Releases of Chemicals

Release or disposal of chemical waste into the environment occurs in several ways. Facilities may release chemical waste directly into the air or water or dispose of it on land, or ship (transfer) wastes that contain Toxics Release Inventory (TRI) chemicals to an off-site location for disposal. Release and disposal practices are subject to a variety of regulatory requirements and restrictions designed to minimize potential exposure or harm to human health and the environment.

Facilities are required to report the quantities of TRI-listed chemicals they release into the environment. Evaluating these release data helps to:

- identify potential concerns in communities,
- better understand potential risks chemical releases may pose, and
- identify opportunities for engagement or technical assistance to mitigate potential associated risks.

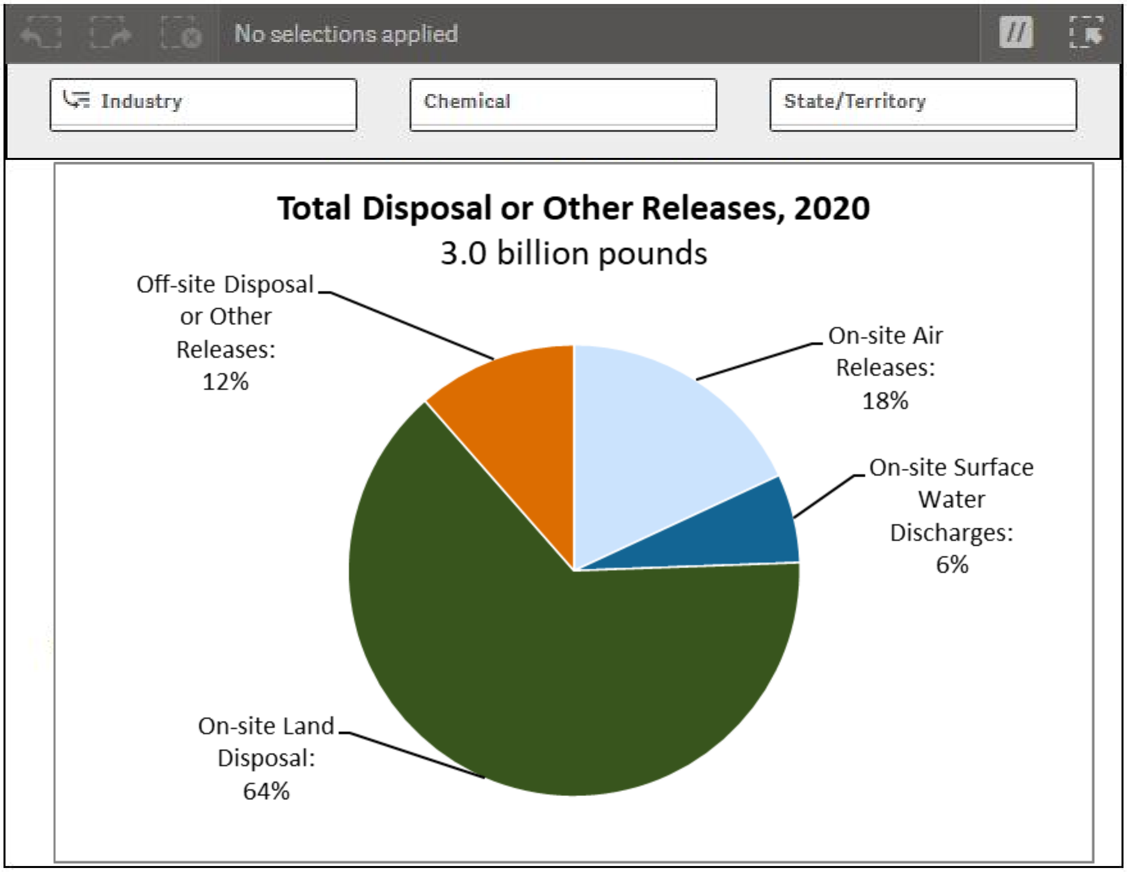
It is important, however, to understand that the quantity of releases is not necessarily an indicator of health impacts posed by the chemicals. Potential risks to human health from releases of TRI chemicals are determined by many factors, as discussed in the section Hazard and Potential Risk of TRI Chemicals.

Use the interactive chart below to explore the 2020 TRI chemical releases by industry sector, chemical, or state/territory. Visit the full TRI National Analysis data visualization dashboard to explore even more information about releases of chemicals.

Helpful Concepts

What is a release?

In the context of TRI, a "release" of a chemical generally refers to a chemical that is emitted to the air, discharged to water, or disposed of in some type of land disposal unit. Most TRI releases happen during routine production operations at facilities. To learn more about what EPA is doing to help limit the release of toxic chemicals into the environment, see the EPA laws and regulations webpage.



2020 Highlights
• Facilities released 3.0 billion pounds of TRI chemicals, a 27% decrease since 2011. • Air releases decreased 34% from 2011 to 2020, driven by reduced air emissions from electric utilities. • 2020 data include data on newly-added per- and polyfluoroalkyl substances (PFAS). Facilities submitted data for 43 distinct PFAS.

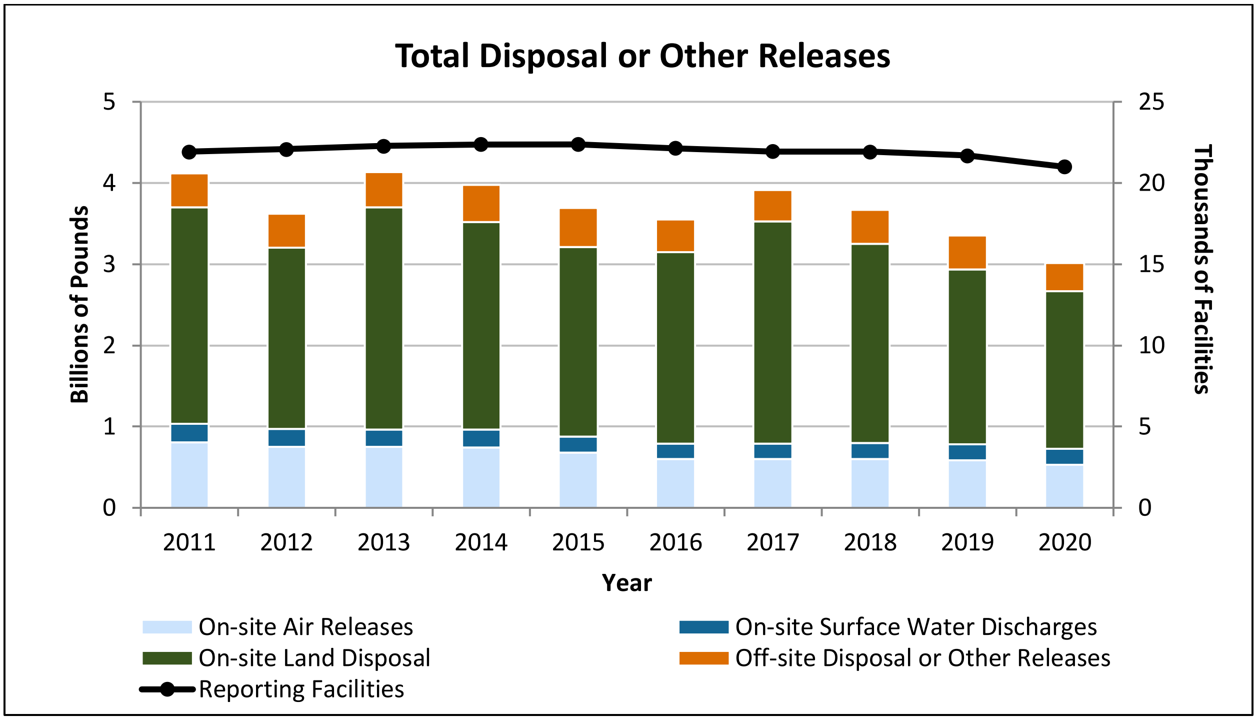
Note that the 2020 TRI data reflect chemical waste management activities that occurred during calendar year 2020, which may have been impacted by the COVID-19 public health emergency as discussed in the Introduction.

TRI Data Considerations

As with any dataset, there are several factors to consider when using the TRI data. Key factors associated with data used in the National Analysis are summarized in the Introduction. For more information see *Factors to Consider When Using Toxics Release Inventory Data*.

Releases Trend

The following graph shows the 10-year trend in total disposal or other releases of TRI chemicals (also referred to as "total releases"). Many factors can affect trends in releases at facilities, including production rates, management practices, the composition of raw materials used, and the installation of control technologies.



Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2011 to 2020:

- Total disposal or other releases of TRI chemicals decreased by 27%.
    - Reduced land disposal from metal mines and electric utilities, as well as reduced air emissions from electric utilities were the most significant contributors to the decline.
- Air releases decreased by 34%, on-site land disposal decreased by 27%, surface water discharges decreased by 13%, and off-site disposal decreased by 16%.
- The number of facilities that reported to TRI declined by 4%.

From 2019 to 2020:

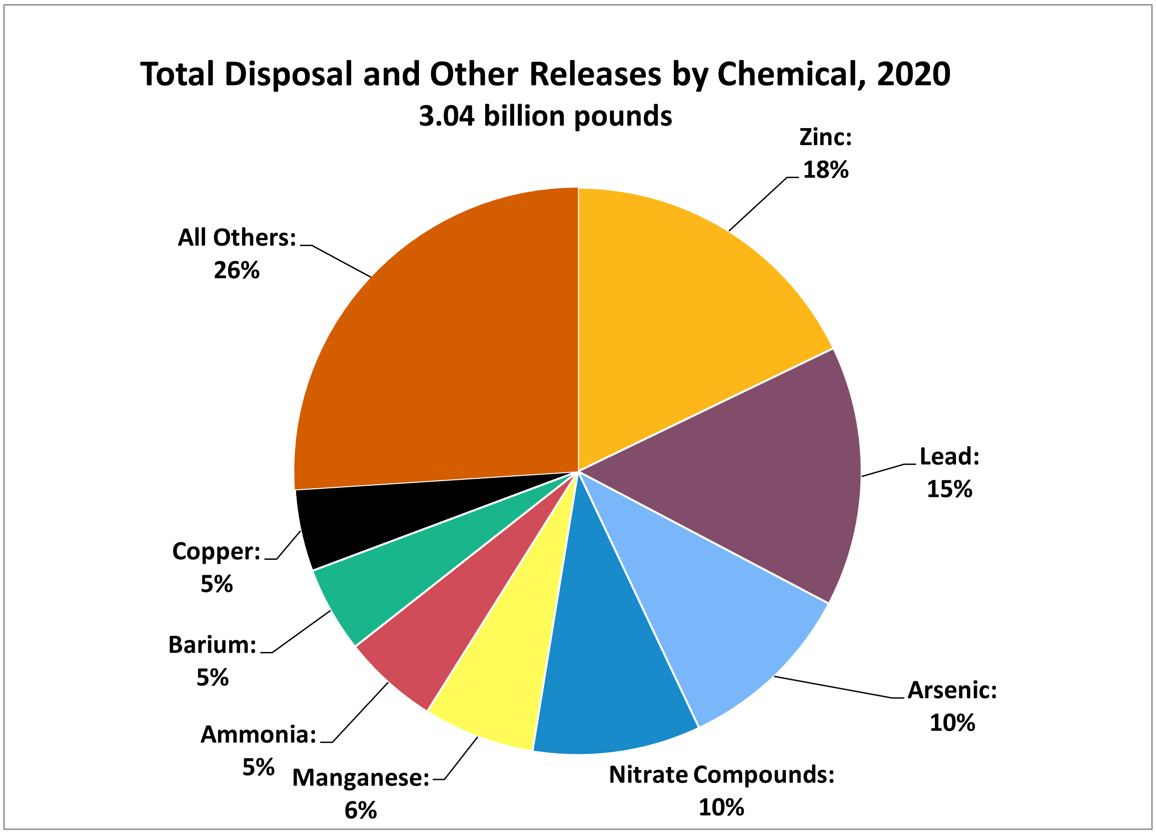
- Total disposal or other releases decreased by 10%, mainly driven by a 10% decrease in land disposal.

- Quantities released into the air decreased by 9%, quantities transferred off site for disposal decreased by 18%, and quantities discharged into surface water decreased by 4%.

Releases by Chemical and Industry

Releases by Chemical

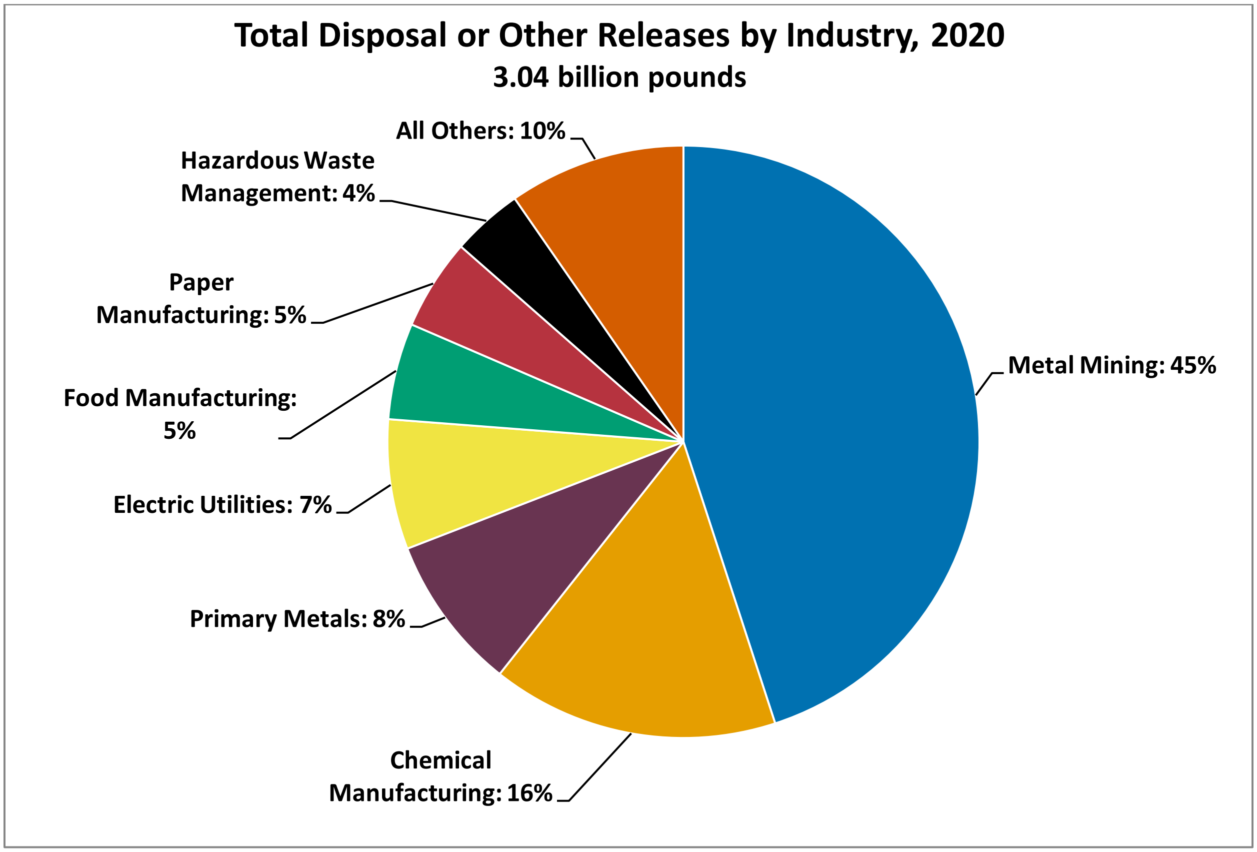
Release quantities of 8 chemicals made up 74% of total releases.



Note: 1) In this figure, metals are combined with their metal compounds, although metals and compounds of the same metal are listed separately on the TRI list (e.g., lead is listed separately from lead compounds).

Releases by Industry

The metal mining sector accounted for 45% of releases (1.37 billion pounds), which were primarily in the form of on-site land disposal. Learn more about this sector in the Metal Mining sector profile.

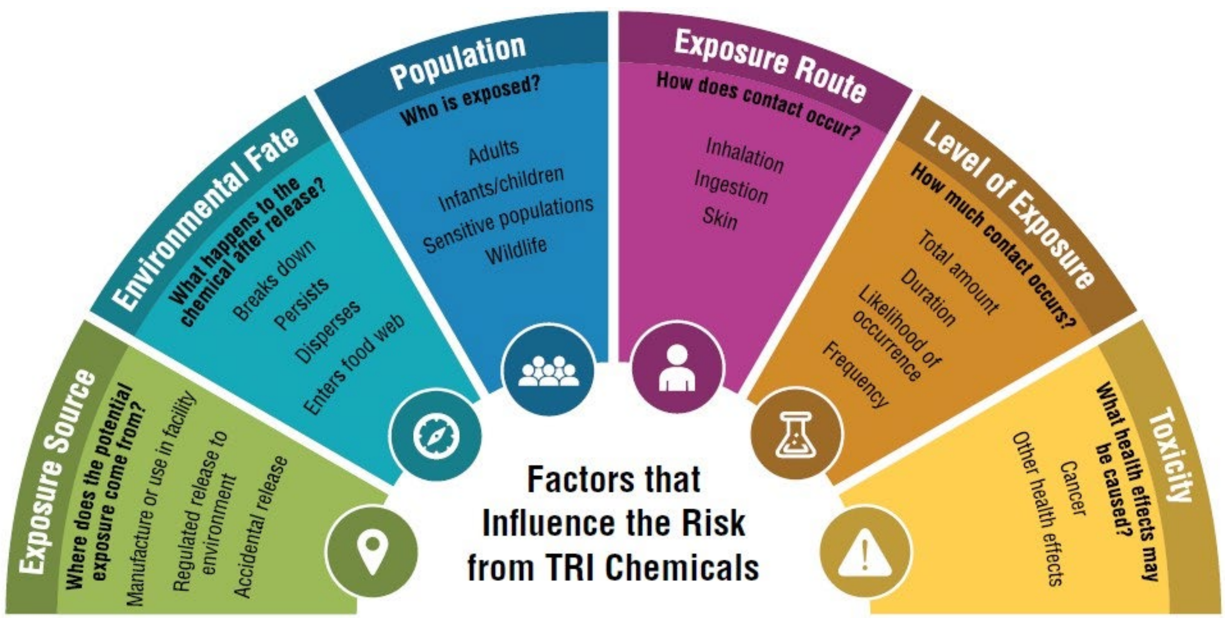


Hazard and Potential Risk of TRI Chemicals

The chemical release data collected and made publicly available in the Toxics Release Inventory (TRI) are reported in pounds, except for dioxin and dioxin-like compounds, which are reported in grams. The quantity of releases is not necessarily an indicator of risk to humans or the environment because TRI data generally cannot indicate the extent of exposure to chemicals. However, TRI data can be used as a starting point to evaluate exposure and potential risks to human health and the environment.

Human health risks that may result from exposure to chemicals are determined by many factors, as shown in the figure below. The TRI database contains some of this information, including what chemicals are released from reporting facilities; the amount of each chemical released; and the environmental medium to which they are released.

Overview of Factors that Influence Risk



It is important to keep in mind that while the TRI database includes information on many toxic chemicals used by industry, it does not cover all facilities, all chemicals, or all sources of releases of TRI chemicals in communities. Other potential sources of TRI chemicals or other chemicals, such as those in exhaust from cars and trucks, chemicals in consumer products, and chemical residues in food and water, are not tracked by TRI.

To provide context on the relative hazards and potential for risks posed by releases of TRI chemicals by facilities, the TRI Program uses EPA's Risk-Screening Environmental Indicators (RSEI) model.

The EPA developed the screening-level RSEI model to characterize trends in the potential hazards and relative potential risks of releases reported to TRI, and to compare and help identify geographic areas, industry sectors, and chemical releases that may be associated with significant potential human health risks. RSEI incorporates information from the TRI together with factors such as the chemical's fate and transport through the environment, each chemical's relative toxicity, and potential human exposure. RSEI model results can be used to help establish priorities for further investigation and to look at changes in potential human health impacts over time.

Helpful Concepts

The ***hazard*** of a chemical is its inherent ability to cause an adverse effect on health (e.g., cancer, birth defects).

Exposure is how a person comes into contact with a chemical (e.g., inhalation, ingestion) and can be described in terms its magnitude (how much), frequency (how often), and duration (how long).

The likelihood that a toxic chemical will cause an adverse health effect is often referred to as ***risk***. Risk is a function of hazard and exposure.

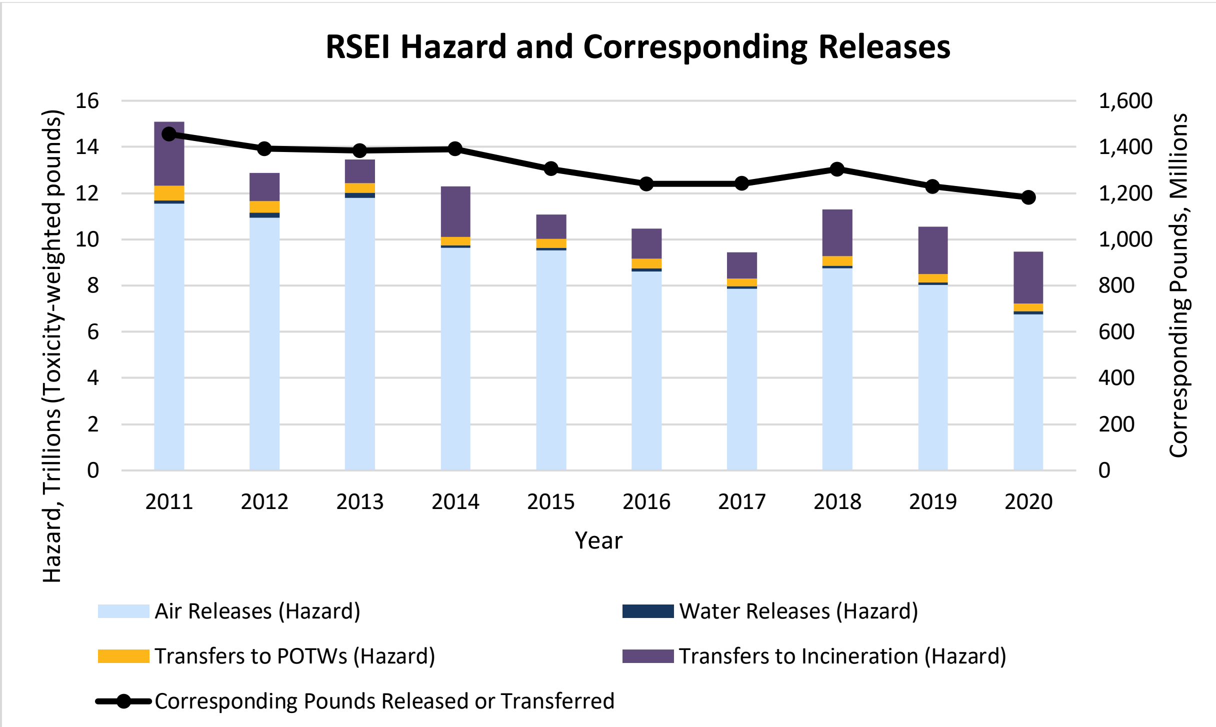
RSEI enables the comparision of relative risk-related results by calculating numerical values that reflect the potential risk-related impacts of TRI chemicals. RSEI produces hazard estimates (RSEI Hazard) and risk scores (RSEI Score) that represent potential harm and relative potential risks to human health following exposure to a TRI chemical:

- **RSEI Hazard** estimates consist of the pounds released multiplied by the chemical's toxicity weight. They do not include any exposure modeling or population estimates.
- A **RSEI Score** is an estimate of relative potential human health risk. It is a unitless value that accounts for the magnitude of the release quantity of a chemical, the fate and transport of the chemical throughout the environment, the size and locations of potentially exposed populations, and the chemical's inherent toxicity.

Both RSEI Score and RSEI Hazard provide greater insight on potential impacts than consideration of TRI release quantities alone. More information on RSEI and its applications are available at EPA's RSEI website.

Hazard Trend

RSEI Hazard estimates provide insight on the potential human health impacts of TRI chemicals beyond consideration of release quantities alone. The following graph shows the 10-year trend in calculated RSEI Hazard values compared to the trend in the corresponding pounds of TRI chemicals released or transferred that are modeled using RSEI.



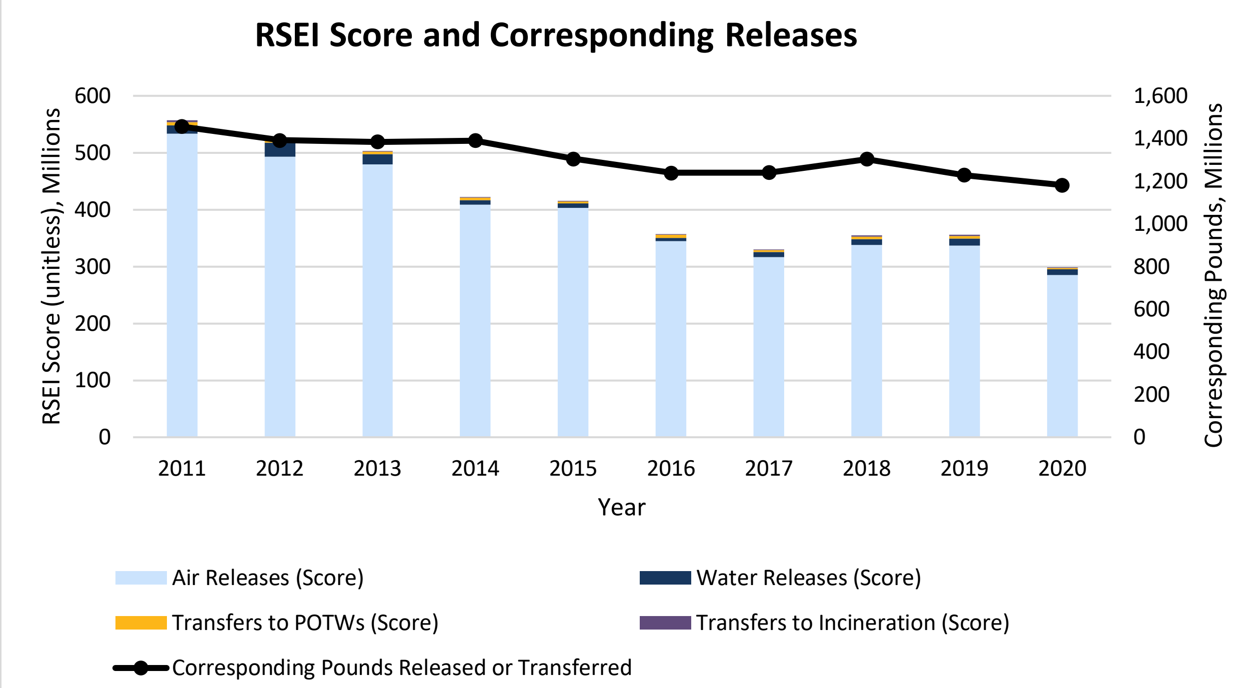
Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented. RSEI Hazard values and corresponding pounds include only on-site air releases (Air Releases), on-site water releases (Water Releases), transfers to POTWs, and transfers to incineration.

From 2011 to 2020:

- The overall calculated RSEI Hazard values for the above waste management activities decreased by 37%, while their corresponding pounds decreased by 19%. This indicates that TRI reporting facilities are not only releasing or transferring fewer pounds of TRI chemicals for these activities but are also releasing or transferring proportionately fewer pounds of the more toxic chemicals.
- The increase in RSEI hazard from 2017 to 2018 was driven by two large transfers to incineration of hydrazine and nitroglycerin, and an increase in air releases of ethylene oxide from one facility in Seadrift, TX.

Risk-Screening Trend

EPA's RSEI model also produces relative risk-related "scores". RSEI Score is a descriptor of relative potential risks to human health from exposure to TRI chemicals following release of the chemicals from facilities. RSEI Scores for a given year can be compared to other RSEI Scores from other years. RSEI Scores are different from RSEI Hazard estimates in that they consider the location of the chemical release or transfer, what happens to the chemical in the environment, and the route and extent of potential human exposure. The following graph shows the 10-year trend in calculated RSEI Score values compared to the trend in the corresponding pounds of TRI chemicals released or transferred.



Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented. RSEI Score values and corresponding pounds include only on-site air releases (Air Releases), on-site water releases (Water Releases), transfers to POTWs, and transfers to incineration.

From 2011 to 2020:

- The overall calculated RSEI Score values decreased by 46%, while their corresponding pounds decreased by 19%. This indicates that TRI reporting facilities are not only releasing or transferring fewer pounds of TRI chemicals for these activities but are releasing proportionately fewer quantities of the more toxic TRI chemicals, and that exposure to the chemicals has decreased. While RSEI Score does not describe what the actual risks from these chemicals are to human health, the overall decreases in RSEI Score indicates the that the overall risks, whatever they may be, have declined from 2011 to 2020.

- Of the types of releases modeled by RSEI, on-site air releases, by far, contributed the most to the RSEI Score values.
    - The decrease in RSEI Score values for on-site air releases was driven in part by large decreases in ethylene oxide from two facilities.

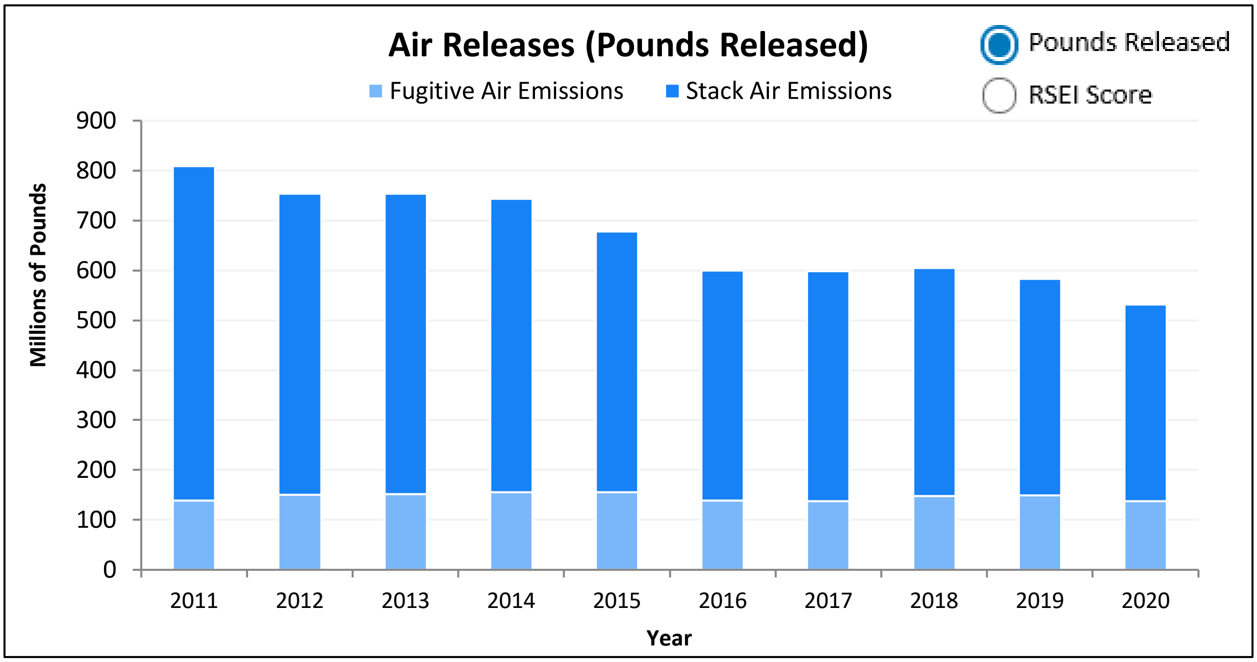
RSEI Dashboard

- Use the EPA's Risk-Screening Environmental Indicators (RSEI) EasyRSEI Dashboard to view the national trend in RSEI Hazard and RSEI Score, or use the Dashboard's filter capabilities to view other RSEI information for a specific chemical or location of interest.

Air Releases

Emissions of TRI chemicals into the air continue to decline, driving decreased total releases. These releases include both fugitive air emissions and stack air emissions.

This graph shows the 10-year trend in the pounds of chemicals released into the air. EPA regulates emissions of chemicals into air under the Clean Air Act, which requires facilities that are major sources of air pollutants to obtain and comply with an operating permit.



Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2011 to 2020:

- Releases into the air decreased by 34% (-277 million pounds).
  - Since 2011, air releases of hydrochloric acid, sulfuric acid, hydrogen fluoride, toluene, and methanol decreased by the greatest quantities.
  - This decrease was driven by electric utilities due to: decreased emissions of hydrochloric acid and sulfuric acid; a shift from coal to other fuel sources (e.g., natural gas); and the installation of pollution control technologies at coal-fired power plants.
    - Note that only those electric utilities that combust coal or oil to generate power for distribution into commerce are covered under TRI reporting requirements. Therefore, electric utilities that shift from combusting coal

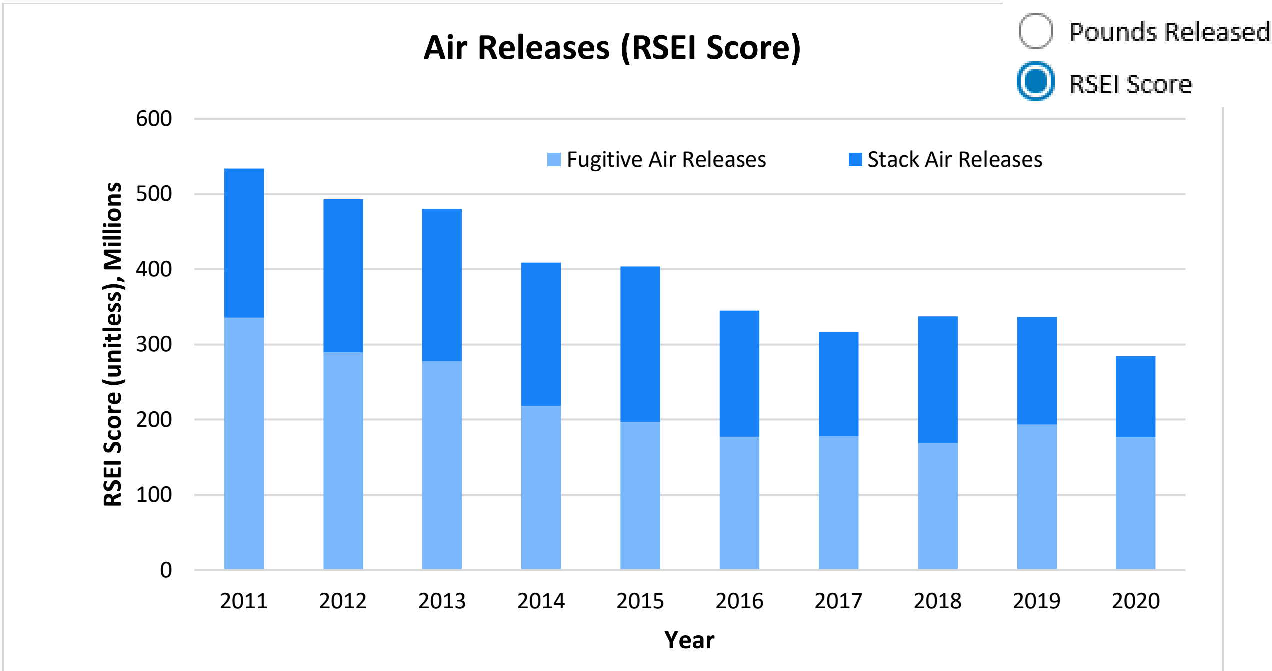
or oil to entirely using other fuel sources (such as natural gas) are not required to report to TRI.

- Air releases of chemicals classified as carcinogens by the Occupational Safety and Health Administration (OSHA) also decreased; see the Air Releases of OSHA Carcinogens figure.
- For trends in air releases of other chemicals of special concern, including lead and mercury, see the Chemicals of Special Concern section.

In 2020:

- The TRI chemicals released into the air in the largest quantities were ammonia and methanol.
- Air releases of TRI chemicals decreased by 9% since 2019.

This graph shows the 10-year trend in RSEI Scores for TRI air releases.

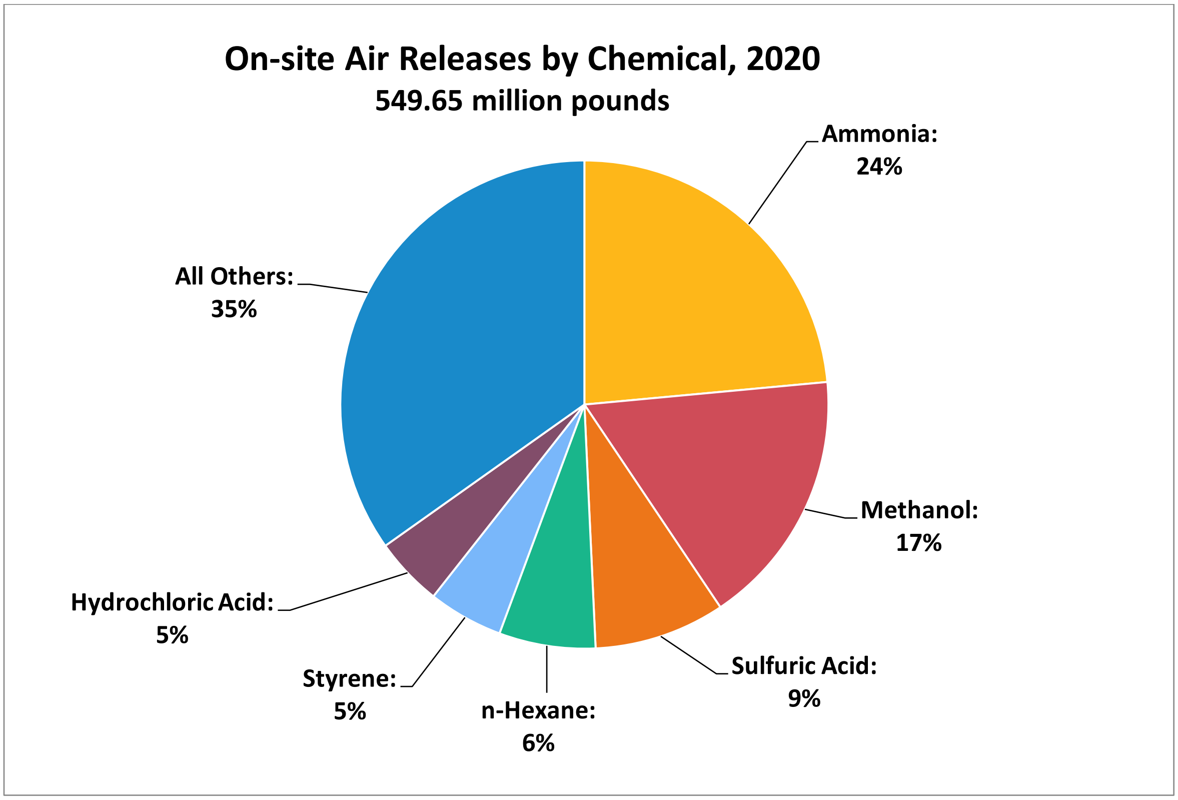


Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

- The chemicals that contributed the most to the RSEI Score values for air releases are ethylene oxide and chromium.
- As shown in the Pounds Released chart, facilities reported considerably more stack air releases than fugitive air releases, but their relative contributions to the RSEI Score values have been similar in recent years, as shown in the "RSEI Score" chart. This is because chemicals released through stacks tend to be dispersed over a wider area than fugitive air releases, resulting in lower average concentrations. As a result, surrounding populations have less chance of being exposed to chemicals released through stacks compared to fugitive emissions.
- For a complete, step-by-step description of how EPA's RSEI model derives and models RSEI Score values from stack air emissions and fugitive air emissions, see "Section 5.3: Modeling Air Releases" in Chapter 5 ("Exposure and Population Modeling") of EPA's Risk-Screening Environmental Indicators (RSEI) Methodology.
- For general information on how RSEI Scores are estimated, see Hazard and Potential Risk of TRI Chemicals.

Air Releases by Chemical

This pie chart shows which TRI chemicals were released into the air in the greatest quantities during 2020.

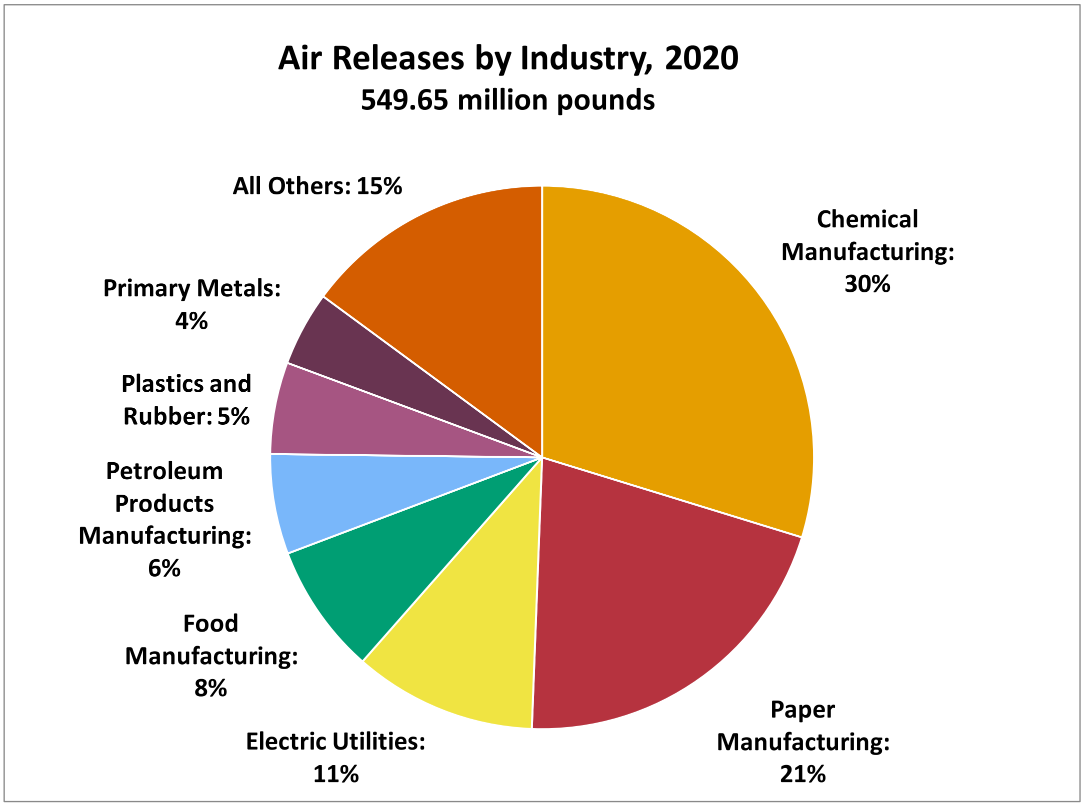


Note: Percentages do not sum to 100% due to rounding.

- Ammonia: Facilities that manufacture nitrogen-based fertilizers accounted for 44% of the ammonia released to air during 2020.
- Methanol: The paper manufacturing sector released the most methanol to air.
- *n*-Hexane: Air releases were primarily from food manufacturing facilities.
- Sulfuric acid and hydrochloric acid: In 2020, 78% of sulfuric acid and 28% of hydrochloric acid air emissions were reported by facilities in the electric utilities sector.

Air Releases by Industry

This pie chart shows the TRI-covered industry sectors that reported the largest quantities of TRI chemicals released into the air during 2020.

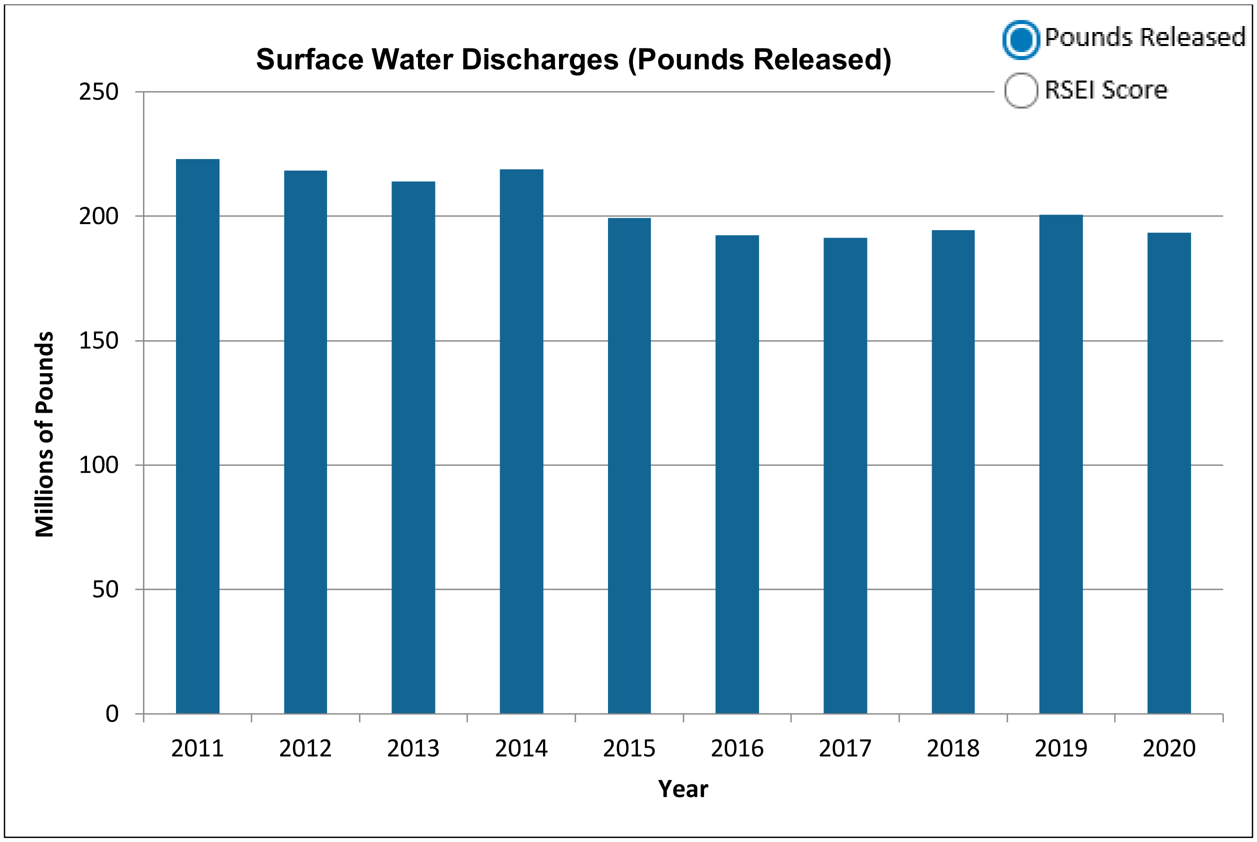


- Facilities in the chemical manufacturing, paper manufacturing, and electric utility sectors accounted for the largest releases of TRI chemicals to air during 2020.
  - Chemical manufacturing: Air releases were mostly of ammonia (46%) and ethylene (10%).
  - Paper manufacturing: Air releases were primarily methanol (65%).
  - Electric utilities: Air releases were mostly of sulfuric acid aerosols (62%).

Water Releases

TRI chemicals released into streams or other water bodies are referred to as "water releases" or "surface water discharges." They are regulated under the Clean Water Act and often require permits under the National Pollutant Discharge Elimination System (NPDES).

The following graph shows the 10-year trend in the pounds of TRI chemicals discharged into water bodies.



Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

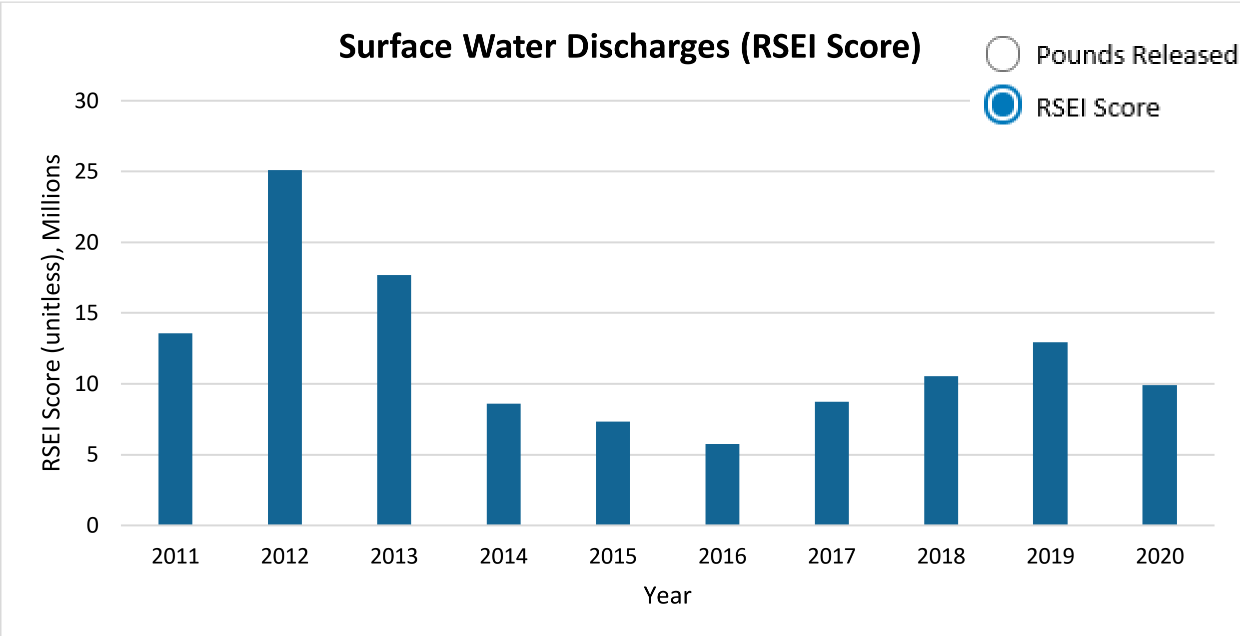
From 2011 to 2020:

- Discharges of TRI chemicals into surface water decreased by 29 million pounds (-13%). Most of this decline was due to reduced releases of nitrate compounds.
    - Nitrate compounds are often formed as byproducts during wastewater treatment processes such as when nitric acid is neutralized, or when nitrification takes place to meet standards under EPA's effluent guidelines. More nitrate compounds are released into the water than any other TRI chemical.

In 2020:

- Nitrate compounds alone accounted for 91% of total TRI water releases.

The following graph shows the 10-year trend in RSEI Scores for TRI chemicals directly released into water bodies.

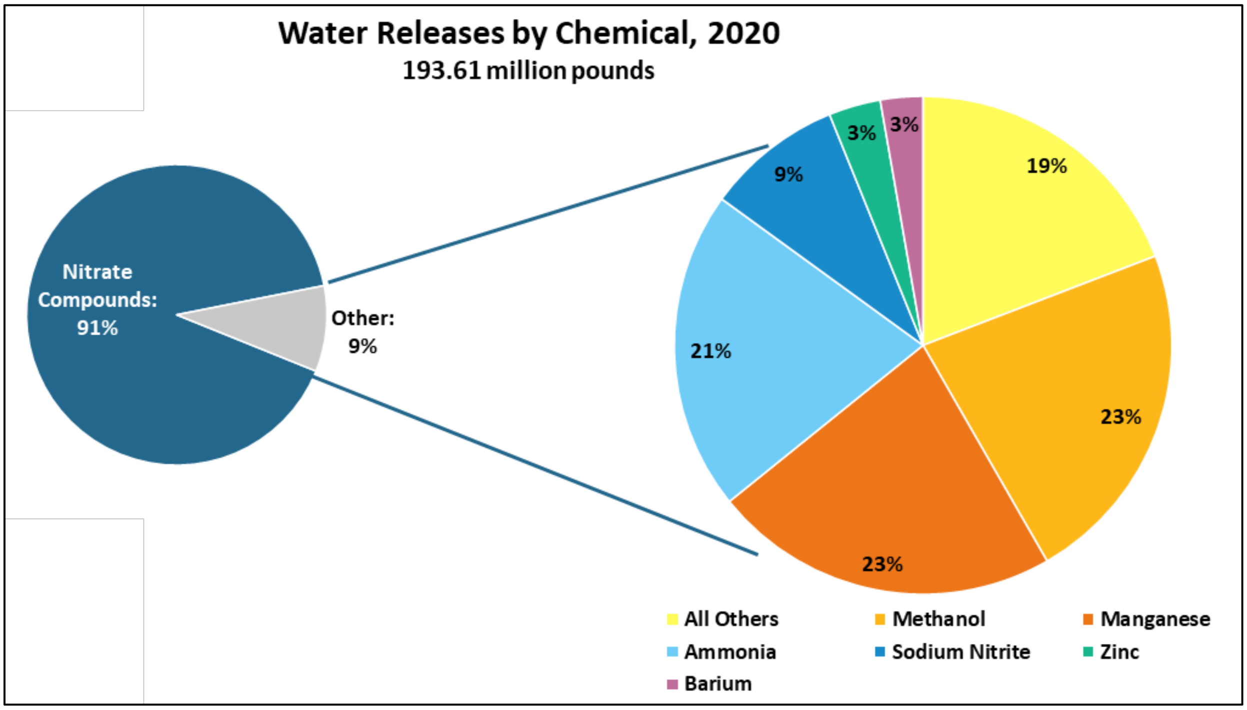


Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

- The biggest chemical contributors to the RSEI Scores for water releases from 2011 to 2020 were arsenic compounds and nitroglycerin.
- The increase from 2011 to 2012 was driven in part by increases in discharges of hexachlorobenzene and nitroglycerin.
- For a complete, step-by-step description of how EPA's RSEI model derives and models RSEI Score values from surface water discharges of TRI chemicals, see "Section 5.4: Modeling Surface Water Releases" in Chapter 5 ("Exposure and Population Modeling") of EPA's Risk-Screening Environmental Indicators (RSEI) Methodology.
- For general information on how RSEI Scores are estimated, see Hazard and Potential Risk of TRI Chemicals.

Water Releases by Chemical

This pie chart shows which TRI-listed chemicals were released into water bodies in the largest quantities during 2020.



Note: 1) In this chart, metals are combined with their metal compounds, although metals and compounds of the same metal are listed separately on the TRI list (e.g., manganese is listed separately from manganese compounds). 2) Percentages do not sum to 100% due to rounding.

- Nitrate compounds accounted for 91% of the total quantity of TRI chemicals released to water in 2020. Nitrate compounds dissolve in water and are commonly formed as part of facilities' on-site wastewater treatment processes. The food manufacturing sector contributed 44% of total nitrate compound releases to water, due to the treatment required for biological materials in wastewater, such as from meat processing facilities.

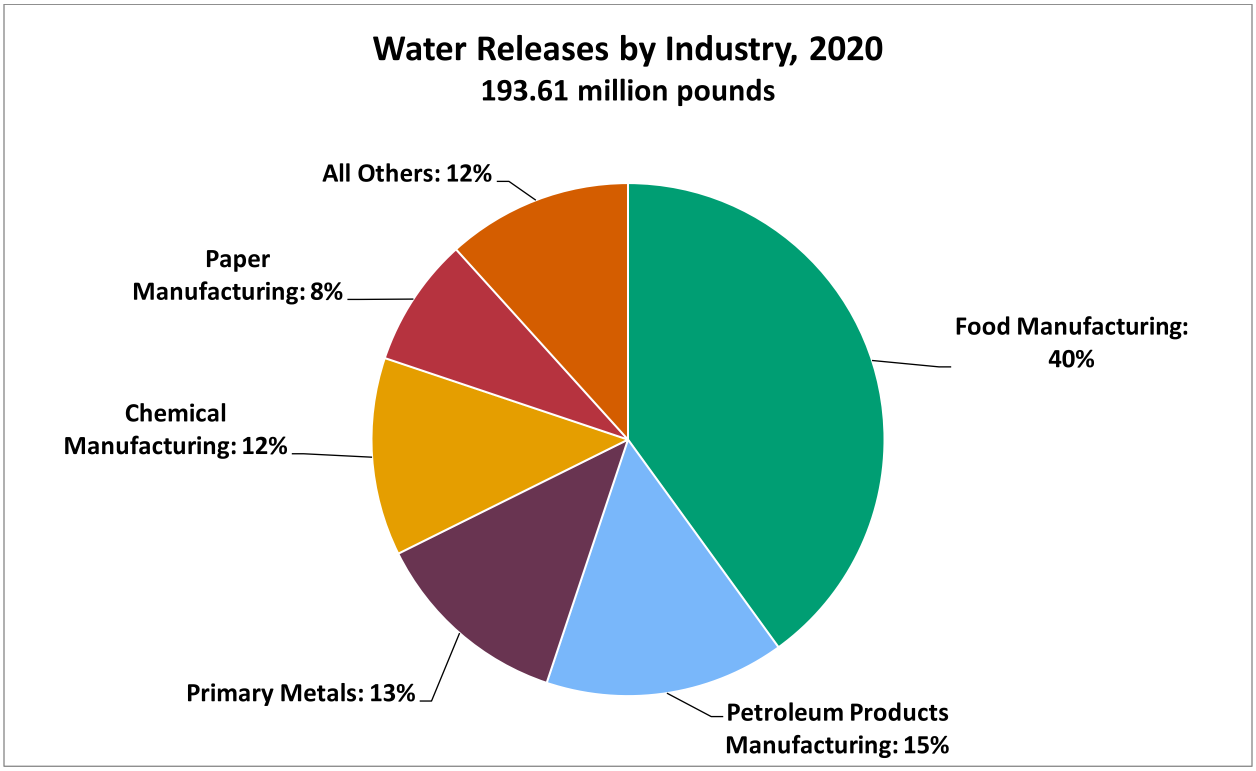
What Are Nitrate Compounds?

Nitrate compounds are a group of chemicals with relatively low toxicity to humans, but in nitrogen-limited waters, nitrates have the potential to cause increased algal growth leading to eutrophication in the aquatic environment. See EPA's Nutrient Pollution webpage for more information about the issue of eutrophication.

- Methanol, manganese compounds, and ammonia were released in the next-largest quantities, and, in terms of combined mass, accounted for 6% of the chemicals released into water.

Water Releases by Industry

This pie chart shows the TRI-covered industry sectors that reported the largest quantities of TRI chemicals released into water bodies during 2020.

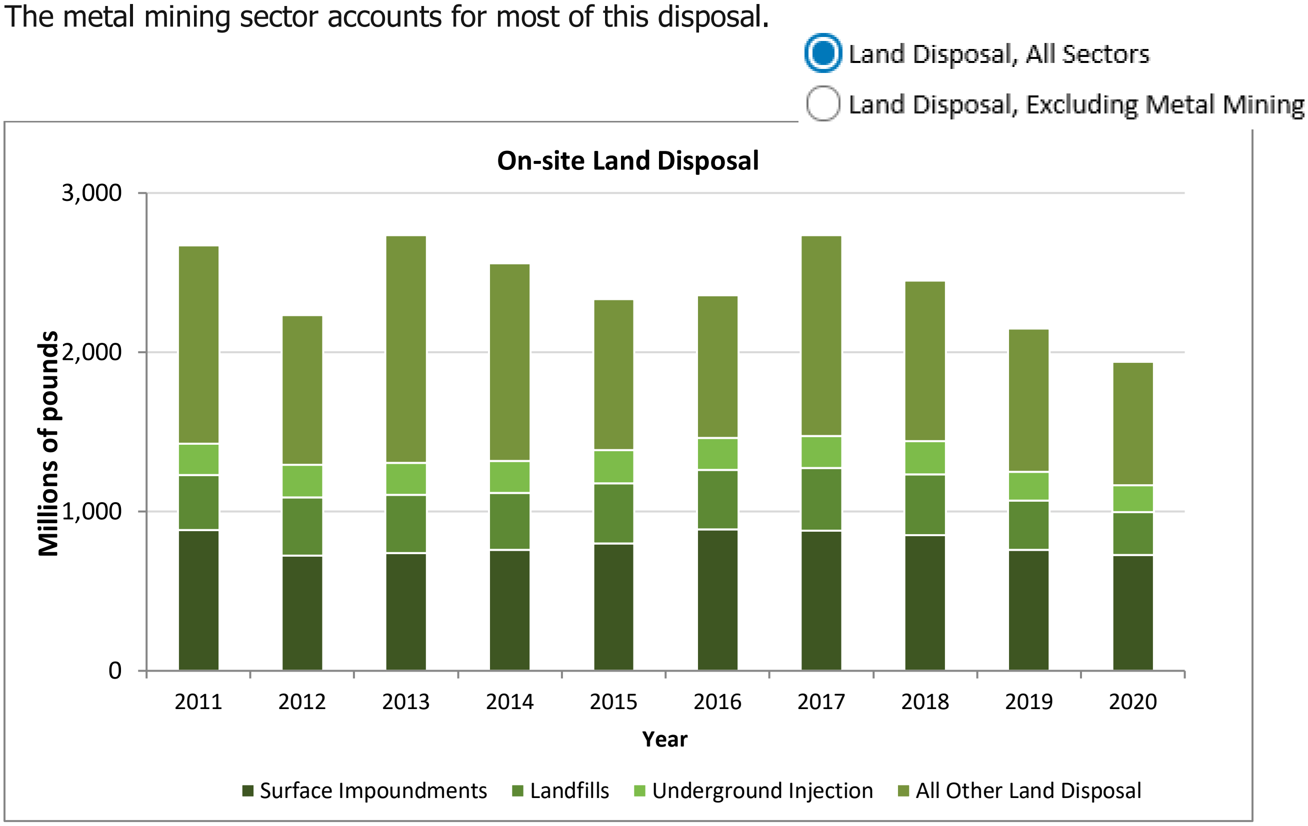


- Facilities in the food manufacturing sector accounted for 40% of water releases of TRI chemicals for 2020 and approximately one-third of annual water releases over the past ten years.
    - Nitrate compounds accounted for 99% of the total quantity of water releases from the food manufacturing sector. Nitrate compounds are relatively less toxic to humans than many other TRI chemicals discharged into surface waters but are formed in large quantities by this sector during wastewater treatment processes due to the high biological content of wastewater.

Land Disposal

Land disposal includes disposal of TRI chemicals in landfills, underground injection wells, surface impoundments, or other types of containment. Land disposal of chemicals is often regulated by EPA under the Resource Conservation and Recovery Act (RCRA). RCRA design standards for landfills and surface impoundments include a double liner, a leachate collection and removal system, and a leak detection system. Operators of these disposal units must also comply with RCRA inspection, monitoring, and release response requirements.

This graph shows the 10-year trend in TRI chemicals disposed of to land on site at facilities. The metal mining sector accounts for most of this disposal.



Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2011 to 2020:

- On-site land disposal has fluctuated over the last ten years.
- The decreases since 2017 were driven primarily by decreases in TRI chemical quantities disposed of on site to land by metal mines.

- "All Other Land Disposal" in the figure includes disposal to soil (land treatment/application farming) and any other land disposal including the disposal of TRI chemicals contained in waste rock at metal mines.

Land releases from metal mines:

Trends in land disposal were largely driven by the metal mining sector, which accounted for 70% of land disposal quantities for 2020. Select the "Land Disposal, Excluding Metal Mining" button to view the land disposal trend without data from metal mines.

- The TRI chemicals disposed to land by metal mines in 2020 were primarily zinc compounds (29%), lead compounds (29%), and arsenic compounds (22%).

Metal mining facilities typically handle large volumes of material. Besides production volume, one factor cited by facilities as a contributor to the changes in quantities of waste managed is the chemical composition of the extracted ore, which can vary substantially from year to year. In some cases, small changes in the ore's composition can impact whether TRI chemicals in ore qualify for a concentration-based exemption from TRI reporting in one year but not in the next year or vice versa.

Regulations require that waste rock, which contains TRI chemicals, be placed in engineered piles, and may also require that waste rock piles, tailings impoundments, and heap leach pads be stabilized and re-vegetated to provide for productive post-mining land use.

For more information on the mining industry, see the Metal Mining sector profile.

This graph shows the 10-year trend in on-site land disposal, excluding quantities reported by the metal mining sector. The metal mining sector accounts for about 70% of the quantities of TRI chemicals disposed to land in most years.

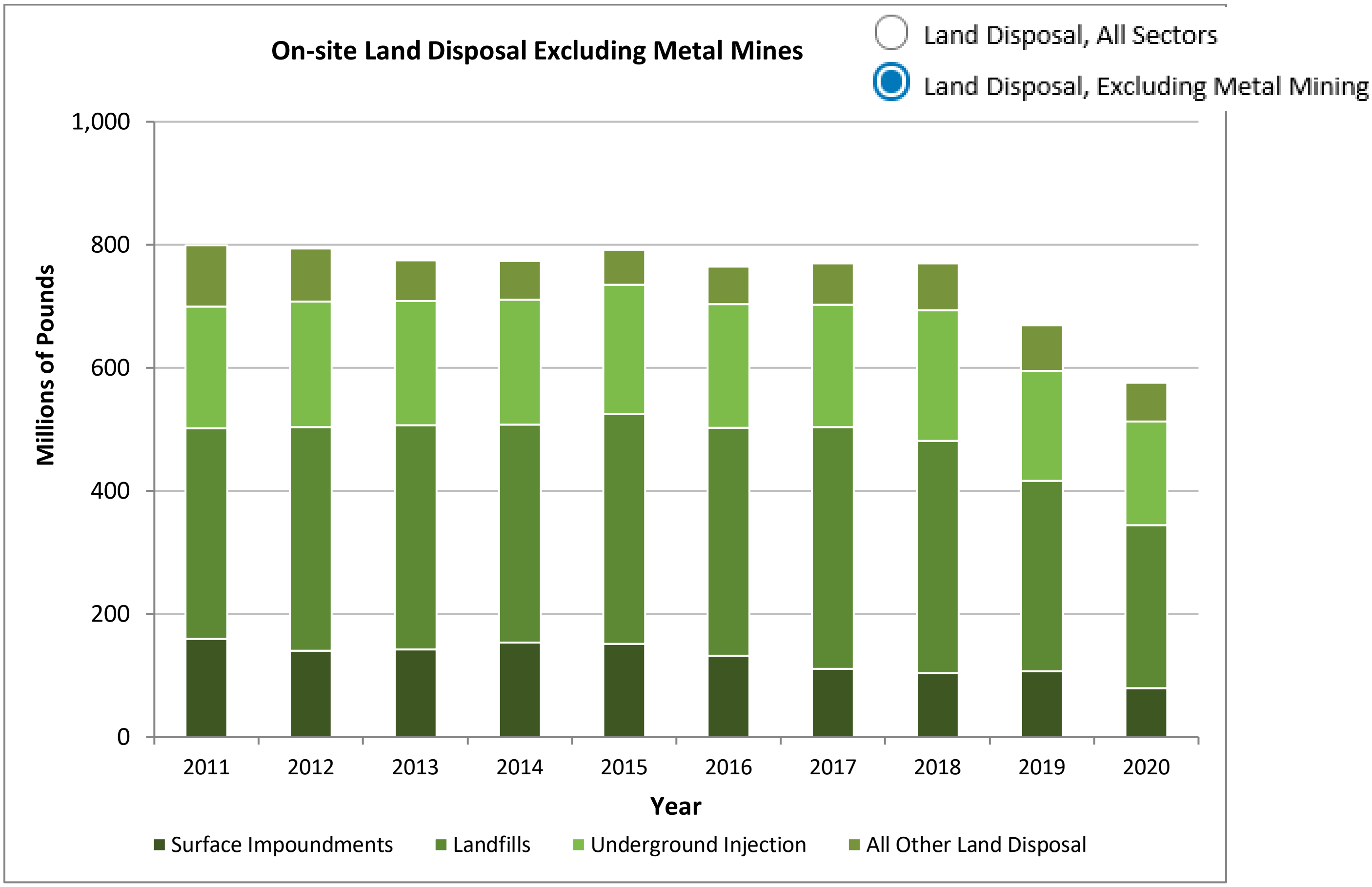
Helpful Concepts

What is underground injection?

Underground injection involves placing fluids underground in porous formations through wells. EPA regulates underground injection through its Underground Injection Control Program under the Safe Drinking Water Act.

What is a surface impoundment?

Surface impoundments are natural or artificial depressions, excavations, or diked areas used to hold liquid waste. Construction of surface impoundments must follow criteria including having a double liner and leak detection system. Surface impoundments are sometimes regulated through the Resource Conservation and Recovery Act.



Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2011 to 2020:

- Total on-site land disposal for all industries other than metal mining was relatively steady for most of the time period presented except for reductions in 2019 and 2020.
- The recent decrease in land disposal for industries other than metal mining was driven by reduced releases to land reported by electric utilities. Land releases from electric utilities have been steadily decreasing since 2014, but the decreases were larger for 2019 and 2020 than in other recent years.
  - For 2011, the first year on this chart, electric utilities reported disposing of 284 million pounds of chemical waste to land, more than any other sector except metal mining. For 2020, the sector reported 118 million pounds of land disposal, a 58% reduction.
  - Note that only those electric utilities that combust coal or oil to generate power for distribution into commerce are covered under TRI reporting requirements.

Electric utilities that shift from combusting coal or oil to entirely using other fuel sources (such as natural gas) are not required to report to TRI. For more information on this sector, see the Electric Utilities sector profile.

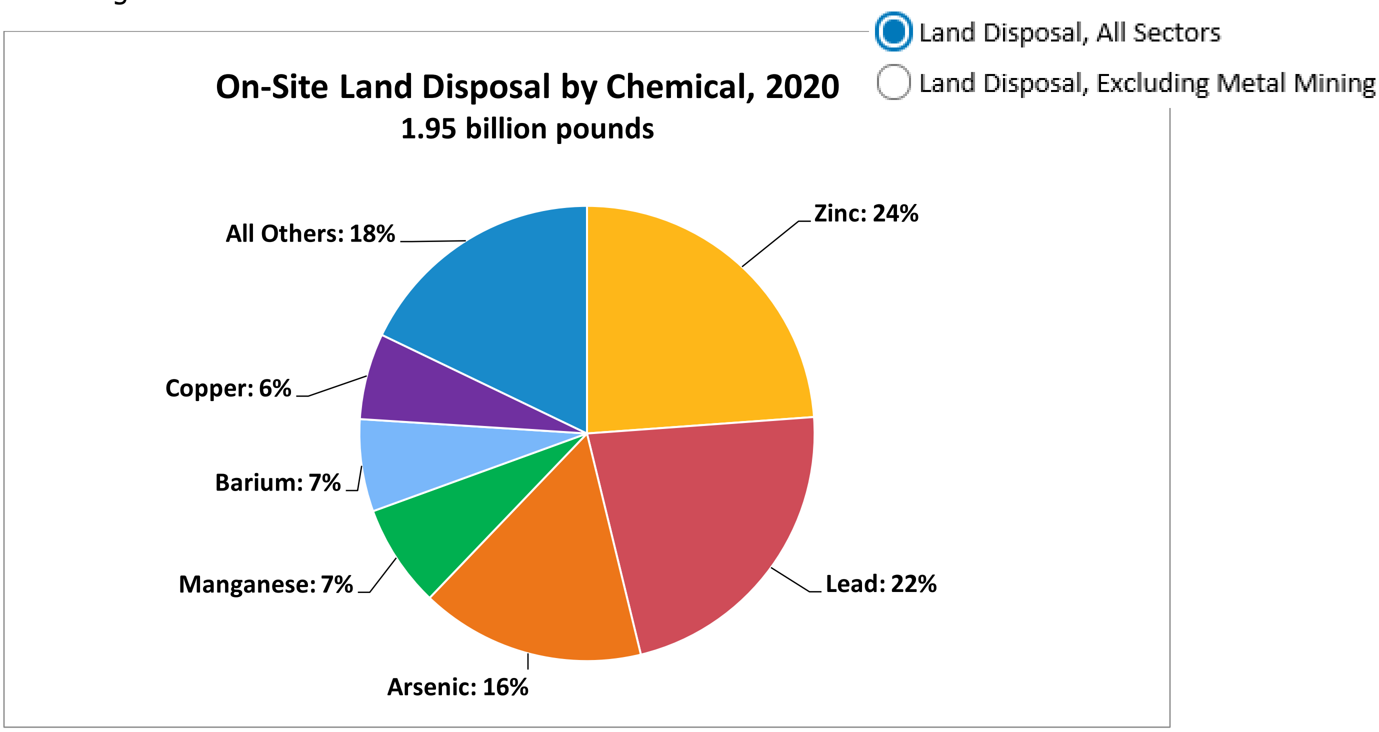
In 2020:

- Excluding the quantities of TRI chemicals disposed of to land by metal mines, the chemicals disposed of on site to land in the largest quantities were: barium and barium compounds (15%), manganese and manganese compounds (13%), and zinc and zinc compounds (11%).
- Excluding metal mines, most on-site land disposal quantities were reported by the chemical manufacturing, electric utilities, primary metals, and hazardous waste management sectors.

Land Disposal by Chemical & Industry

Land Disposal by Chemical

This pie chart shows the chemicals disposed of to land on site in the greatest quantities during 2020. The metal mining sector accounts for most of this disposal. To view the chemicals disposed of to land by sectors other than metal mining, toggle to the "Land Disposal, Excluding Metal Mining" chart.



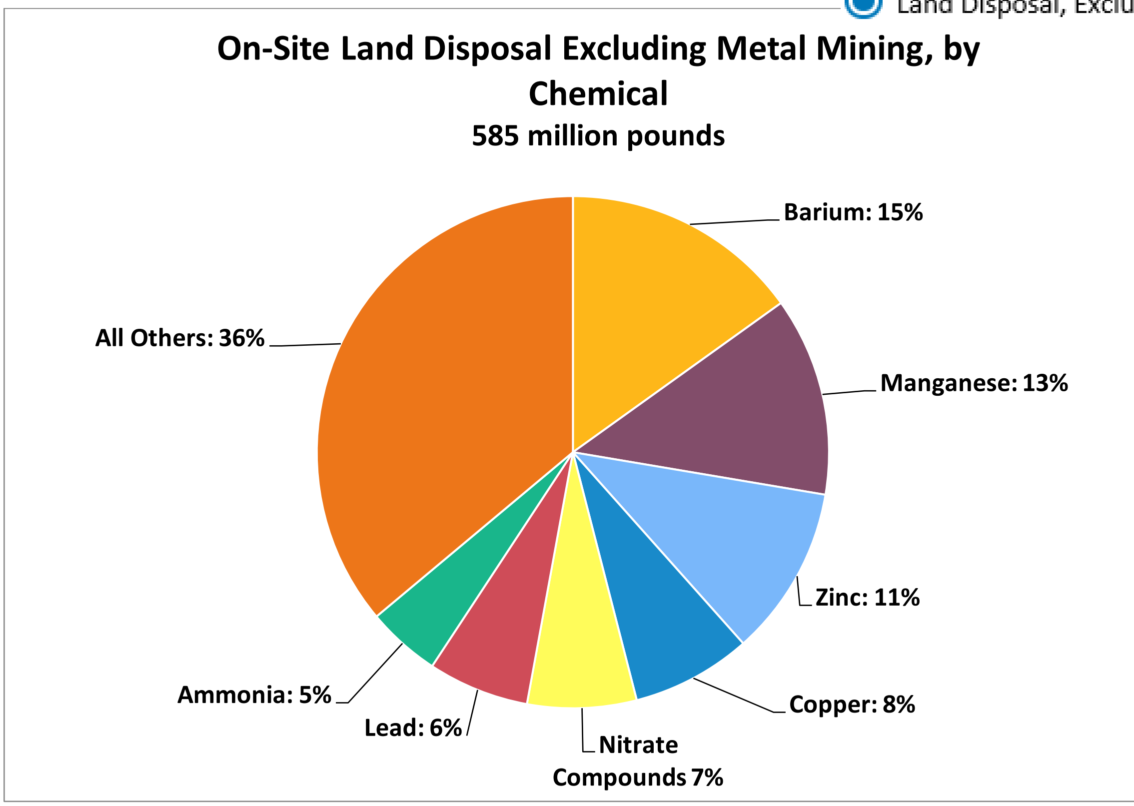
Note: In this chart, metals are combined with their metal compounds, although metals and compounds of the same metal are listed separately on the TRI list (e.g., lead is listed separately from lead compounds).

The metal mining sector alone was responsible for 91% of the zinc, lead, and arsenic disposed of to land in 2020. These 3 chemicals comprised 62% of the total quantities of TRI chemicals released to land. Toggle to the "Land Disposal, Excluding Metal Mining" chart to see the chemicals released in the greatest quantities by other sectors, which shows a wider array of chemicals.

This pie chart shows the chemicals disposed of to land on site in the greatest quantities during 2020, excluding quantities disposed of by facilities in the metal mining sector.

Land Disposal, All Sectors

Land Disposal, Excluding Metal Mining

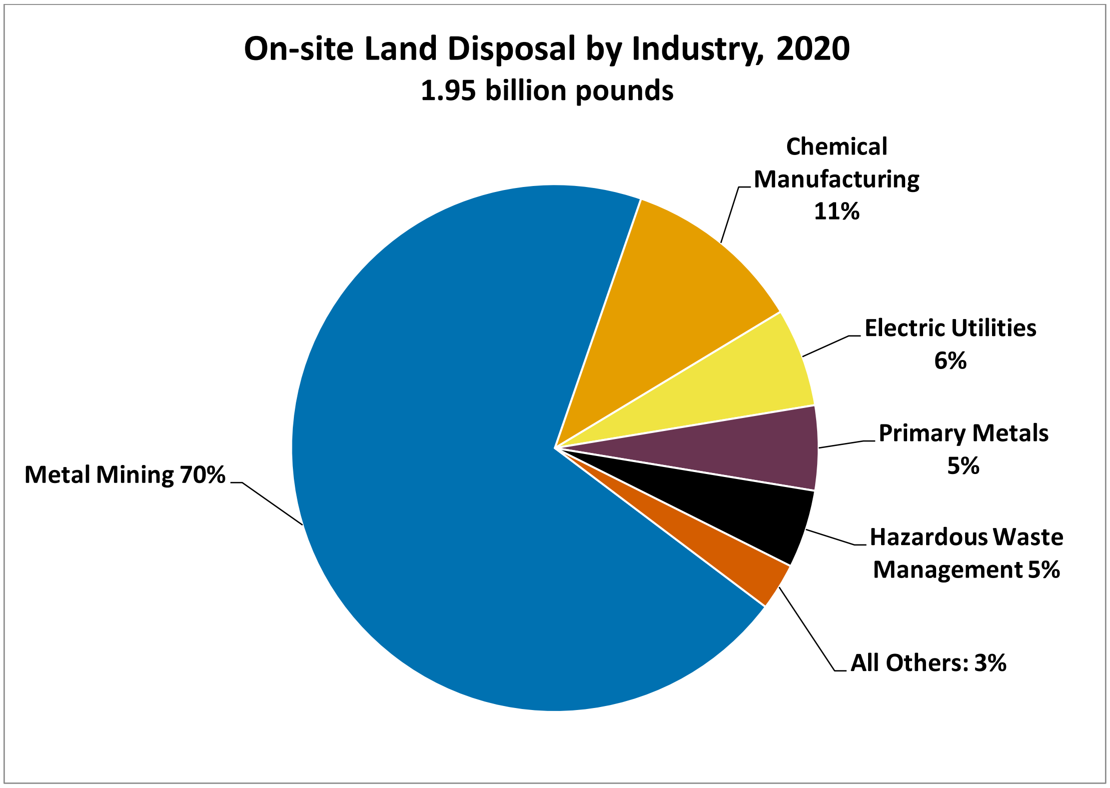


Note: In this chart, metals are combined with their metal compounds, although metals and compounds of the same metal are listed separately on the TRI list (e.g., lead is listed separately from lead compounds). Percentages do not sum to 100% due to rounding.

- When the metal mining sector is excluded, a wider variety of chemicals contribute to most of the land releases. Seven different chemicals, for example, comprised 64% of land releases, as opposed to three chemicals comprising a comparable 62% of releases when metal mining is included (as shown on the "Land Disposal, All Sectors" chart).
- Barium: Most land releases were from the electric utilities sector.
- Manganese: Most land releases were from the chemical manufacturing and primary metals sectors.
- Zinc: Most land releases were from the primary metals sector.

Land Disposal by Industry

This pie chart shows the TRI-covered industry sectors that reported the greatest quantities of on-site land disposal of TRI chemicals during 2020.



- Metal mines accounted for most of the TRI chemicals disposed of to land in 2020.
- The relative contribution by each industry sector to on-site land disposal has not changed considerably in recent years.

Chemicals of Special Concern

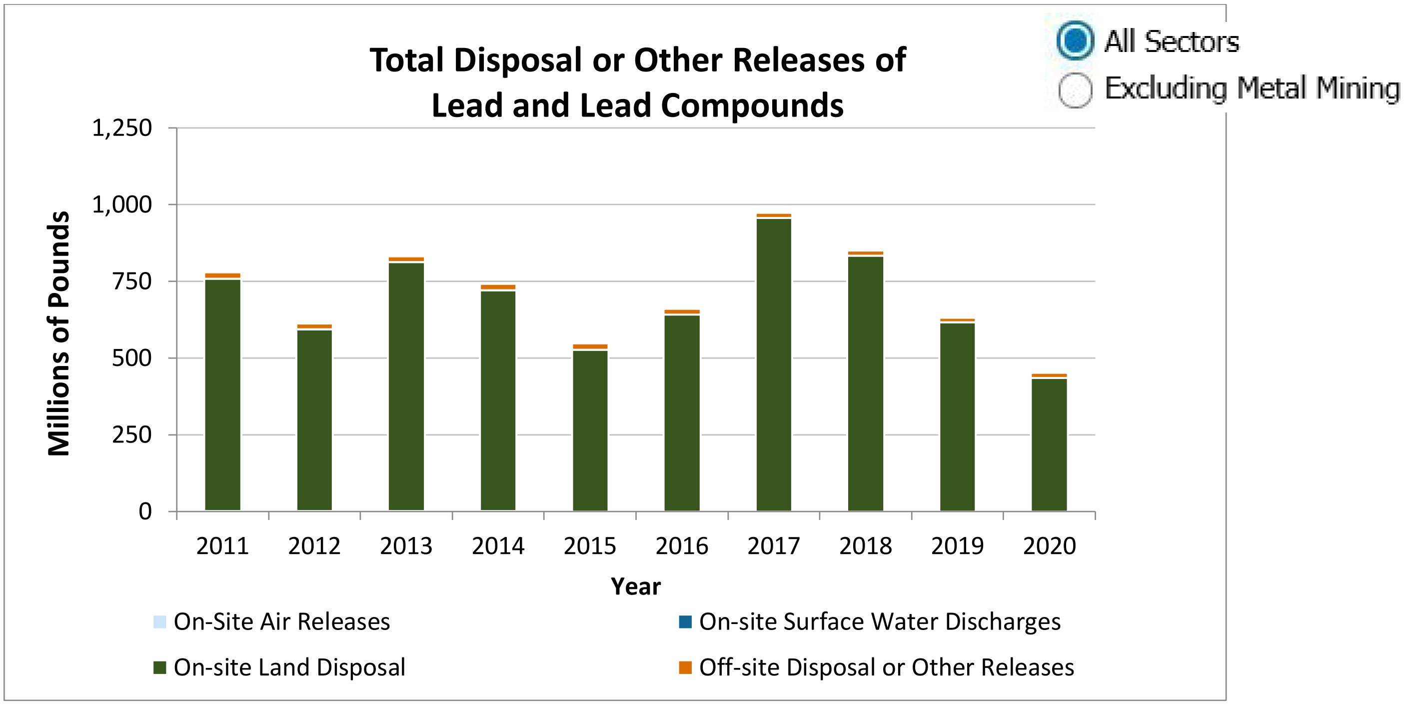
In this section, we take a closer look at some of the Toxics Release Inventory (TRI) chemicals that are persistent, bioaccumulative, and toxic (PBT) and are classified as chemicals of special concern, including lead and lead compounds, mercury and mercury compounds, dioxin and dioxin-like compounds.

PBTs are toxic, break down very slowly in the environment, and tend to build up in the tissue of organisms throughout the food web. These organisms serve as food sources for other organisms, including humans, that are sensitive to the toxic effects of PBT chemicals.

Reporting thresholds for the 16 chemicals and 5 chemical categories designated as PBTs on the TRI chemical list are lower than for other TRI chemicals. Thresholds vary by chemical but range from 10 pounds to 100 pounds for most PBTs, or 0.1 grams for dioxin and dioxin-like compounds.

Lead Releases Trend

This graph shows the 10-year trend in the pounds of lead and lead compounds disposed of or otherwise released by facilities in all TRI reporting industry sectors including metal mines, manufacturing facilities, hazardous waste management facilities and electric utilities.



From 2011 to 2020:

- Releases of lead and lead compounds fluctuated between 2011 and 2020.
- Land disposal by metal mines drives the annual lead and lead compound releases. For 2020, for example, metal mines reported 88% of all releases of lead and lead compounds, which was almost all land disposal.

Learn more about lead

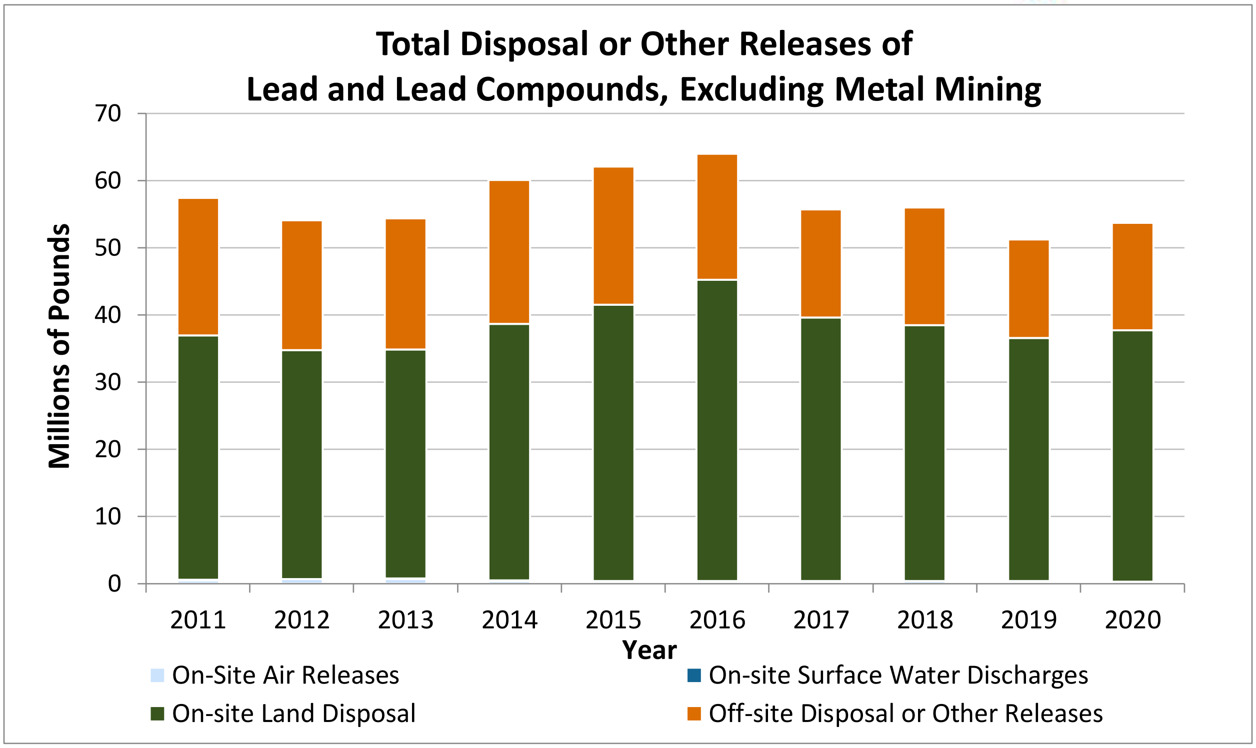
Visit EPA's lead homepage for more information about lead and EPA's actions to reduce lead exposures.

From 2019 to 2020:

- Total releases of lead and lead compounds decreased by 28% (180 million pounds), driven by a decrease in releases of lead compounds from the metal mining sector.

This graph shows the 10-year trend in lead and lead compounds disposed of or otherwise released, but excludes quantities reported by the metal mining sector.

All Sectors
Excluding Metal Mining

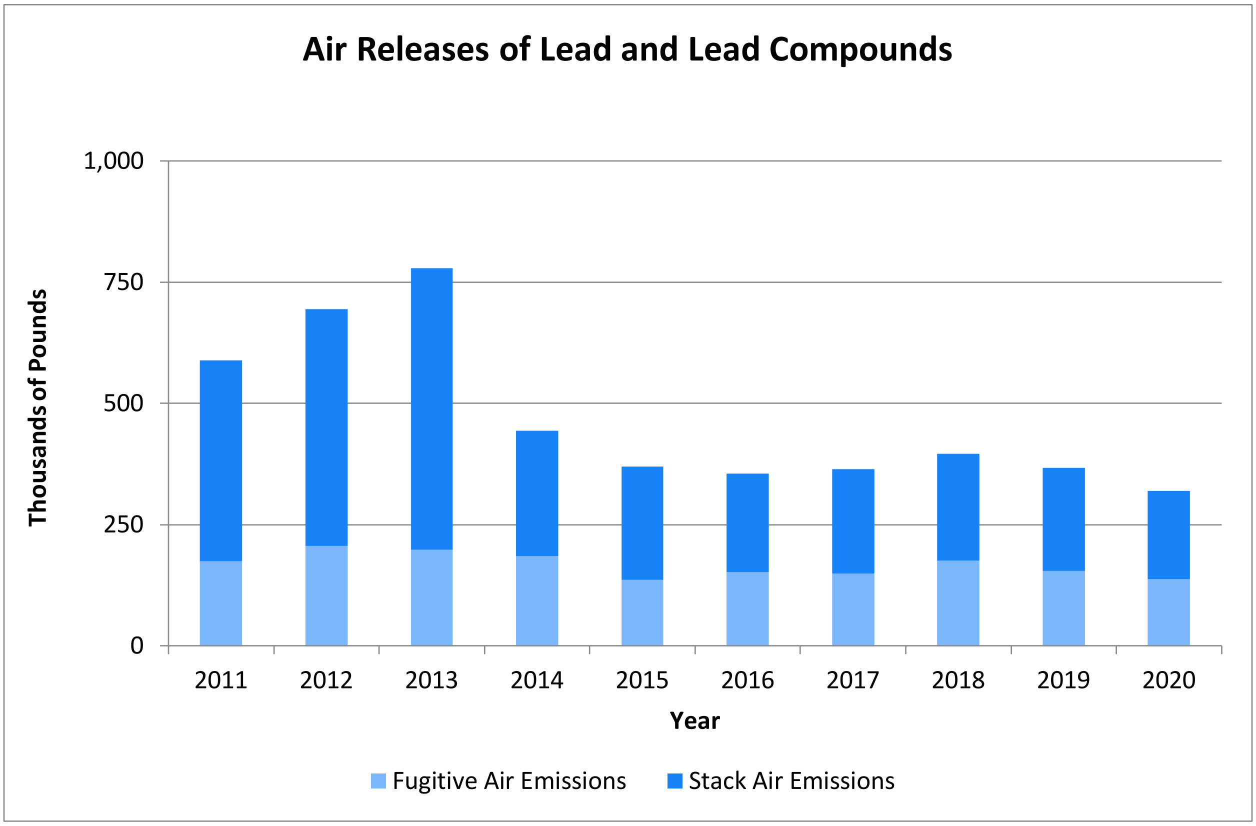


From 2011 to 2020:

- For sectors other than metal mining, releases of lead and lead compounds fluctuated between 2011 and 2020.
- Among sectors other than metal mining, most releases of lead and lead compounds were from the hazardous waste management and primary metals sectors.

Lead Air Releases Trend

This graph shows the 10-year trend in the pounds of lead and lead compounds released to air.



From 2011 to 2020:

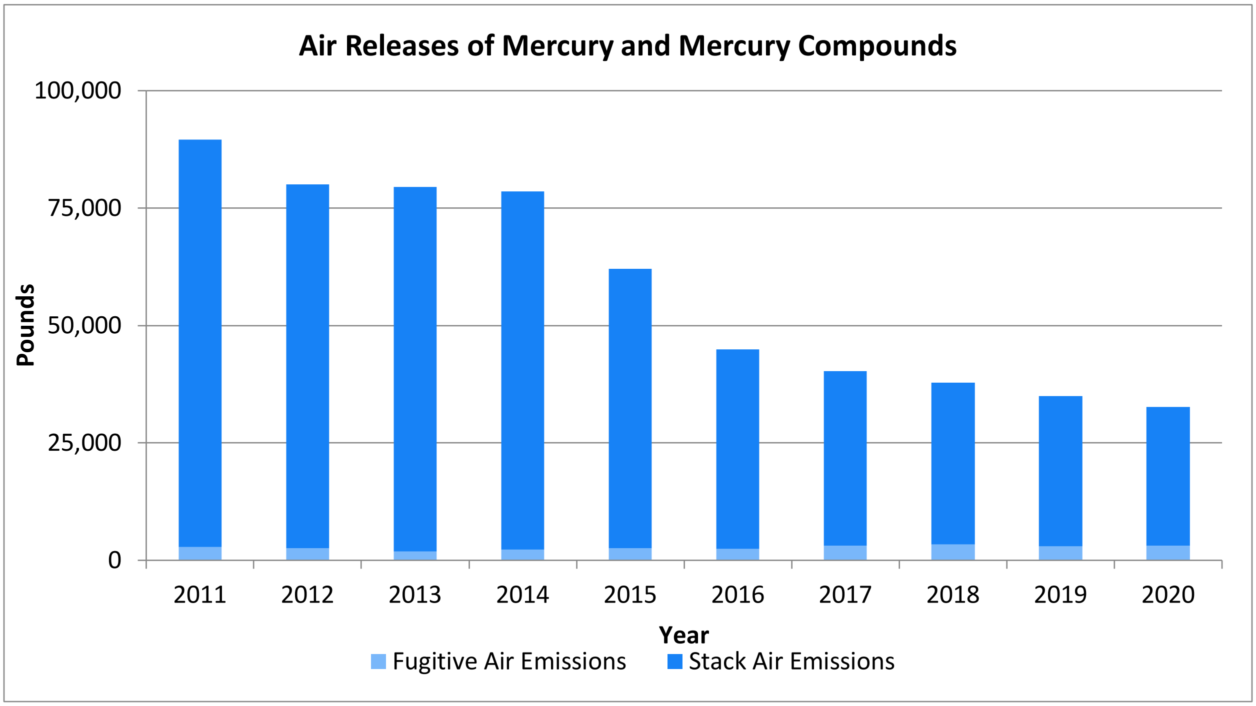
- Air releases of lead and lead compounds decreased by 46%. The primary metals and electric utilities industry sectors have driven this decrease.
- The primary metals sector, which includes copper smelting and iron and steel manufacturing, reported the greatest quantities of releases of lead and lead compounds to air.

From 2019 to 2020:

- Air releases of lead and lead compounds decreased by 13%. The largest decreases in air releases of lead and lead compounds were from the primary metals and plastics and rubber products manufacturing sectors.
- In 2020, 37% of air releases of lead were from the primary metals industry sector.

Mercury Air Releases Trend

This graph shows the 10-year trend in the pounds of mercury and mercury compounds released to air by facilities that reported to TRI.



From 2011 to 2020:

- Releases of mercury and mercury compounds to air decreased by 64%.
- Electric utilities drove the decline in mercury air emissions, with an 88% reduction (-51,000 pounds). The decrease was driven by a shift from coal to other fuel sources (e.g., natural gas) and by the installation of pollution control technologies at coal-fired power plants.
  - Note that only those electric utilities that combust coal or oil to generate power for distribution into commerce are covered under TRI reporting requirements. Therefore, electric utilities that shift from combusting coal or oil to entirely using other fuel sources (such as natural gas) are not required to report to TRI.

Learn more about mercury

Visit EPA's mercury homepage for more information about mercury and EPA's actions to reduce mercury exposures.

From 2019 to 2020:

- Releases of mercury and mercury compounds to air decreased by 7%.

- The primary metals sector, which includes iron and steel manufacturers, accounted for 37% of the air emissions of mercury and mercury compounds reported to TRI for 2020. The electric utilities sector, which released the second-most mercury and mercury compounds to air, accounted for 21% of these air emissions for 2020.

Dioxins Releases Trend

Dioxin and dioxin-like compounds ("dioxins") are persistent bioaccumulative toxic (PBT) chemicals characterized by EPA as probable human carcinogens. Dioxins are the byproducts of many forms of combustion and several industrial chemical processes.

TRI requires facilities to report data on the 17 individual members (congeners) that make up the TRI dioxin and dioxin-like compounds category. While each of the dioxin congeners causes the same toxic effects, they do so at different levels of exposure because of their varying toxic potencies. As a result, the mix of dioxins from one source can have a very different toxic potency than the same total amount of a different mix of dioxins from another source.

EPA accounts for the differences in toxic potency of the dioxin congeners using Toxic Equivalency (TEQ) values. TEQs help the public better understand the toxicity of dioxin releases and are useful when comparing releases of dioxins from different sources or different time periods, where the mix of congeners may vary.

This graph shows the trend in the grams of dioxin releases from 2011 to 2020. Note that the dioxins chemical category is reported in grams while all other TRI chemicals are reported in pounds.

Helpful Concepts

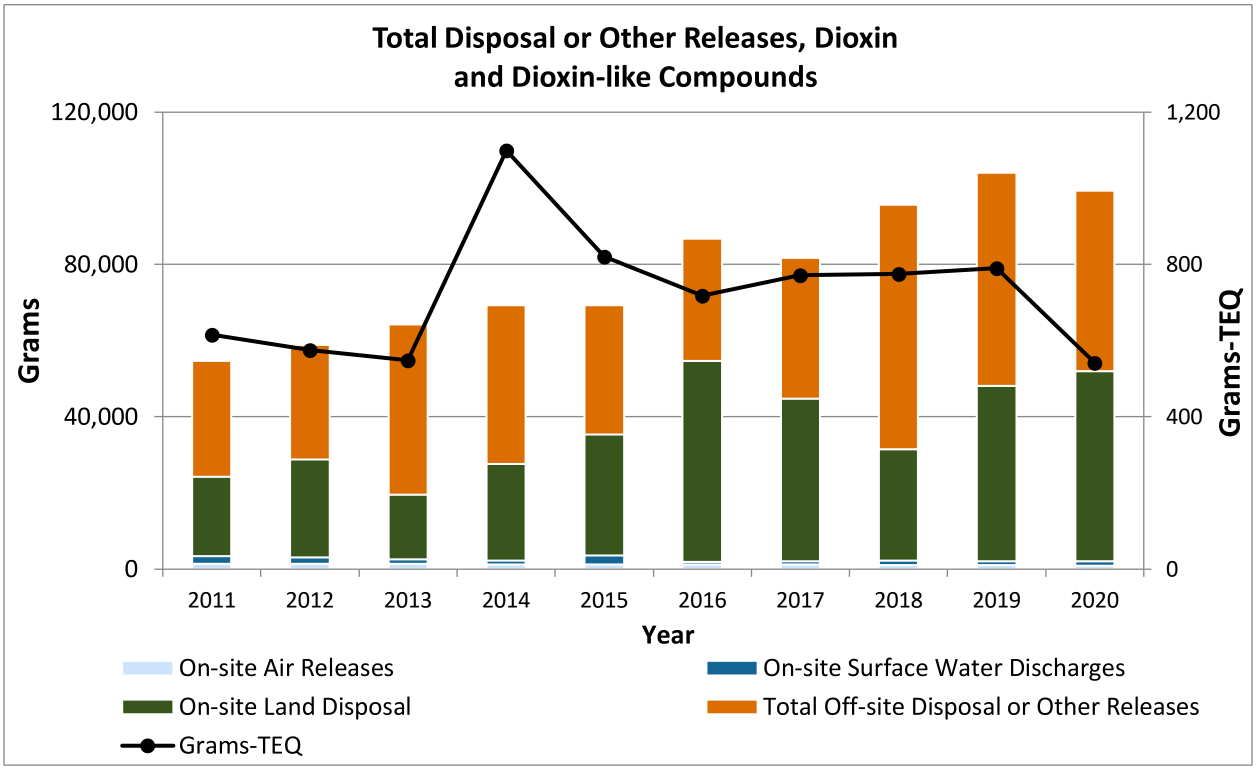
Toxic Equivalent Factor (TEF)

Each dioxin congener is assigned a TEF that compares that compound's toxicity to the most toxic dioxin in the category.

Toxic Equivalency (TEQ)

A TEQ is calculated by multiplying the reported grams of each congener by its corresponding TEF and summing the results, referred to as grams-TEQ.

Learn more about dioxins.



From 2011 to 2020:

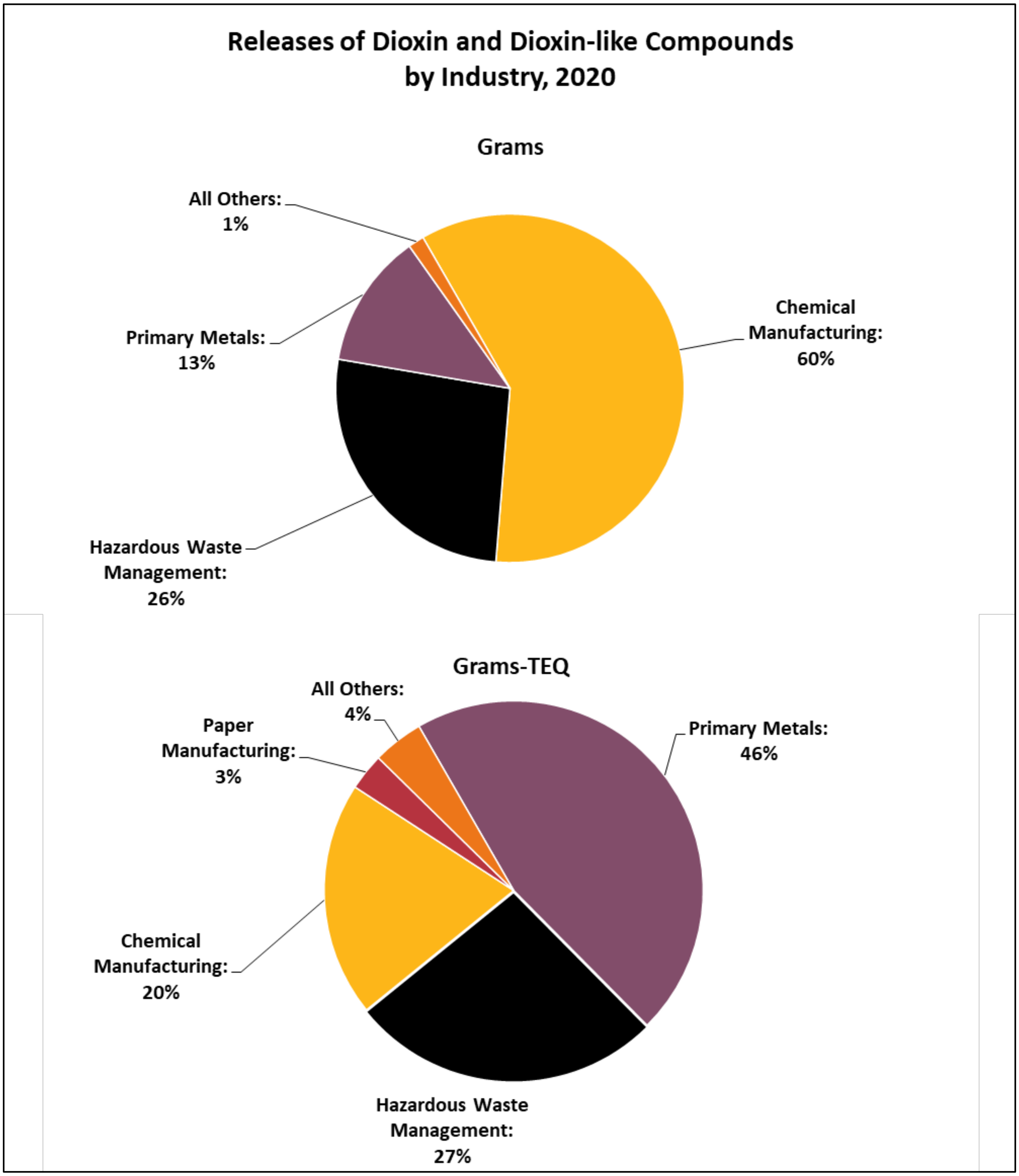
- Dioxin releases increased by 81%. Most of the overall increase can be attributed to increased releases from two organic chemical manufacturing facilities and one hazardous waste management facility.
  - Toxicity equivalents (grams-TEQ) decreased by 12%, indicating that the overall toxicity of dioxin releases decreased despite an increase in the quantity released. This is due to changes in which dioxin congeners were released.

From 2019 to 2020:

- Releases of dioxins decreased by 5%, driven by decreased releases reported by a smelting and refining facility and an organic chemical manufacturing facility.
  - Toxicity equivalents (grams-TEQ) decreased by 31%. This is largely due to one primary metal manufacturing facility reporting more dioxin toxicity-equivalents than any other facility for 2019, but reported a 96% reduction in grams and 90% reduction in grams-TEQ released for 2020.
- In 2020, most of the dioxin releases were disposed of on site to land (50%) or disposed or otherwise released off site (48%).

Dioxins Releases by Industry

The following two pie charts compare the TRI-covered industry sectors that reported the greatest releases of dioxins in grams to those that reported the greatest releases of grams in toxicity equivalents (grams-TEQ). Note that only data from those reporting forms that provided the congener detail for calculating grams-TEQ are included in these charts.



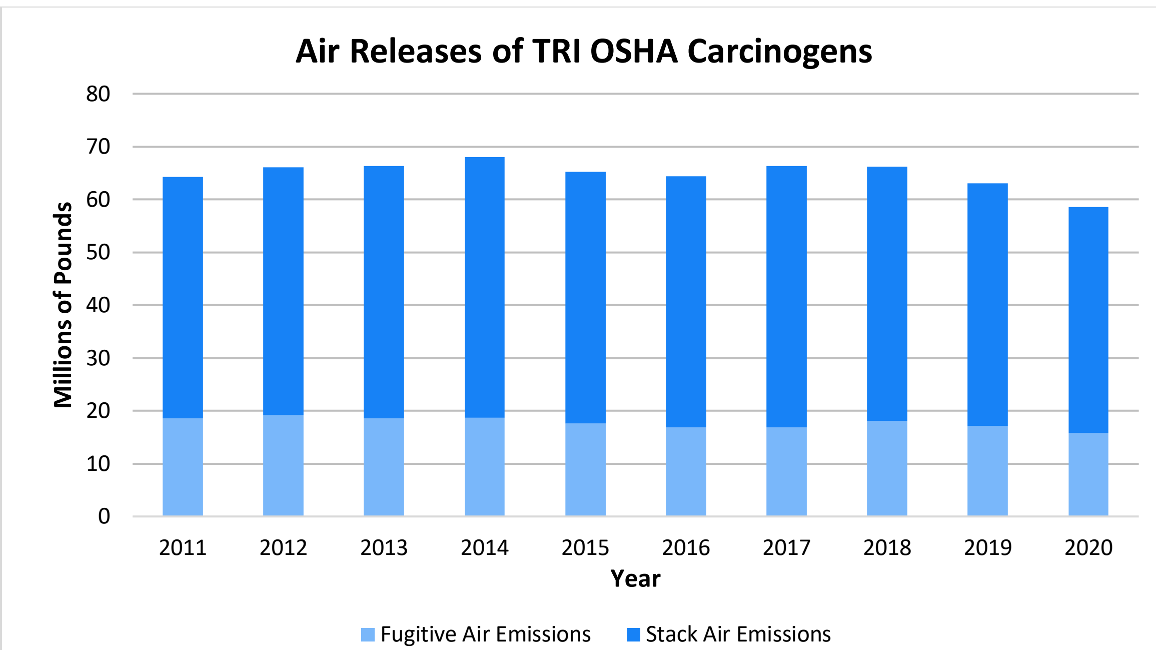
- Various industry sectors may dispose of or otherwise release very different mixes of dioxin congeners.

- The chemical manufacturing industry accounted for 60% and the primary metals sector for 13% of total grams of dioxins released.
- In terms of toxicity equivalents, however, the primary metals sector accounted for 46% and the chemical manufacturing sector for 20% of the total grams-TEQ.

Occupational Safety and Health Administration (OSHA) Carcinogens

Air Releases

Some chemicals that are reportable to the TRI Program are included on OSHA's list of carcinogens. EPA refers to these chemicals as TRI OSHA carcinogens. These chemicals are either known or believed to cause cancer in humans. A list of the TRI carcinogens can be found in the TRI basis of OSHA carcinogens technical document. This graph shows the 10-year trend in air releases of TRI OSHA carcinogens.



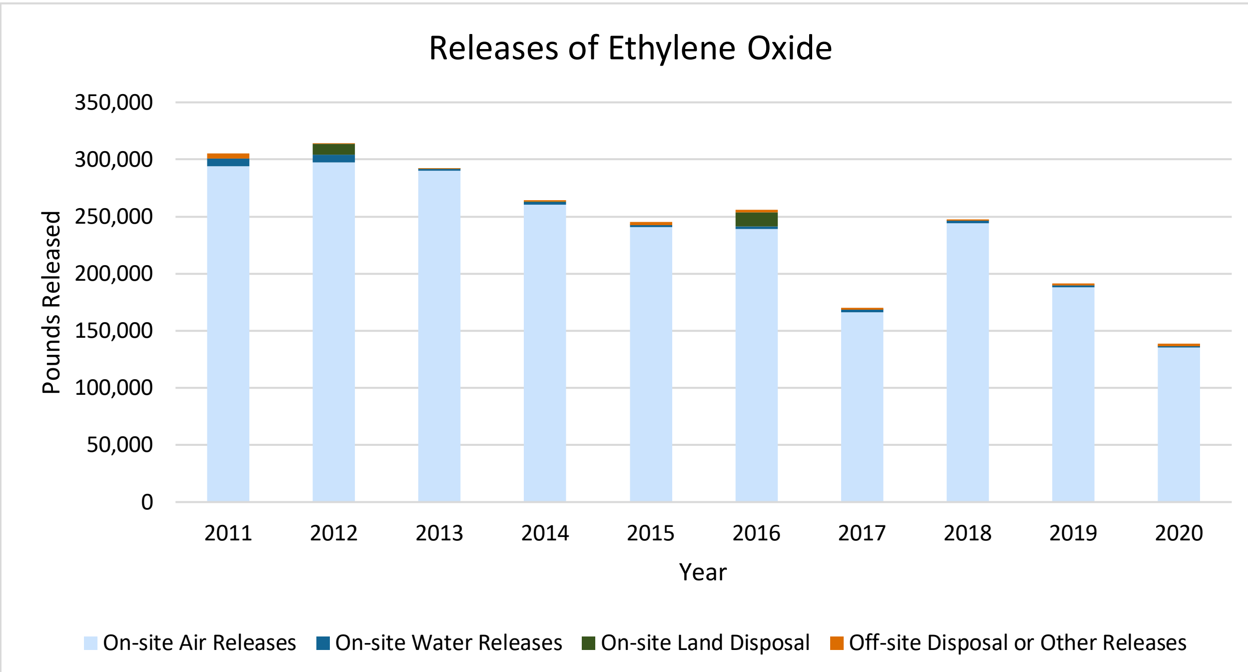
Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2011 to 2020:

- Air releases of these carcinogens decreased by 9%.
- Air releases of many OSHA carcinogens decreased, with reductions in most sectors. However, decreases were partially offset by increases in releases of styrene from the plastics and rubber products manufacturing sector and the transportation equipment manufacturing sector.
- In 2020, air releases of OSHA carcinogens consisted primarily of styrene (47% of the air releases of all OSHA carcinogens), acetaldehyde (13%) and formaldehyde (8%).

Ethylene Oxide Releases Trend

This section focuses on one of the TRI OSHA carcinogens, ethylene oxide. The figure below presents the 10-year trend in releases of ethylene oxide as reported to TRI by about 115 facilities per year.



- From 2011 to 2020, releases of ethylene oxide decreased by 166,000 pounds (-54%), driven by reductions in air releases.

- From 2019 to 2020, releases of ethylene oxide decreased across most sectors. Most individual facilities also reported lower releases of ethylene oxide from 2019 to 2020.
- Two chemical manufacturers in Texas reported that they had large one-time (non-production-related) releases of ethylene oxide to air in 2018 and 2019, driving the increase from 2017 to 2018 and the decrease from 2018 through 2020.

Learn More About Ethylene Oxide

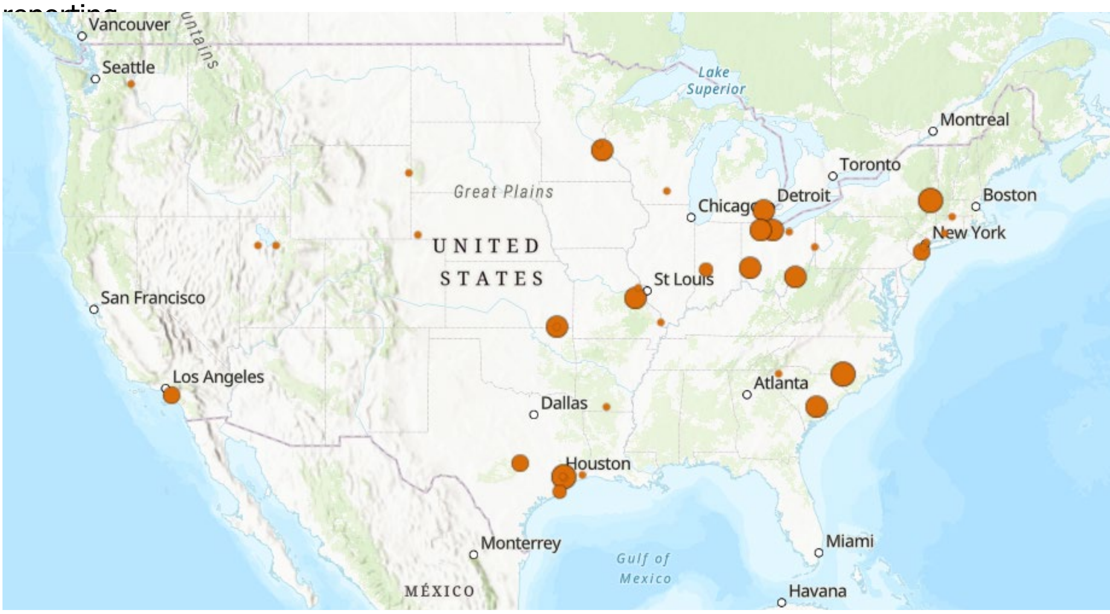
Ethylene oxide is a human carcinogen, meaning that it is known to cause cancer in humans. In 2021, EPA extended TRI reporting requirements to certain contract sterilization facilities that use ethylene oxide. This action became effective for the 2022 reporting year with the first reports for these particular facilities due on July 1, 2023.

Learn More about Ethylene Oxide.

Per- and Polyfluoroalkyl Substances (PFAS)

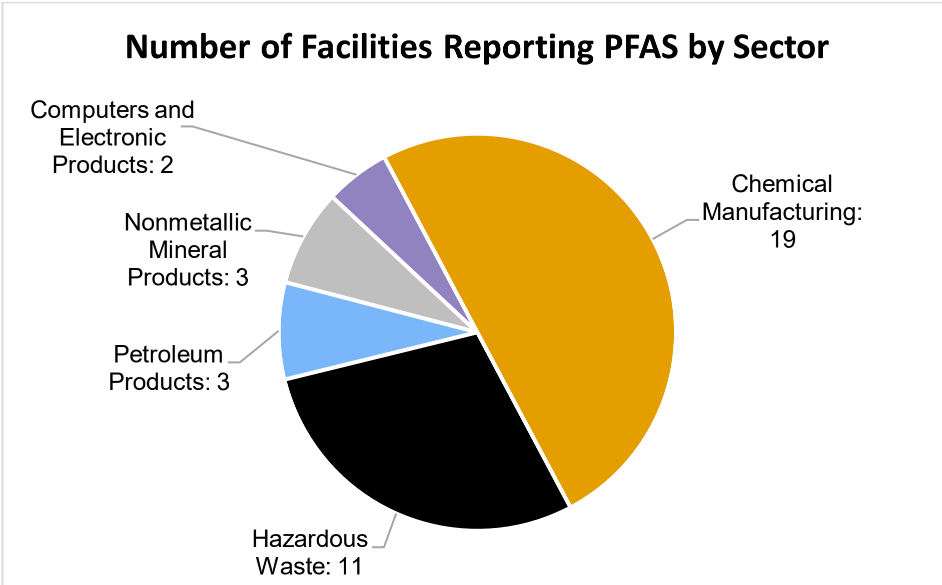
Recently, 172 per- and polyfluoroalkyl substances (PFAS) were added to the list of chemicals covered by TRI. Facilities reported their releases and waste management practices for these PFAS for the first time for 2020. The TRI reporting threshold for these PFAS is 100 pounds, which is lower than the thresholds for most TRI chemicals. PFAS have been manufactured and used in a variety of industries in the United States and around the globe since the 1940s, and they are still being used today. Harmful PFAS are an urgent public health and environmental issue facing communities across the United States because current scientific research suggests that exposure to certain PFAS may lead to adverse health effects. PFAS on the TRI chemical list include compounds such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS). Note that definitions of which chemicals are considered PFAS vary, and the 172 substances required to be reported to TRI do not include all PFAS. See EPA's *PFAS Explained* page for more information about these chemicals and EPA actions related to PFAS.

This map shows the locations of the facilities that reported a PFAS to TRI for 2020, sized by their relative releases. Click on a facility for details on the facility location and its TRI PFAS reporting.



Note: One facility in the food manufacturing sector erroneously reported for a PFAS instead of another chemical and has withdrawn the PFAS form. That facility is not included in this map.

This chart shows the number of facilities in each sector reporting for any of the 172 PFAS for 2020.

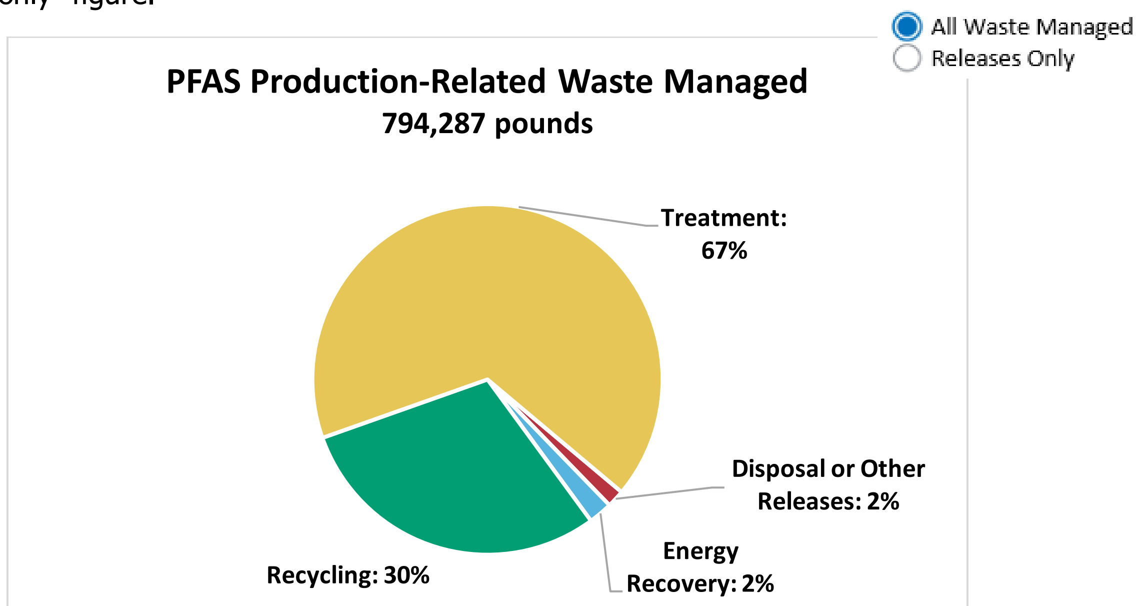


Note: One facility in the food manufacturing sector erroneously reported for a PFAS instead of another chemical and has withdrawn the PFAS form. That facility is not included in this chart.

- Most facilities reporting for PFAS were in the chemical manufacturing sector or the hazardous waste management sector.
    - No reports for PFAS were received from any federal facilities, although some Department of Defense facilities have used PFAS in the past. Discontinuing certain uses of PFAS may be a factor since the 2019 National Defense Authorization Act, which added PFAS to the TRI chemical list, also included provisions to phase out the use of PFAS in certain circumstances by the Department of Defense.
- Facilities reported for 43 different PFAS. The most commonly reported PFAS were perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS) and its potassium salt, and hexafluoropropylene oxide dimer acid (HFPO-DA) and its ammonium salt.

PFAS Waste Management

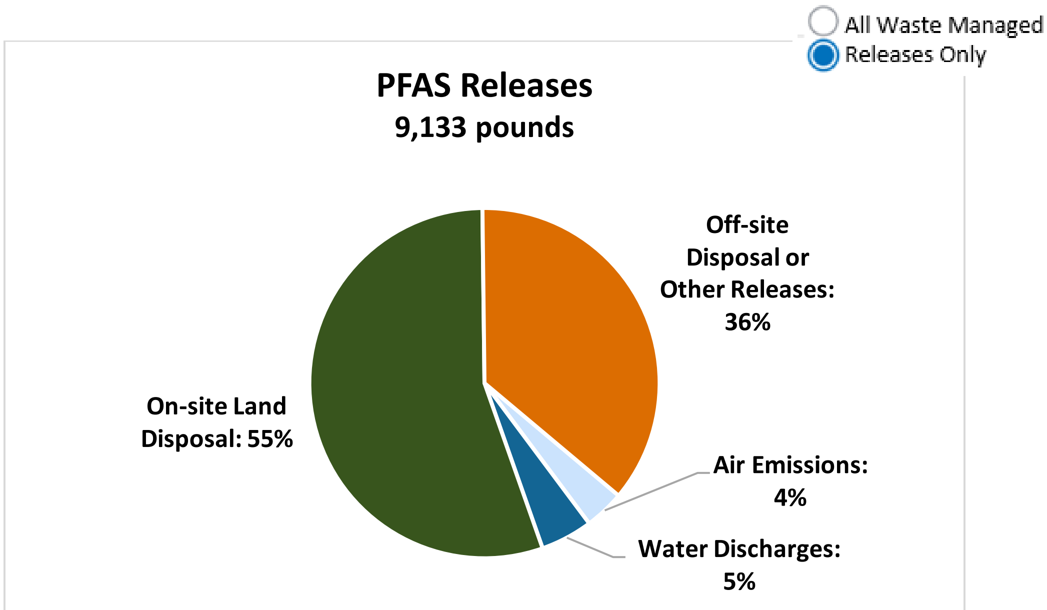
This chart shows how PFAS waste was managed. Hover over the chart to see the pounds of waste managed by each method. For more details on quantities released, toggle to the "Releases only" figure.



Note: 1) Note: This analysis excludes PFAS releases reported from one facility that has withdrawn its report. 2) Percentages do not sum to 100% due to rounding.

- Most PFAS waste was treated or recycled.
- The hazardous waste management and chemical manufacturing sectors managed the most PFAS waste.
  - Hazardous waste management facilities reported the most treatment.
  - Recycling was reported almost exclusively by chemical manufacturing facilities.

This chart shows PFAS releases by medium. Hover over the chart to see the pounds released to each medium.



Note: This analysis excludes PFAS releases reported from one facility that has withdrawn its report.

- Of the quantities of PFAS released, most were disposed of on site to land or transferred off site for disposal.
- The chemical manufacturing sector reported the most releases (78%).