chain, in tons of CO^2 equivalents.[263]

BP refinery in Whiting, IN
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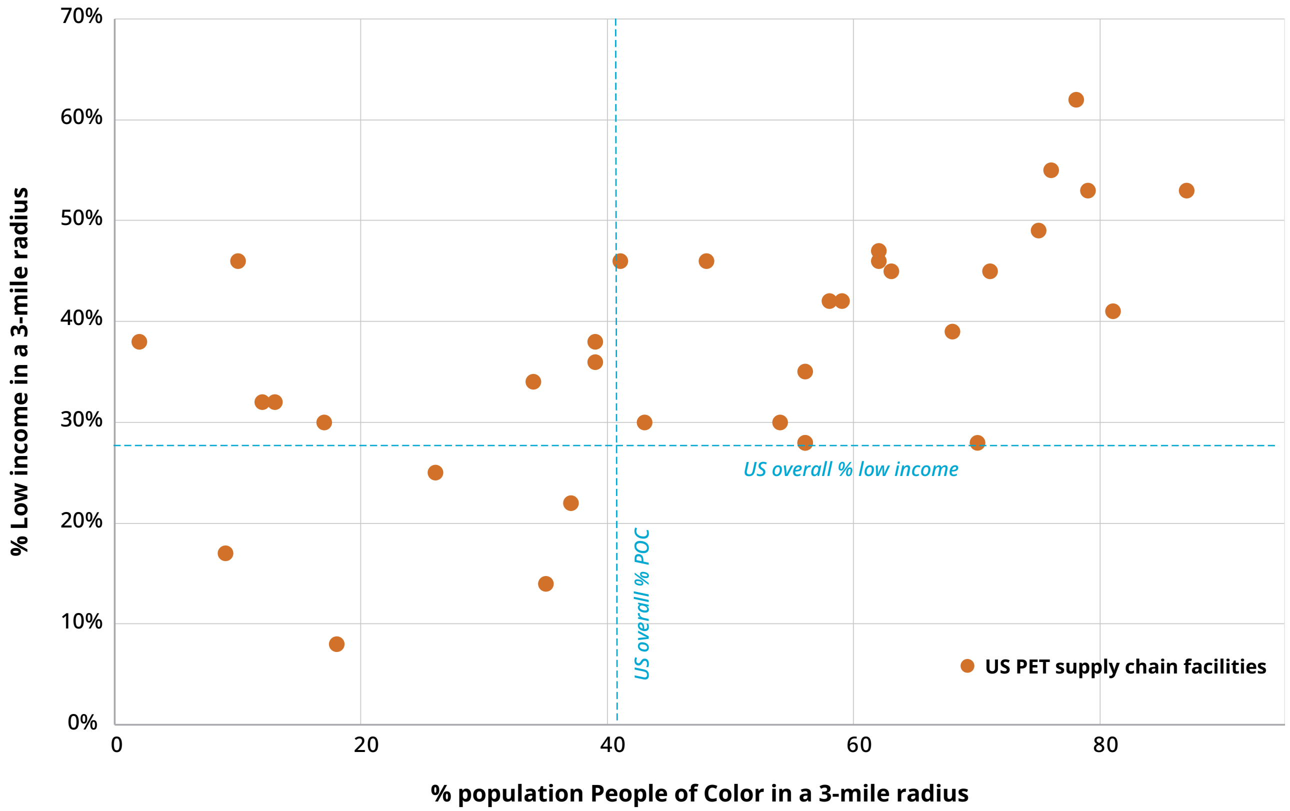
Figure 3. Demographics of PET Supply Chain Fenceline Communities

Points represent communities in a 3-mile radius around industrial facilities in the US PET plastic supply chain in the United States. Demographic data from EJScreen and US Census. See appendix A for data sources.



Conclusions and Recommendations

A simple, seemingly benign item like a plastic bottle doesn't just contain your favorite beverage. That bottle also embodies all the harm accrued by making it, from resource extraction through chemical manufacturing and plastic production. Chemicals in the plastic may leach into the beverage the bottle contains and may be a source of pollution after disposal. This cumulative burden of a plastic bottle tends to fall disproportionately on the most vulnerable groups, including communities of color, lower income people, children, and workers.

This analysis of the chemical footprint of a plastic bottle has broader implications. The methods applied support the following general conclusions, which should be applied to other uses of petrochemical plastics.

Assessing the **chemical footprint** of a plastic bottle—or any product or packaging material—provides a powerful tool for characterizing the often-hidden toxic chemical hazards to human health and the environment that are inherently associated with the production and use of everyday goods.

Pollution inset images: © iStockphoto

Bottle image: Photo by nerea arance from Pexels: https://www.pexels.com/photo/a-clear-plastic-bottle-in-blue-background-11860559/

Brenda Hampton at the Tennessee River. © Maya Rommwatt

"We're all impacted by [petrochemical pollution]. A lot of people have the attitude 'As long as it's not in my backyard I'm ok.' But what they don't understand is that this contamination is a worldwide problem."

BRENDA HAMPTON, Concerned Tennessee River Resident, Environmental Activist and Educator

Mapping the **chemical supply chain** of a product is a critical step toward understanding its chemical footprint. This mapping allows for characterization of the process flow across each stage of chemical production leading to the final product and is especially valuable for plastics and other chemically intensive products.

The general lack of **chemical hazard assessments** presents a barrier to fully assessing a product's chemical footprint. Known hazards, such as evidence that a chemical causes cancer, are easy to profile. But for too many substances, known hazards have not been systematically assessed using the GreenScreen® for Safer Chemicals or a similar method. In many cases, critical data gaps on hazards remain.

Implementing **safer solutions** will reduce the chemical footprint of a product and better protect the health of people and the planet. Solutions range from eliminating unnecessary uses of plastics and toxic chemicals to substituting with safer chemicals or more sustainable materials.

RECOMMENDATIONS

Market leaders and the federal government are in the best position to reduce the chemical footprint of a plastic bottle.

The Coca-Cola Company and other beverage brand owners should reduce the chemical footprint of their plastic bottles by taking these actions:

1. Immediately require PET resin suppliers to end all use of cancer-causing **antimony** and **cobalt** compounds as processing aids or additives in the production of PET plastic resin used for bottles;
2. Require PET resin suppliers to achieve zero discharge of cancer-causing **1,4-dioxane** to all drinking water sources as soon as practicable;
3. Require upstream chemical suppliers for PET plastic to virtually eliminate all air emissions of cancer-causing **ethylene oxide** as soon as practicable;
4. Offset **environmental injustice** by investing in community-based programs that benefit residents who live near plants along PET chemical supply chain;
5. By 2025, assess the hazards of **all chemical substances** used or produced to make PET plastic using the GreenScreen® for Safer Chemicals and disclose the results publicly;
6. By 2030, replace at least 50% of plastic bottles with reusable and refillable containers that are GreenScreen Certified™ for reusable food service; and
7. By 2040, phase out all use of virgin fossil PET plastic in favor of safer solutions, including more just and sustainable materials.

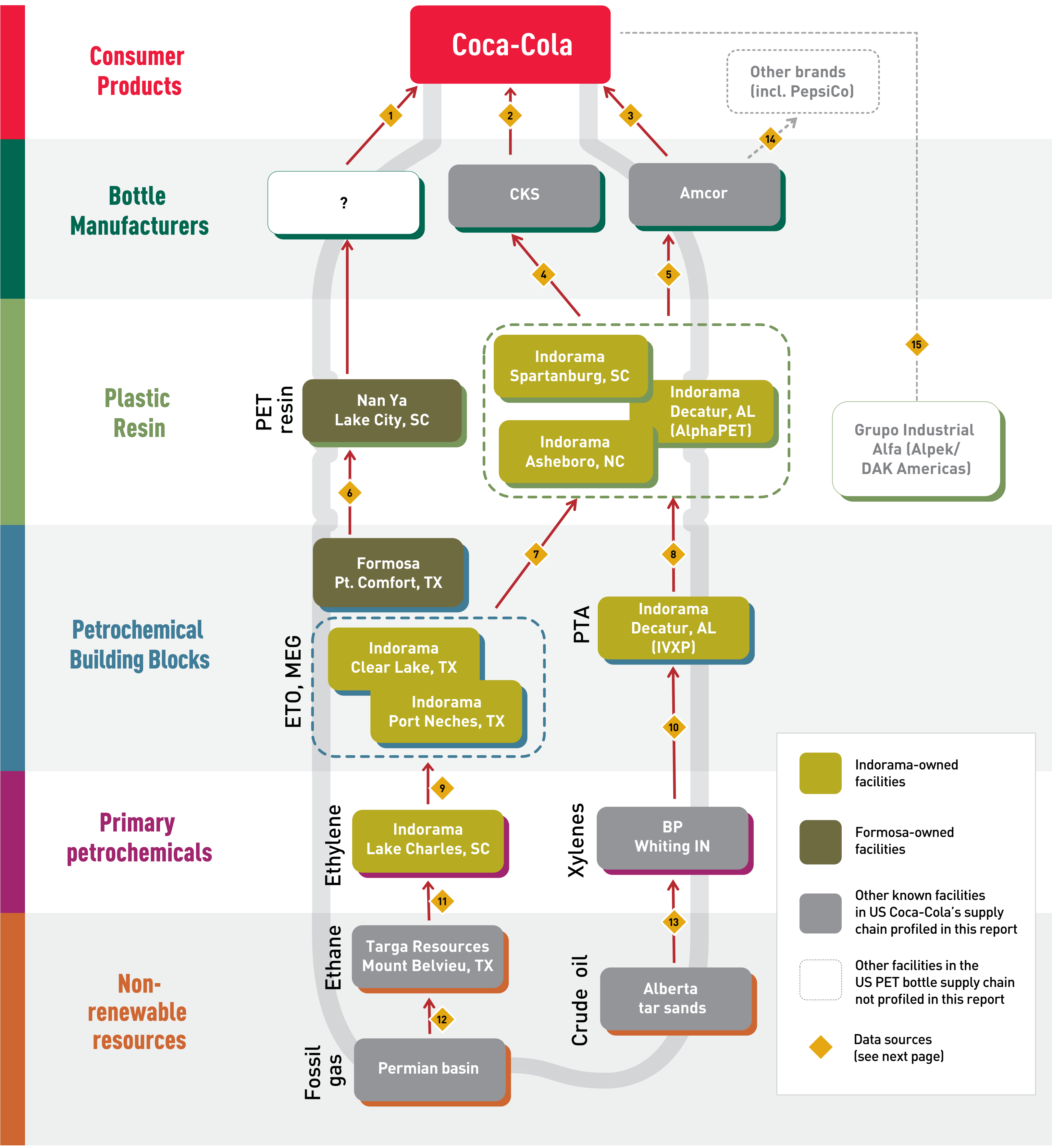
The **US EPA** should continue to lead by acting to:

- Strengthen its proposed Hazardous Organic NESHAP rule to further reduce **air emissions of ethylene oxide** to achieve a greater than 90% reduction in population cancer risk for the more than 3 million predominantly Black and Brown residents that will still face serious excess cancer risk greater than one in one million if the rule is adopted as proposed;
- Determine that **1,4-dioxane in drinking water** poses an unreasonable risk to human health in the risk evaluation soon to be issued under the Toxic Substances Control Act. This action should trigger risk management proposals to achieve zero discharge of 1,4-dioxane from PET plastics production plants.

The **US Food and Drug Administration** should use its food safety authority to:

- Declare that **antimony in food and beverages** is an unauthorized adulterant that requires immediate action by the PET plastics, beverage, and packaging industries to replace its use with safer alternatives by a date certain.

Figure 4. The Coca-Cola Company's US Chemical Supply Chain



Footnotes/Sources for Figure 3. The Coca-Cola Company's US Chemical Supply Chain

#	Connection	Note: this figure and the associated table do not constitute either a comprehensive list of every suspected connection between The Coca-Cola Company and its upstream suppliers or a comprehensive list of all references. Rather they include a subset representing high-confidence connections based on reputable industry, news, and peer-reviewed sources.
1	Nan Ya to Coca-Cola	NanYa names Coca-Cola as a customer. Wren, David. "SC manufacturer's plan to fill wetlands for warehouse has environmentalists fuming." The Post and Courier, South Carolina. May 21, 2022. https://www.postandcourier.com/business/sc-manufacturers-plan-to-fill-wetlands-for-warehouse-has-environmentalists-fuming/article_62e03d26-d6c1-11ec-9804-e3caa30e27d2.html Accessed 3/14/2023.
2	CKS to Coca-Cola	Industry news reports that "The Coca-Cola Co. finished a three-year project with plastic producer Indorama Ventures and converter CKS Packaging to create a new recyclable bottle for its Simply brand juices." Reynolds, Matt. "Coca-Cola's Simply Orange More Sustainable, Still Structurally Sound." AutomationWorld. Date Unknown. https://www.automationworld.com/industry/beverage/article/13375860/cocacolas-simply-orange more-sustainable-still-structurally-sound. Accessed 11/23/2022.
3	Amcor to Coca-Cola	Amcor Website and annual reports name Coca-Cola as a customer. Amcor: Smart, Sustainable Packaging. Digital Report 2021. Available online. https://issuu.com/businessreviewusa/docs/bro_amcor_march2021. Accessed 11/22/2023.
4	Indorama to CKS	See #2.
5	Indorama to Amcor	Interview with Amcor's CEO includes a statement that Indorama Ventures (IVL) is a PET supplier to Amcor. EnquiStock. "In-Depth – Supply constraints to benefit plastic producers like IVL with footprints in the US" Thai Enquirer [Online]. August 30, 2021. https://www.thaienquirer.com/31904/in-depth-supply-constraints-and-higher-margins-in-the-west-are-likely-to-benefit-ivl/. Accessed 3/14/2023.
6	Formosa to Nan Ya	Nan Ya Plastics corporation webpage notes that the Formosa Point Comfort plant provides MEG to Nan Ya Lake City's PET operations. https://www.npcam.com/nj-sc/AAAAA-02.htm Last modified Aug 2021. Accessed 3/12/2023.
7	Indorama MEG producers to PET producers	Indorama's report notes integration among PX, PTA, ethylene, EtO, MEG, and PET resin producers. Indorama Ventures (IVL). "IVL Firmly On Track: BP Amoco Chemical's Decatur – 8th Highly Complementary Acquisition Since Jan 2015" January 7, 2016. http://www.chemwinfo.com/private_folder/Uploadfiles2016_January/IVL_acq_BP_PTA_Psent.pdf Accessed 3/14/2023.
8	Indorama Decatur PTA to PET producers	Indorama's PTA production in Decatur supplies to Indorama PET resin producers. "IVL Completes Acquisition of BP Alabama Petrochem Complex Adds about 1.8 million tonnes of Aromatic, PTA and Specialty business in USA" April 1, 2016. https://www.indoramaventures.com/en/updates/other-release/157/ivl-completes-acquisition-of-bp-alabama-petrochem-complex-adds-about-18-million-tonnes-of-aromatic-pta-and-specialty-business-in-usa Accessed 3/14/2023. 2. See also source for #7.
9	Indorama Lake Charles to Indo. MEG producers	See #7.
10	BP Whiting to Indorama Decatur	Indorama's report notes pipeline integration with BP Whiting refinery to supply PX. Same source as #7.
11	Targa to Indorama Lake Charles	Indorama press release reporting long-term agreement for its feedstock supply in Lake Charles from Targa Resources' ethane. "IVL Signs long-term Gas Cracker Feedstock deal in the USA" Indorama Ventures. December 12, 2016. https://www.indoramaventures.com/en/investor-relations/newsroom/press-releases/164/ivl-signs-long-term-gas-cracker-feedstock-deal-in-the-usa. Accessed 3/14/2023.
12	Permian to Targa	Targa website reports NGL transport from the Permian Basin to its Mont Belvieu storage facility via the Grand Prix Pipeline. "Targa - Logistics & Transportation Segment." https://www.targaresources.com/operations/logistics-transportation-segment. Accessed 3/13/2023.
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15	DAK/Alpek to Coca-Cola	Coca-Cola names Alpek a "technology partner" in PET bottle innovations. "Coca-Cola, Suntory Cross the 100% Plant-Based Bottle Finish Line" Packaging World [Online]. April 25, 2022. https://www.packworld.com/news/sustainability/article/22171823/cocacola-suntory-debut-100-plantbased-bottles. Accessed 3/11/2023.

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