VINYL CHLORIDE: THE POISON THAT MAKES THE PLASTIC

Considerations for the EPA's Evaluation of Vinyl Chloride Under the Toxic Substances Control Act

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Cover photo: Following the draining and burning of vinyl chloride after the Norfolk Southern train derailment in East Palestine, Ohio, members of the Ohio National Guard's 52nd Civil Support Team prepare to enter an incident area to assess and monitor public facilities for any potential remaining hazards with a lightweight inflatable decontamination system (LIDS, Feb. 7, 2023. Image courtesy of U.S. Air National Guard, Capt. Jordyn Craft, Ohio National Guard Public Affairs via Flickr.

I. Introduction: Background and Context

It has been known for decades that vinyl chloride is a human carcinogen and liver toxicant, but it has remained in widespread use despite its dangers. In December 2023, the U.S. Environmental Protection Agency finally announced that it was considering whether to review the risks posed by vinyl chloride under the Toxic Substances Control Act (TSCA). EPA Administrator Michael Regan has until December 2024 to decide whether to designate vinyl chloride as a TSCA high-priority chemical: the first stage of a multi-year process that could lead to a ban, phase-out, or significant restrictions on its use.

This summary report is based on the "TSCA Technical Report: Exposure to Vinyl Chloride" prepared by Material Research L3C and on comments submitted to the U.S. Environmental Protection Agency (EPA) by Beyond Plastics, Earthjustice, and Toxic-Free Future. It documents a wide array of human exposures to vinyl chloride, a known acute toxicant and carcinogen. These include exposures from releases of vinyl chloride into the air and water in fenceline communities by facilities that manufacture and process vinyl chloride, as well as unplanned releases of vinyl chloride into the environment that are occurring at a rate of more than one per week, some of which are disastrous in scope, such as in East Palestine, Ohio. Some exposures are from drinking water that flows through polyvinyl chloride (PVC) pipes, and from the thousands of sites around the country where vinyl chloride contaminates soil and/or groundwater. Other exposures are from consumer products containing vinyl chloride. This information was developed to urge EPA to designate vinyl chloride a TSCA high-priority chemical without delay, and then to expeditiously conduct its TSCA risk evaluation of vinyl chloride, and to underscore the urgency of banning this chemical as quickly as possible.

During the forthcoming TSCA process, EPA must specially consider risks from vinyl chloride to groups with greater susceptibility to harm and greater exposure. Groups with ***greater susceptibility to harm*** from exposure to vinyl chloride include fetuses, children, pregnant women, the elderly, and people with certain health conditions, such as liver disease, or whose genetic structure puts them at greater risk of harm from vinyl chloride exposure.

Groups with ***greater exposure*** to vinyl chloride include:

- **Fenceline and environmental justice communities:** The majority of those living near vinyl chloride and PVC plants or disposal facilities are low-income people of color. Among residents within a 3-mile radius of these sites, 63% are people of color, compared to 41% nationwide. Residents of these areas earn an average of $23,747 per capita: 37% below the national average of $37,638. Twenty-seven percent are children, compared to the national average of 22%.[1] Notably, toxic pollution from vinyl chloride manufacture and processing has forced a large proportion of the residents in at least four Louisiana fenceline communities to relocate:[2] Mossville, Reveilletown, Morrisonville, and Plaquemine.[3]
- **Communities along transportation corridors** that are more likely to incur exposures compared to the general population, such as occurred in East Palestine, OH and Paulsboro, NJ.[4]

- **First responders,** including firefighters, police, and others on the scene of accidents involving vinyl chloride or PVC, and firefighters who may be routinely exposed to dioxins and other toxic chemicals when products made of PVC — such as vinyl siding, vinyl windows, vinyl flooring, and PVC plastic furniture — burn during building fires.[5]

- **Workers** involved in manufacturing and transporting vinyl chloride, processing it into PVC, fabricating it into PVC plastic products, and cutting and welding PVC pipes.[6]

A. History of manufacturing and regulating vinyl chloride

Vinyl chloride (commonly referred to as vinyl chloride monomer, or VCM) is a highly flammable, explosive, and toxic gas that is the primary building block of polyvinyl chloride plastic (PVC). Vinyl chloride is made from ethylene dichloride, which is made from ethylene gas and chlorine, both of which are toxic in and of themselves.[7]

More than 18 billion pounds of vinyl chloride were manufactured in the United States in 2021, almost triple the amount produced in 1974 (6.8 billion pounds),[8] largely due to the dramatic increase in sales of PVC plastic. PVC and vinyl are used widely in the building and construction industries [siding and roofing, windows and doors, flooring, electrical, and pipes (including drinking water, drainage, irrigation, and sewage)]; for packaging consumer goods; for shoes and clothing; for children's toys; and in medical devices.

Companies make vinyl chloride primarily in the southern U.S., reflecting a significant industry shift from the Northeast and Upper Midwest to fewer but larger manufacturing facilities in the South. Chemical facilities located in Texas produce about 48% of all vinyl chloride, facilities in Louisiana produce 46%, and plants in Kentucky produce 6%.

The toxicity of vinyl chloride has been known for decades. As far back as 1959, chemical industry leaders knew that vinyl chloride posed a threat to factory workers, and by 1969, they knew that it was a threat to beauty salon workers who were exposed to it because it was used as a propellant in hairspray.[9] In 1972, animal studies revealed that vinyl chloride causes angiosarcoma — a rare liver cancer — at half the dose that factory workers were exposed to.[10]

Other scientists' work made similar findings. All the while, chemical industry leaders worked to hide this toxicity information from the public, workers, and government regulators.[11] But by 1973, four workers who had been exposed to vinyl chloride in a BF Goodrich plant in Kentucky had died of angiosarcoma and non-alcoholic cirrhosis of the liver,[12] and the risks posed by vinyl chloride could no longer be ignored.

The federal government classified vinyl chloride as a Group A carcinogen nearly 40 years ago,[13] after recognizing the "substantial probability" that vinyl chloride causes liver cancer in workers in 1974.[14] In 1979, the International Agency for Research on Cancer classified vinyl chloride as a Group 1 carcinogen.[15] In 2000, EPA's Integrated Risk Information System re-confirmed that vinyl chloride is a known human carcinogen by the inhalation route of exposure (breathing), and also found it highly likely to be carcinogenic by the dermal route (skin).[16] Yet, even though authoritative governmental and scientific bodies have known the dangers of vinyl chloride for many decades, the chemical industry has been allowed to continue producing and releasing

dangerous amounts of vinyl chloride that affects environmental justice communities, workers, and the environment. These releases include routine vinyl chloride emissions to the air, disposal of vinyl chloride waste to landfills where it can leach into groundwater, and unplanned releases occurring from "incidents" involving manufacture, storage, as well as shipping.

B. After decades of inaction, the EPA started the process of evaluating and regulating vinyl chloride under TSCA in December 2023.

The known dangers of vinyl chloride were part of the impetus for Congress to pass TSCA in 1976. But the initial version of TSCA "grandfathered" vinyl chloride into commerce without any safety review; and although EPA could have chosen to assess, and then regulate, the risks of this chemical, it never did so.[17] However, the 2016 amendments to TSCA require the EPA, finally, to evaluate the risks of high-priority chemicals already in commerce.[18]

On December 14, 2023, the EPA announced it was beginning the process of "prioritizing" vinyl chloride and four other toxic chemicals for risk evaluation under the TSCA review process.[19] After the year-long prioritization process, the EPA may designate vinyl chloride as a "**high priority substance**." If EPA does this, the agency will begin a five- to seven-year process involving a comprehensive risk evaluation. If the EPA finds that vinyl chloride presents "unreasonable risk," it must then adopt a risk management rule that may require a full or partial **phaseout or ban** on the manufacture and use of vinyl chloride, restriction on releases of the chemicals into air and water – even beyond what is allowed by permits issued under other laws – and/or restrictions on occupational exposure levels that are stricter than permitted by OSHA.

Throughout the TSCA review and regulation process, the EPA must consider the risks presented by vinyl chloride from "cradle to grave," taking into account all of the ways that people are exposed to this substance. In deciding whether to designate vinyl chloride as "high priority," and then in determining whether vinyl chloride presents "unreasonable risk," the EPA must evaluate known and foreseeable risks resulting from all of vinyl chloride's uses (such as in industrial settings and consumer products), as well as when it is released into air and water as pollution during manufacturing, processing, and distribution in commerce, including as a result of its disposal. The EPA's risk analysis must give special consideration to populations that are at greater risk of harm from vinyl chloride, due either to greater exposure or greater susceptibility (or both) — including workers, children, and fenceline communities. If a chemical is determined to present "unreasonable risk" — whether to the general population or to a subpopulation identified by the EPA as being at greater risk — the EPA must regulate the chemical.

TSCA requires the EPA to solicit information from the public about any chemical for which it has initiated the prioritization process. In response to the EPA's request for information about vinyl chloride, on March 18, 2024, Earthjustice, together with Beyond Plastics and Toxic-Free Future, submitted a comment letter and an accompanying technical report to the EPA.[20] The technical report was researched and written by Materials Research L3C (MRL). The summary report you're now reading summarizes MRL's findings (the "technical report"), as well as the specific recommendations for further investigation that the three groups made to the EPA in the March 18 letter (the "comment letter"). The technical report and comment letter make the case that exposure to vinyl chloride is widespread, with fenceline communities and workers bearing the brunt.

II. Exposures to Vinyl Chloride: Findings and Recommendations

Throughout the prioritization, risk evaluation, and risk management process, the EPA must consider the risks posed by vinyl chloride under its "conditions of use." Conditions of use is a legal term in TSCA that means the known, intended, or reasonably foreseen circumstances under which vinyl chloride is manufactured, processed into PVC plastic or other products, transported, used, and disposed of.

Findings: The technical report documents that large quantities of vinyl chloride are released into the air as part of the known and intended conditions of use of this substance, as well as during "reasonably foreseen" incidents that occur during the manufacturing, processing, and distribution of vinyl chloride by rail and water. Unplanned releases are termed "incidents," whether they are relatively minor or disastrous, and are tracked via reporting to various government agencies and databases. The technical report contains a full list of 966 reported incidents between 2010 and 2023 — **an average of one incident every 5.3 days**.[21]

Our recommendations to the EPA are compiled at the end of this report; references to each recommendation follow the various sections.

A. Routine air releases of vinyl chloride

Routine air releases of vinyl chloride from daily operations at vinyl chloride and PVC plastic manufacturing facilities subject plant workers and community residents to exposure from inhalation. According to data reported to the EPA's Toxics Release Inventory (TRI), total U.S. air releases of vinyl chloride have averaged around 500,000 pounds per year since 2010.[22] This number is likely understated (per a different EPA database, more than 850,000 pounds were released into the air in 2017).[23] While 49 different facilities have reported releasing 1 pound or more of vinyl chloride during that period, the 12 facilities shown in the table at right are responsible for 82% of all air releases.

Top air emitters of vinyl chloride by location and type of manufacturing plant, 2010-2022

State	Company	City	Vinyl chloride monomer (VCM)	Polyvinyl chloride plastic (PVC)
Kentucky	Westlake	Calvert City	✓	✓
Illinois	Orbia	Henry		✓
Mississippi	Westlake	Aberdeen		✓
New Jersey	Orbia	Pedricktown		✓
Louisiana	Shintech	Plaquemine	✓	✓
	Westlake	Geismar	✓	
	Shintech	Addis		✓
	Formosa	Baton Rouge	✓	
	Westlake	Westlake	✓	
	Westlake	Plaquemine	✓	✓
Texas	Shintech	Freeport		✓
	Formosa	Point Comfort	✓	✓

Source: see Technical Report, III.C. Vinyl Chloride Air Releases from Manufacturing VCM and Processing VCM Into PVC.

The Westlake plant in Calvert City, Kentucky, is the nation's leading source of vinyl chloride air pollution, often emitting more than 100,000 pounds per year. Local residents and workers have increased cancer risks,[24] and air concentrations of vinyl chloride exceed cancer risk screening levels at an elementary school just 1.5 miles away.[25] The EPA's recent fenceline monitoring near the Westlake site found that people in that community face greatly elevated cancer risks from vinyl chloride and other chemicals emitted from that vinyl chloride operation.[26] Westlake also releases significant quantities of vinyl chloride at its other plants in Louisiana and Mississippi.[27]

See recommendation 1 at end: Consider real-world risk for fenceline communities

See recommendation 6 at end: Consider subpopulations at greater risk

See recommendation 9 at end: Visit sites with high vinyl chloride exposure

B. Exposures from leaks, spills, fires, and explosions

People can be exposed to vinyl chloride from contaminated water, soil, and air at manufacturing plants, storage facilities, and ports, and from full-blown chemical disasters at plants and on railways. According to reports submitted to the U.S. Coast Guard's National Response Center and local news stories, there have been 966 unplanned vinyl chloride "incidents" between 2010 and 2023: *an average of more than one per week.* Some examples of exposure incidents:

1. **Vinyl chloride and PVC manufacturing facilities** were the sites of 930 incidents from 1964 to 2022. Eight separate explosions and accidents killed 14 people and injured 120.[28] Some notable examples:

    - **Raritan, New Jersey:** An accidental fall against a valve led to a vinyl chloride fire at the Tenneco Polymers PVC manufacturing facility in 1969.[29] Two workers were killed, 38 were injured, and 30 homes were evacuated.[30] A 1972 explosion at the same facility injured three workers.[31]

    - **Fitchburg, Massachusetts:** A 1980 explosion at the Great American Chemical PVC plant injured two people and "sen[t] noxious fumes throughout the area."[32]

    - **Illiopolis, Illinois:** A 2004 release of vinyl chloride ignited a major explosion at the Formosa Plastics PVC plant, killing five workers and seriously injuring four. Fires burned for days and forced an evacuation of the community.[33]

Vinyl Chloride Explosion, Formosa Plastics, Illiopolis, April 23, 2004.
Photo credit: U.S. Chemical Safety Board.

- **Westlake, Louisiana:**
    - 2012: A fire at the Axiall vinyl chloride plant released an estimated 15,000 pounds of vinyl chloride, as well as ethylene dichloride.[34] One worker was sent to the hospital for observation.[35]
    - 2013: A fire at the Axiall plant released 2,400 pounds of vinyl chloride. One person was hospitalized, and 27 others sought medical treatment. Five thousand people were told to shelter in place, and 130 personnel were evacuated from the adjacent PPG Silicas plant.[36]
    - 2021: A piping leak at the North Plant released 14,869 pounds of vinyl chloride. During the event, a caller to the National Response Center said, "...the release is not secure at this time." Three hundred people sheltered in place.[37]
- **Louisville, Kentucky:** On March 4, 2023, an agitator valve broke at the Lubrizol chlorinated PVC manufacturing facility, resulting in a fire. The building and an unknown number of people outside the facility were evacuated.[38]

An additional 36 incidents took place on roads and railroads, and at ports, waste management facilities, and chemical manufacturing plants. A sampling of these events:

2. Railways

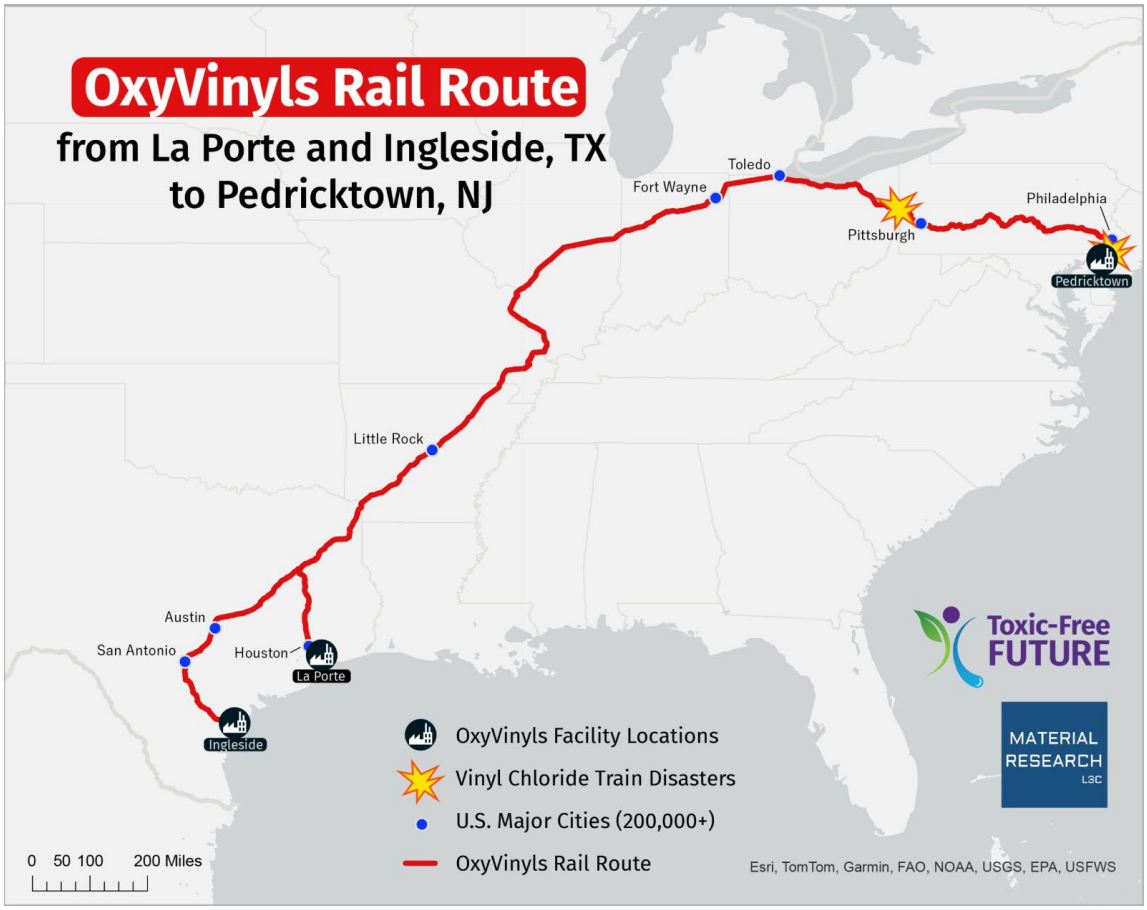
- **Paulsboro, New Jersey:** Seven cars from a Conrail train en route to an Occidental plant in Pedricktown derailed on a bridge over Mantua Creek on November 30, 2012. One of the three tank cars containing vinyl chloride was breached and released about 20,000 gallons of vinyl chloride. More than 250 residents and emergency responders visited hospital emergency departments as a result of the vapor-cloud engulfing the scene, and 680 people living within a 27-block area were evacuated for seven days.[39] Thousands of other area residents were exposed at levels "likely high enough to cause reversible, short-term health effects."[40]
- **East Palestine, Ohio:** On February 3, 2023, a Norfolk Southern train derailed at 8:54 pm local time in East Palestine, Ohio,[41] causing a fire that stretched for half a mile.[42] Five of the derailed cars were carrying approximately 115,000 gallons of vinyl chloride from OxyVinyls' La Porte vinyl chloride plant enroute to its PVC plant in New Jersey.[1] On February 6, officials in charge of the still-smoldering scene directed that the vinyl chloride be drained into ditches and ignited, asserting that this was done to avert a more catastrophic explosion. The massive blaze created a giant cloud of toxic pollution which lingered for hours in stagnant air over an area straddling Ohio and Pennsylvania. More than 2,000 residents within a 1-mile radius were evacuated,[43] and local schools were closed for a week.[44] Leaking liquid

[1] Additional chemicals released in the derailment included phosgene, hydrogen chloride, carbon dioxide, carbon monoxide, n-butyl acrylate, 2-ethylhexyl acrylate (2-EHA), ethylene glycol monobutyl ether, and isobutylene. Sources: "East Palestine Train Derailment, Frequently Asked Questions." Pennsylvania Environmental Protection Agency, November 6, 2023; Letter to Mr. Gernand, Norfolk Southern Railway Company, from U.S. Environmental Protection Agency Re: East Palestine Train Derailment Site Norfolk Southern Rail Line, East Palestine, Columbiana County, Ohio Site/Spill Identifier (SSID): C5XR General Notice of Potential Liability," February 10, 2023.

chemicals and firefighting runoff both made their way into the soil and into multiple creeks feeding the Ohio River, potentially killing "more than 43,000 fish, amphibians, crustaceans and other aquatic animals."[45]

In the aftermath of the incident, local residents also reported serious health concerns. Vinyl chloride released from the derailment and fire led to contamination in at least sixteen states with a population of 110 million people.[46]

In a recent report, Toxic-Free Future and Material Research L3C estimated that "up to 36 million pounds of vinyl chloride travels on more than 200 rail cars across nearly 2,000 miles of U.S. railways at any given moment." The report also estimated that more than 3 million people live within 1 mile of these train routes (the evacuation radius for a major accident) from Texas to New Jersey, including about 670,000 children in more than 1,500 schools.[47]



3. **Roads:** On April 10, 2023, a truck carrying contaminated soil from the train derailment in East Palestine rolled over and released "an unknown quantity of vinyl chloride and butyl acrylate from storage totes… The released materials went onto the soil and asphalt."[48]

4. **Ports and vessels:** Several vinyl chloride release incidents have occurred at chemical loading docks and aboard refrigerated chemical tankers in U.S. waters near the cities of Corpus Christi, Lake Charles, and Baton Rouge. Below is a sampling of vinyl chloride releases reported to the U.S. Coast Guard's National Response Center and in news outlets:[49]

- **Ingleside/Corpus Christi Bay, Texas**:
    - **July 10, 2008:** First responders, chemical plant workers, and ship crewmembers aboard the *Venus Gas* were exposed to vapors from a leak.
    - **August 5, 2011:** A caller reported a release "onboard a chemical tanker vessel."
    - **November 12, 2018:** A caller reported a release "from a leaking loading line" aboard a vessel.

- **Plaquemine, Louisiana | August 23, 2010:** A caller reported a release at the Dow Chemical dock facility on the Mississippi River at river mile 209.9.

- **Westlake/Calcasieu River, Louisiana | February 16, 2011:** A caller reported a release from a vapor line and a liquid line onboard a vessel.

5. **Reasonably foreseen catastrophic incidents:** While many of the unplanned releases, spills, leaks, and fires described above have caused serious harm — contaminating communities' air and drinking water, causing cancers and other chronic diseases, and injuring or killing people — it is easy to foresee how any one of those incidents could have been far worse. For example, if the February 2023 train derailment in East Palestine had happened in a densely populated city like Philadelphia or San Antonio instead of a rural part of Ohio, and if the fires on the train — which traveled for more than a mile while burning before derailing[50] — had ignited one of the five vinyl chloride tankers and caused a chain reaction of explosions (as happened in 1974 in Climax, Texas),[51] many people could have been killed. Mass casualty events could also occur around facilities where vinyl chloride is stored in high volume, such as Shin-Etsu's vinyl chloride manufacturing and processing facility in Plaquemine, Louisiana, where as much as 28 million pounds of vinyl chloride is on hand at any given time.[52]

   Given the frequency of such incidents, the reactivity of vinyl chloride, and the densely populated areas where vinyl chloride is manufactured, used, and transported, catastrophic releases that result in large-scale injuries and casualties are not only possible but also reasonably foreseen. Given the flammability of vinyl chloride, it's also likely that first responders, firefighters, and residents may be exposed to the toxic combustion byproducts of vinyl chloride during major incidents.

See recommendation 2 at end: Evaluate risks from reasonably foreseen incidents
See recommendation 4 at end: Include byproducts of burning vinyl chloride and PVC

C. Vinyl Chloride Releases from Waste Management

Vinyl chloride is released into the environment from the direct discharge of industrial plant waste into water, hazardous waste incinerators, hazardous waste dumps, landfills, and municipal solid waste landfills. Releases can happen during a reported incident or over a period of time. Examples include:

1. **Waste incinerators:**
   Most vinyl chloride and ethylene dichloride (EDC) waste is burned on the premises of plants that produce or use them. In 1996, the industry captured an estimated 14,493,189 pounds of EDC/vinyl chloride sludge from wastewater and burned most of it in on-site incinerators.[53]

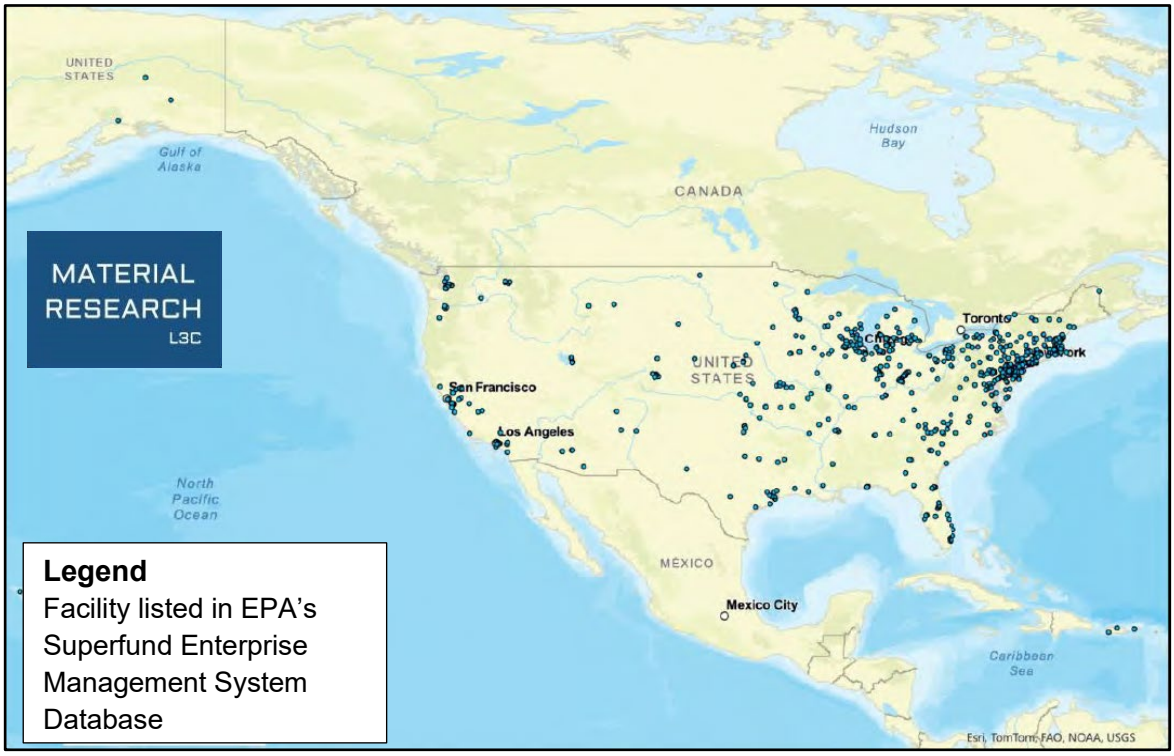
In the EPA's Toxic Release Inventory (TRI), on-site waste incineration is embedded in the categories of "waste treatment" and "energy recovery." TRI data indicates that as much as 27.4 million pounds of vinyl chloride were burned in on-site incinerators in 2022 — about twice the amount burned in 1996.[54] While most of the vinyl chloride is burned in incinerators, some is released in stacks and valves, and toxic byproducts including dioxins and furans are created in the process. Dow Chemical's hazardous waste incinerator in Midland, Michigan, accidentally released vinyl chloride on 17 separate occasions between 2010 and 2018.[55]

2. Landfills and Superfund sites

- **Landfills**: Vinyl chloride wastes are disposed of in landfills near the facilities that produce them. Some are ordinary municipal solid waste (i.e., household garbage) landfills; others are designated hazardous waste landfills. Historically, landfill dumping operations have resulted in widespread contamination of groundwater:
    - **Stauffer Chemical, Delaware**: Nine years after the closure of the municipal waste (simple garbage) Tybouts Corner Landfill in New Castle, Delaware, the EPA found that Stauffer Chemical's PVC plant had dumped more than 15,000 tons of PVC production waste, including vinyl chloride, there. Contamination from the landfill was "threatening the drinking water for up to 100,000 people," reported the Philadelphia Inquirer.[56]
    - **Chemical Waste Management, Louisiana:** The hazardous waste landfill owned by Chemical Waste Management in Sulphur, Louisiana, near Lake Charles, received 161.6 pounds of vinyl chloride waste in 2022 from several different vinyl chloride and PVC manufacturers.[57]
- **Superfund sites:** As of early 2024, there are at least 699 federally listed Superfund sites with vinyl chloride contamination of the soil, soil gas, sediment, surface water, groundwater, debris, and buildings.[58] While some of this comes from the degradation of other chlorinated chemicals, vinyl chloride and PVC plants create their own substantial legacy pollution.
    - **Multiple companies, New Jersey:** Price's Pit in Egg Harbor Township, New Jersey, was the burial site for 9 million gallons of toxic wastes from 49 companies, resulting in the contamination of ground water with vinyl. Residents who depend on public and private well water have complained of headaches, nausea, skin rashes, and seizures, and 37 households switched from well to utility water.[59]
    - **Formosa, Delaware:** Although Formosa Plastics' Delaware PVC plant has been a Superfund site since 1983 due to vinyl chloride and other chlorinated substances contaminating groundwater, the plant only closed in 2018. About 50 people live within 1 mile of the site.[60]
- **Landfill and Superfund site breakdown products:** Other chlorinated chemicals that are deposited in landfills and Superfund sites can break down into vinyl chloride in the environment. A significant amount of the vinyl chloride in landfills and Superfund sites is present as a result of the degradation of other chemicals into vinyl chloride. For example,

the Agency of Toxic Substances and Disease Registry (ATSDR) of the Centers for Disease Control and Prevention (CDC) reports that vinyl chloride "can enter groundwater after being produced as a byproduct during the bacterial degradation of trichloroethylene, tetrachloroethylene, and 1,1,1-trichloroethane."[61]

Superfund Sites with VCM Contamination



See recommendation 3 at end: Include degradation products of waste disposal
See recommendation 5 at end: Include ongoing releases from past disposals

3. **Wastewater discharges from vinyl chloride and PVC plants** discharge vinyl chloride-contaminated wastewater directly into waterways or transfer them to off-site management systems. Neighboring chemical plants operate most of these wastewater facilities, and some are publicly owned treatment works (POTWs).

   Major waterways into which vinyl chloride is discharged include the Calcasieu River, Corpus Christi Bay, Delaware River, Houston Ship Channel, Illinois River, Lavaca Bay, Mississippi River, Ohio River, and Tennessee River. Vinyl chloride wastewater discharge reports to the Toxics Release Inventory remain sporadic. Since January 2021, six facilities have been in violation of the Clean Water Act.[62]

   Communities that get drinking water from vinyl chloride-contaminated groundwater or surface waters are at risk of cancer and other health effects. Vinyl chloride in groundwater and soil can seep into people's homes through vapor intrusion. It can also volatilize out of water used for bathing and other household water uses leading to inhalation exposures.[63]

D. PVC Pipes for Drinking Water

Residual vinyl chloride monomer from PVC plastic pipes is not molecularly bound to the PVC polymer, and it can leach into drinking water, especially when water has sat stagnant in pipes, as a 2011 study reported.[64] In the study, researchers found that vinyl chloride levels tested in the laboratory and in the tap water of consumers' homes reached in the tens of parts per trillion range after a few days, and hundreds of parts per trillion after two years.

While there are safety certifications for PVC pipes, there is a lack of transparency around them, according to Andrew Whelton, a drinking water systems expert. "Those certifications are handed out by third-party organizations such as [the National Sanitation Foundation]. The plastics industry manufacturers pay an industry-backed organization to do their testing behind closed doors and issue them certification. There's a deeper systemic problem."[65]

Another problem is that public agencies charged with protecting our drinking water are only required to test for vinyl chloride at the water source *before* it is conveyed via PVC pipes to consumers: not at our taps.

We know that vinyl chloride is released from PVC drinking water pipes under high-heat conditions, such as those that occurred during the Tubbs and Camp wildfires in California, where residual vinyl chloride was detected in drinking water after the fires.[66]

See recommendation 7 at end: Ascertain…exposure from PVC drinking water pipes

E. Consumer Products

Despite its toxicity, vinyl chloride is still present in consumer products, both where it is used as a functional ingredient and where it is present as an impurity in PVC plastic products. Risk from vinyl chloride in any consumer products must be quantified in the EPA's risk evaluation.

- **Functional ingredients:** Vinyl chloride is used as content in some wet-applied coatings, including adhesives, glues, and inks. Some of these types of products contain as much as 25% vinyl chloride.[67]

- **Residual ingredients:** Some vinyl chloride remains as a residual, unpolymerized chemical "entrapped" in PVC plastic pellets. This entrapped vinyl chloride monomer can be released when the pellets are heated:[68] first when they're melted and combined with chemical additives into PVC plastic compounds, and again when the compounds are molded or extruded into vinyl consumer products, from clothing and footwear to carpet backing to pipes that deliver tap water.[69]

that contains more than 1% vinyl chloride

- Products with high concentrations of vinyl chloride include children's products, sometimes at levels far beyond typical residuals. One company, Excelligence Learning Corp., recently disclosed to the states of Oregon, Vermont, and Washington that many of its developmental,

educational toys and accessories for children contain more than 0.1% vinyl chloride. Other product lines, including “Fancy Dress Costumes,” baby cots, and infant stimulation toys contain more than 1% vinyl chloride (10,000 parts per million) in the PVC plastic components of these products.[70]

See recommendation 8 at end: Evaluate risk from consumer products

E. Recommendations

1. **Ensure that the risk evaluation considers real-world fenceline community exposures**: Building on its fenceline monitoring effort in Calvert City, Kentucky — which determined that residents are at a greatly increased risk of cancer from toxic air releases of multiple chemicals from the vinyl chloride manufacturing and processing facility there — the EPA should conduct real-time fenceline monitoring in the vicinity of all 12 of the high-emitting vinyl chloride manufacturing and processing sites around the country. See Table on page 4. The EPA must account for measured data showing levels of exposure to vinyl chloride, in combination with other chemicals fenceline communities are exposed to, in its risk evaluation. At a minimum, the EPA should not rely exclusively on the Toxics Release Inventory for release data, but should develop models that show the true volume and environmental fate of releases. The EPA must also consider the cumulative and synergistic exposure to other chemicals released at or near vinyl chloride sources. For example, many vinyl chloride plants (such as Westlake in Kentucky) also release significant quantities of the hazardous chemical ethylene dichloride (EDC) into the air, another chemical EPA is currently reviewing under TSCA. EPA must consider and evaluate the health risks from these cumulative exposures at vinyl chloride and PVC production and disposal sites.

2. **Evaluate risks from reasonably foreseen incidents**: The EPA must consider leaks, spills, fires, and explosions related to the manufacture, processing, and distribution of vinyl chloride — and resulting exposures — to be “reasonably foreseen” because they are regular and predictable, occurring every 5.3 days on average, and must include the risks from these exposures in its risk evaluation. Also reasonably foreseen is that if vinyl chloride continues to be manufactured, processed, and distributed, there will be a catastrophic event involving vinyl chloride at a manufacturing or processing facility, or in transportation and distribution, where a large population could suffer mass casualties.

3. **Include degradation products of waste disposal:** The EPA’s risk evaluation must account for environmental exposure to vinyl chloride arising from the presence of vinyl chloride in the environment as a result of the breakdown of other chlorinated chemicals.

4. **Include byproducts of burning vinyl chloride and PVC:** Given the flammability and explosiveness of vinyl chloride, the EPA’s risk evaluation should include the reasonably foreseen circumstance that people will be exposed to hazardous combustion byproducts produced when vinyl chloride burns during fires or explosions at plants or along transportation routes. The EPA should also assume that dioxins (which are potent carcinogens and neurotoxicants) will be created and released when vinyl chloride monomer burns in incinerators and uncontrolled settings (such as landfill fires and building fires).[71]

5. **Include ongoing releases from past disposals**: The EPA is required to consider ongoing releases of vinyl chloride resulting from past disposals, meaning that municipal solid waste landfills, hazardous waste landfills, and Superfund sites with vinyl chloride contamination from past disposal should be included in the scope of the risk evaluation if vinyl chloride-contaminated leachate continues to enter groundwater, or contaminated groundwater plumes continues to spread.

6. **Consider subpopulations at greater risk**: The EPA must conclude that a number of subpopulations have either a greater risk of exposure to vinyl chloride, or greater susceptibility to harm from vinyl chloride — or both — than the general population, and therefore must be considered "potentially exposed or susceptible subpopulations" for purposes of the EPA's risk evaluation:

    a. **Subpopulations with greater *risk of exposure* to vinyl chloride** include workers involved in manufacturing and transporting vinyl chloride, processing it into PVC, fabricating it into PVC plastic products, and cutting and welding PVC pipes; fenceline communities and those along transportation routes; and first responders, including firefighters, police, and others on the scene of accidents involving vinyl chloride or PVC, and firefighters who may be routinely exposed to dioxins and other toxic chemicals from burning buildings with vinyl siding, vinyl windows, vinyl flooring, PVC plastic furniture, and related items.

    b. **Subpopulations with greater *susceptibility to harm* from vinyl chloride exposure** include fetuses, children, pregnant women, the elderly, and people with some health conditions, such as liver disease, or people with certain genetic structures.

    The EPA must consider whether these groups face unreasonable risk from vinyl chloride, apart from whether the general population faces unreasonable risk.

7. **Ascertain and incorporate levels of vinyl chloride exposure from PVC plastic pipes that carry drinking water**: The EPA must determine the extent to which vinyl chloride is present in drinking water due to the leaching of residual vinyl chloride from PVC plastic pipes — both under routine conditions and under high-heat conditions, such as wildfires — and must include these exposures in its risk evaluation. EPA is currently providing billions of dollars to local governments to replace lead drinking water pipes and is not providing any guidance on avoiding the use of PVC pipes to replace them. This needs to be addressed immediately, as federal funding is being used by local governments to install PVC pipes.

8. **Evaluate risk from consumer products:** The EPA must consider exposures to vinyl chloride in consumer products, including toys for children and pets; wet-applied adhesives, glues, and inks; clothing and footwear; building materials, including vinyl windows and flooring, electrical cables; PVC and PVDC food contact materials; and so on.

9. **Visit sites where people experience high vinyl chloride exposure**: High-level EPA officials in the TSCA program should visit communities near vinyl chloride manufacturing, processing, and disposal facilities to see their living situations firsthand, and to meet residents, plant workers, and first responders, and hear directly about their experiences living on the fenceline and working in this industry.

NOTES

[1] Page 8-10, "PVC Poison Plastic." Toxic-Free Future, April 13, 2023.

[2] See Technical Report, III.C.2.

[3] "PVC Plastic and Environmental Justice." Toxic-Free Future, April 13, 2023.

[4] See Technical Report IV.B.1: Chronology of Vinyl Chloride Rail Tank Car Incidents.

[5] See Technical Report IV.B.1: Chronology of Vinyl Chloride Rail Tank Car Incidents.

[6] See, for example, Technical Report, III.C. and III.D.4.

[7] Ethylene gas is made from "cracking" ethane gas (extracted by hydrofracking) under high heat and pressure, and chlorine is made by subjecting a brine (salt) solution to a strong electrical current. Both processes create toxic, caustic, or explosive by-products.

[8] See vinyl chloride Technical Report, footnote 29.

[9] "Trade Secrets." PBS documentary by Bill Moyers. March 26, 2001

[10] "Vinyl Chloride: A Case Study of Data Suppression and Misrepresentation." Sass, J.B. *et al. Environmental Health Perspectives.* July 2005.

[11] The multi-decade suppression of toxicity data is detailed (with links to primary source documents) in the article "Dirty Secrets: Vinyl Chloride" by the Environmental Working Group (updated 2023).

[12] "Angiosarcoma of the Liver Among Polyvinyl Chloride Workers -- Kentucky." MMWR 1974;23:49-50, Centers for Disease Control, February 9, 1974. By 2003, 24 workers at the Louisville Goodrich facility had died from angiosarcoma of the liver. Markowitz, Gerald, and David Rosner. "Uncovering a Deadly Cancer: The National Implications of Revelations at the B. F. Goodrich Plant in Louisville." *The Register of the Kentucky Historical Society* 102, no. 2 (2004): 157–81.

[13] "Health Effects Assessment for Vinyl Chloride." Office of Research and Development, U.S. Environmental Protection Agency, Sept. 1984.

[14] "Exposure to Vinyl Chloride: Occupational Safety and Health Standards." Occupational Safety and Health Administration. 39 FR 35890. October 4, 1974.

[15] "Vinyl Chloride." Page 377 in "IARC monographs on the evaluation of the carcinogenic risk of chemicals to humans: some monomers, plastics and synthetic elastomers, and acrolein." (1979), Volume 19. International Agency for Research on Cancer, World Health Organization, February 1979.

[16] "Vinyl chloride; CASRN 75-01-4." Integrated Risk Information System (IRIS) Chemical Assessment Summary." U.S. Environmental Protection Agency | National Center for Environmental Assessment 08/07/2000.

[17] "Legislative History of the Toxic Substances Control Act." Environmental and Natural Resources Policy Division of the Library of Congress for the House Committee on Interstate and Foreign Commerce. December 1976., at 161, 207.

[18] "Prioritization, risk evaluation, and regulation of chemical substances and mixtures." U.S.Code 2023 Title 15 Chapter 53, subchapter i, § 2605(b).

[19] "EPA Begins Process to Prioritize Five Chemicals for Risk Evaluation Under Toxic Substances Control Act." U.S. Environmental Protection Agency news release, December 14, 2023.

[20] "Comment submitted by Earthjustice et al." posted by the Environmental Protection Agency on March 21, 2024.

[21] See Technical Report, II. Major Findings.

[22] See Technical Report, III.C.1. Vinyl Chloride Air Releases, TRI reports, pounds.

[23] U.S. EPA, 2017 National Emissions Inventory (NEI) Data, scroll to Data Queries, search Vinyl Chloride in all sectors (last updated on December 8, 2023).

[24] "Air Monitoring Study near Calvert City Industrial Complex Reveals Increased Emissions Levels." WKMS, January 26, 2024.

[25] "Quality Assurance Project Plan for Volatile Organic Compound Monitoring near the Calvert City Industrial Complex (Category II)." Division for Air Quality, Department for Environmental Protection, Commonwealth of Kentucky, July 2021.

[26] "Calvert City, Kentucky Air Monitoring." U.S. EPA website, accessed April 29, 2024; "Calvert City, Kentucky VOC Air Quality Risk Assessment." U.S. EPA, January 22, 2024; "Calvert City residents seek answers about health concerns from environmental officials over chemical plant emissions." WKMS, February 14. 2024.

[27] "The largest vinyl chloride polluters" in "PVC Poison Plastic: An investigation following the Ohio train derailment of widespread vinyl chloride pollution caused by PVC production." Toxic Free Future, 2024.

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[30] "Tenneco Says Fire Started When Worker Fell Against Valve." *The Courier-News* (Bridgewater, NJ), August 26, 1969.

[31] "Fish Will Benefit from Dam Removal on the Raritan River, Paid for by past Owner of Tenneco Plant in Raritan Twp." *Hunterdon County Democrat* / NJ.Com, January 30, 2011.
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[36] Eagle US 2 LLC, Lake Charles Plant, Risk Management Plan, January 14, 2016, as published by Data Liberation Project.
[37] "Westlake, Lake Charles North," Risk Management Plan, submitted January 10, 2024, as published by Data Liberation Project; National Response Center via SkyTruth Alerts.
[38] National Response Center via SkyTruth Alerts.
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[48] National Response Center via SkyTruth Alerts.
[49] See Technical Report, IV.C.4. Chronology of Vinyl Chloride Vessel Incidents.
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