Releases of Chemicals

Release or disposal of chemical waste into the environment occur 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 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 released to the environment. Evaluating release data can help to:

- identify potential concerns in communities,
- better understand potential risks chemical releases may pose, and
- identify opportunities for government and communities to work with facilities to reduce chemical releases and potential associated risks.

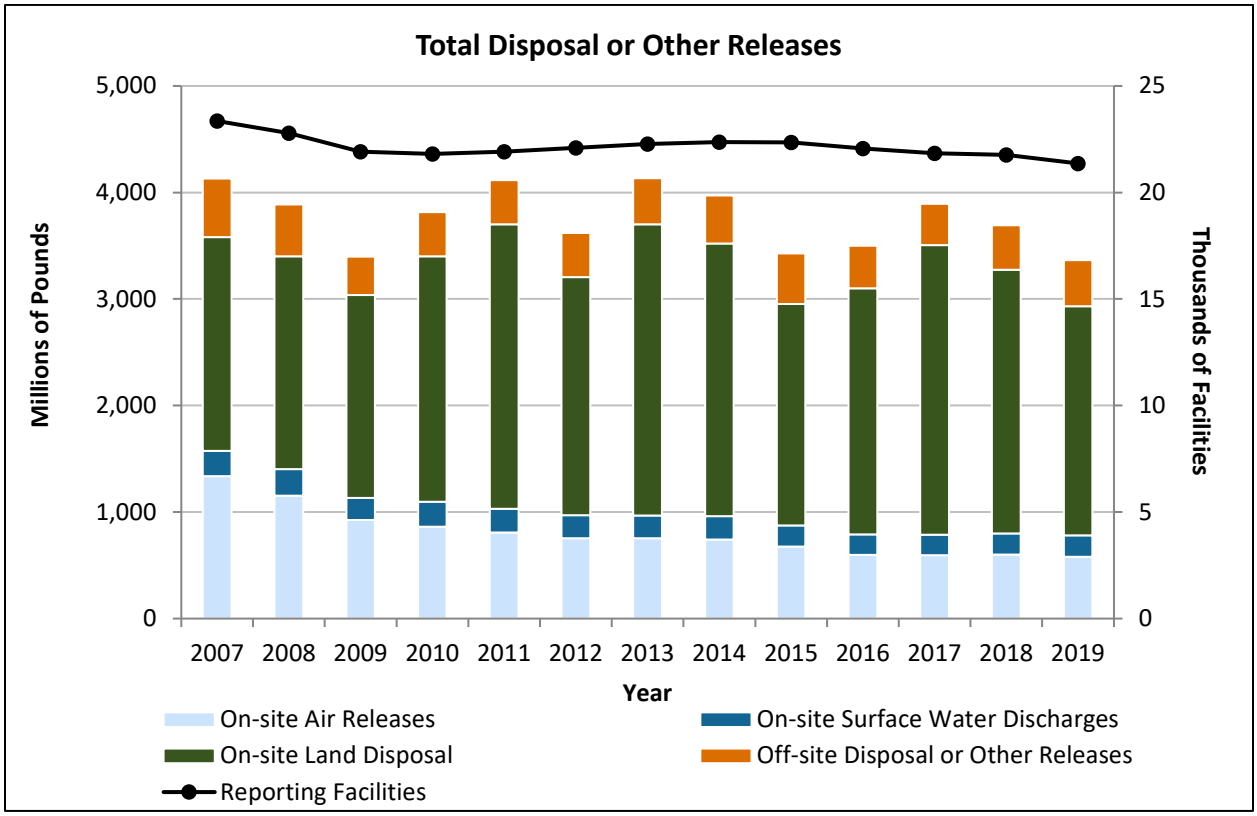
It is important, however, to understand that the quantity of releases is not necessarily an indicator of health impacts posed by the chemicals. Potential risks to human health from releases of TRI chemicals are determined by many factors, as discussed in the Hazard and Potential Risk of TRI Chemicals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

The following graph shows the change in total disposal or other releases of TRI chemicals (also referred to as "total releases") over time. 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.

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. The majority of TRI releases happen during routine production operations at facilities. To learn more about what EPA is doing to help limit the release of TRI chemicals into the environment, see the EPA laws and regulations webpage.



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

From 2007 to 2019:

- Total disposal or other releases of TRI chemicals decreased by 19%.
  - Excluding the metal mining sector, releases decreased by 37%.
  - Reduced hazardous air pollutant (HAP) emissions, such as hydrochloric acid, from electric utilities were the most significant contributor to the decline.
- Releases to air decreased by 57%, discharges to surface water decreased by 16%, and off-site disposal decreased by 21%.
- Releases to land, driven by the metal mining sector, increased by 7%.
- The number of facilities that reported to TRI declined by 9%.

From 2018 to 2019:

- Total disposal or other releases decreased by 9%.
  - On-site land disposal decreased by 13%, which is the main driver for the decrease in total releases.
  - Quantities released to air on site decreased slightly, while quantities discharged on site to surface water and transferred off site for disposal increased slightly.

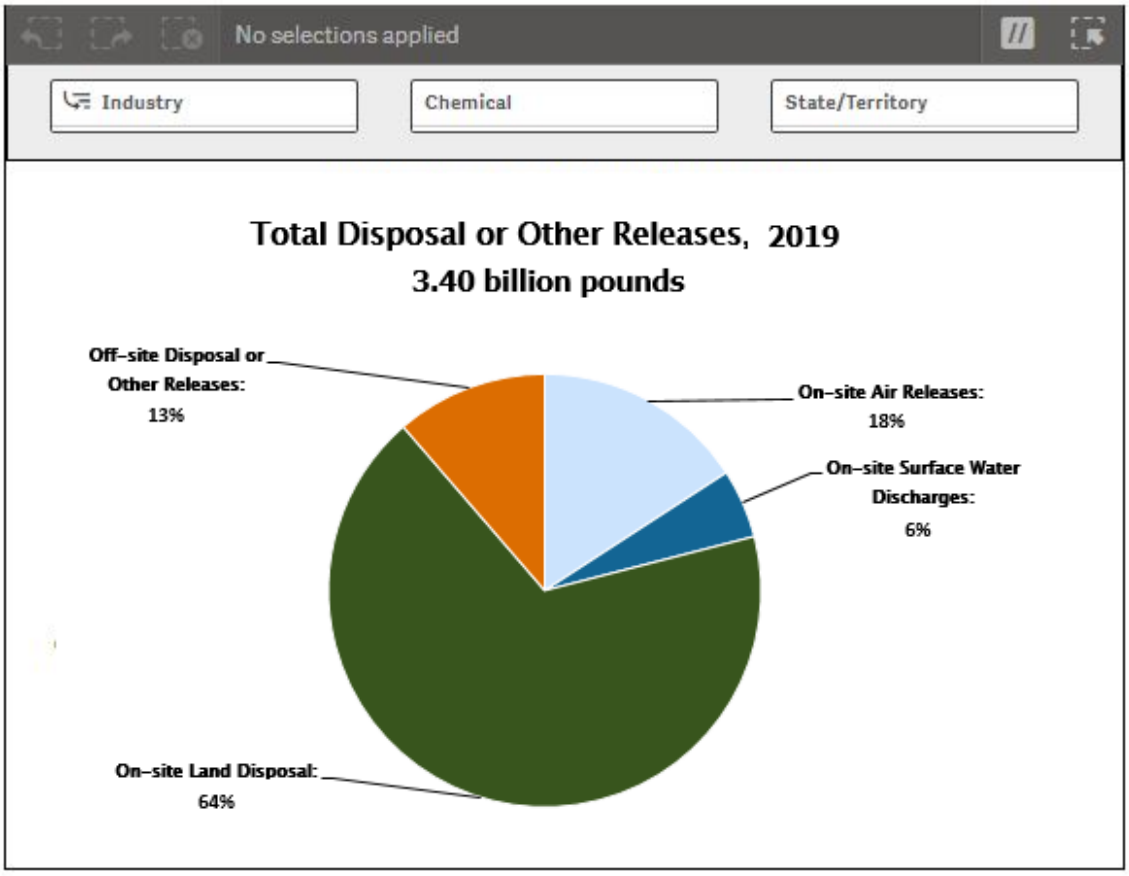
- Please note that the most recent TRI dataset reflects chemical waste management activities that occurred during calendar year 2019, and therefore does not indicate any potential impacts of the COVID-19 pandemic, which began in the U.S. in early 2020.

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*.

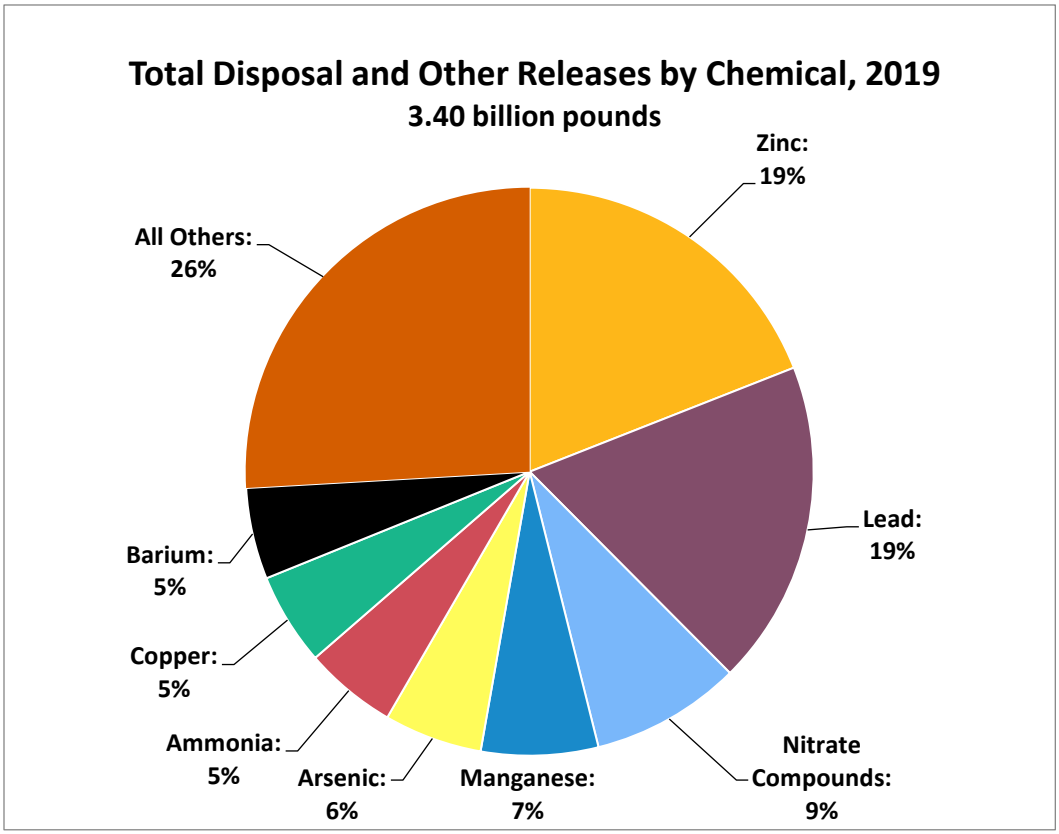
Releases in 2019

Use the interactive chart below to explore the 2019 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.



Releases by Chemical

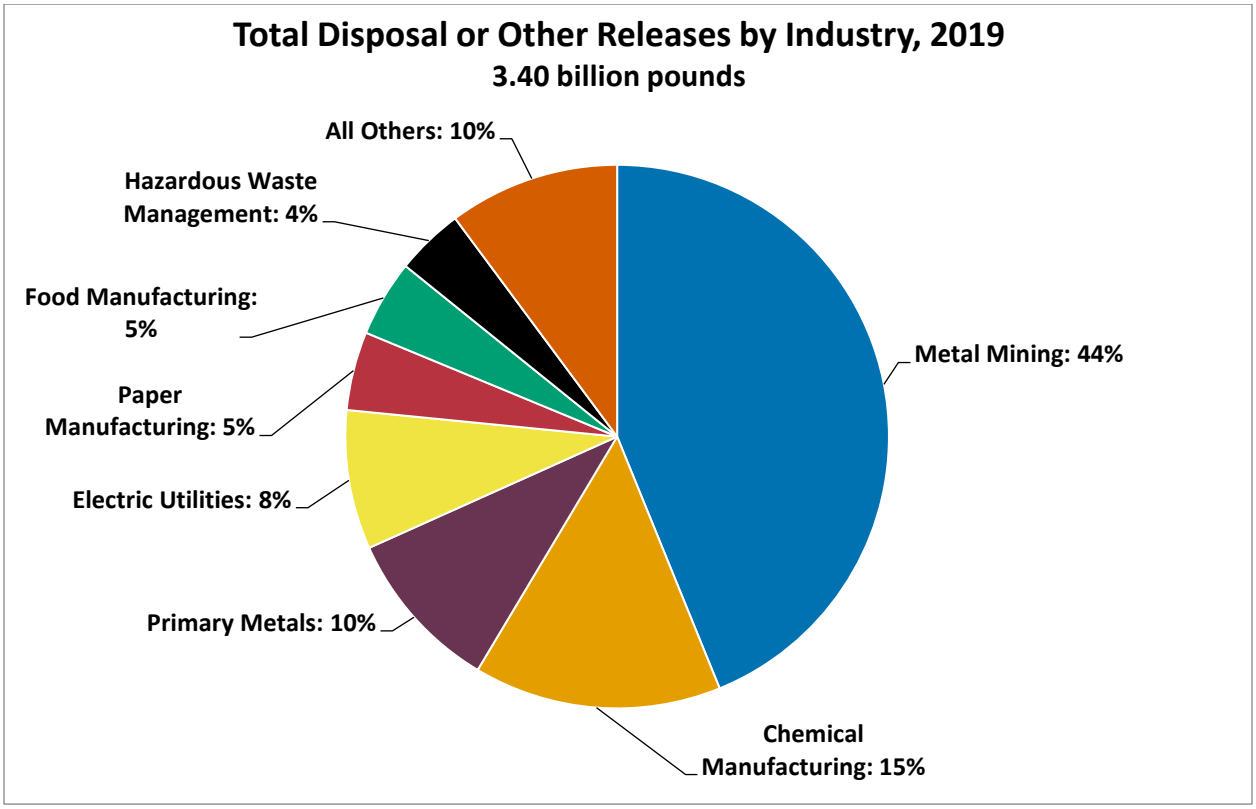
Release quantities of 8 chemicals made up 74% of total releases.



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). 2) Percentages do not sum to 100% due to rounding.

Releases by Industry

The metal mining sector accounted for 44% of releases (1.49 billion pounds), which were primarily in the form of on-site land disposal. Learn more about this sector in the Metal Mining profile.



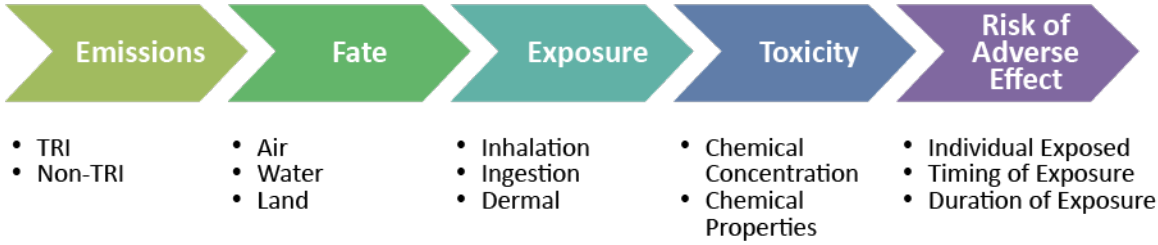
Note: Percentages do not sum to 100% due to rounding.

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, with the exception of dioxin and dioxin-like compounds, which are reported in grams. Pounds or grams of releases, however, is not necessarily an indicator of environmental or human health impacts posed by the chemical releases, as described in EPA's *Factors to Consider When Using Toxics Release Inventory Data*. Although TRI data generally cannot indicate to what extent individuals have been exposed to chemicals, TRI 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. TRI contains some of this information, including what chemicals are released from industrial facilities; the amount of each chemical released; and the amounts released to air, water, and land.

Overview of Factors that Influence Risk



It is important to keep in mind that while TRI includes information on many chemicals used by industry, it does not cover all facilities, all chemicals, or all sources of TRI chemicals in communities. Other potential sources, such as 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 hazard and potential for risks posed by certain waste management activities of TRI chemicals (e.g., from releases to the environment), the TRI Program uses EPA's Risk-Screening Environmental Indicators (RSEI) model.

Helpful Concepts

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

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

RSEI is a screening-level model that provides additional context for human health impacts from TRI release data by considering chemical toxicity, the fate and transport of the chemical

through the environment, and potential human exposure. For chemicals reported to TRI as released to air or water, transferred to publicly-owned treatment works (POTWs), or transferred off site for incineration, the model produces a RSEI Score, which is a numerical descriptor that provides a relative estimate of potential human health risk to help identify situations of greatest potential risk and evaluate trends over time. RSEI does not currently model other waste management activities or release pathways reported to TRI, such as those associated with land disposal. In addition to RSEI Scores, the model produces RSEI Hazard estimates, also called toxicity-weighted pounds.

- 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 risk **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.

RSEI: Risk-Screening Environmental Indicators

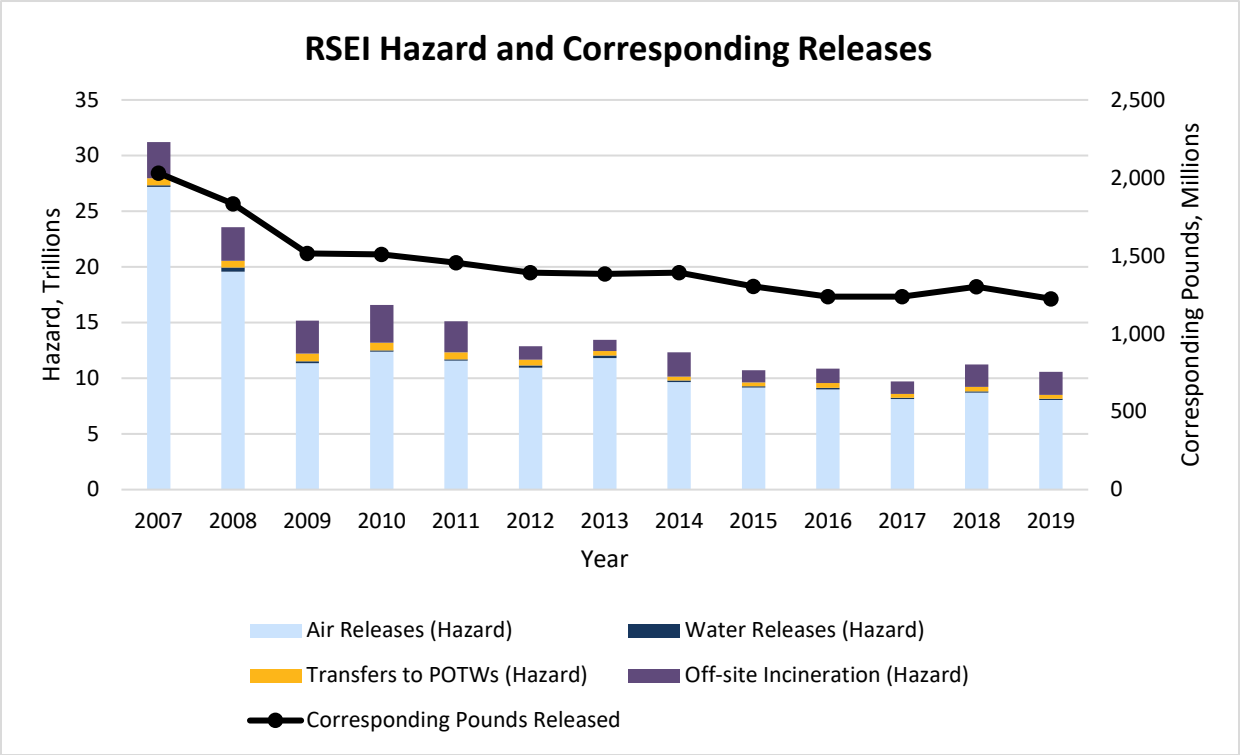
- **RSEI *Hazard*** results consider:
  - Quantity of the chemical released
  - Toxicity of the chemical
- **RSEI *Scores*** consider:
  - Quantity of the chemical released
  - Toxicity of the chemical
  - Location of releases
  - Environmental fate and transport
  - Human exposure pathway

Important notes about RSEI:

- RSEI is not a stand-alone source of information for making conclusions or decisions about the risks posed by any particular facility or environmental release of a TRI chemical.
- RSEI does not assess risk. It provides relative risk rankings from air emissions and water discharges of TRI-listed chemicals.
- RSEI results should not be used to determine whether a facility is in compliance with federal or state regulations.
- RSEI results should only be used for screening-level activities, such as:
  - trend analyses comparing potential relative risks from year to year, and
  - ranking and prioritizing chemicals, industry sectors, or geographic regions for strategic planning.
- RSEI can be used with other data sources and information to help policy makers, researchers, and communities establish priorities for further investigation and to look at changes in potential human health impacts over time.
- RSEI can help identify situations of greatest potential risk and evaluate trends over time.

Hazard Trend

RSEI Hazard estimates provide greater insight on the potential impacts of TRI chemical releases than consideration of the release quantities alone. RSEI Hazard is calculated by multiplying release and certain transfer quantities by the toxicity weight of the chemicals. The following graph shows the trend in RSEI Hazard compared to the trend in the corresponding pounds of TRI chemical releases that are included in the RSEI model. Modeled releases include on-site releases to air and water, and off-site transfers to POTWs or incineration.



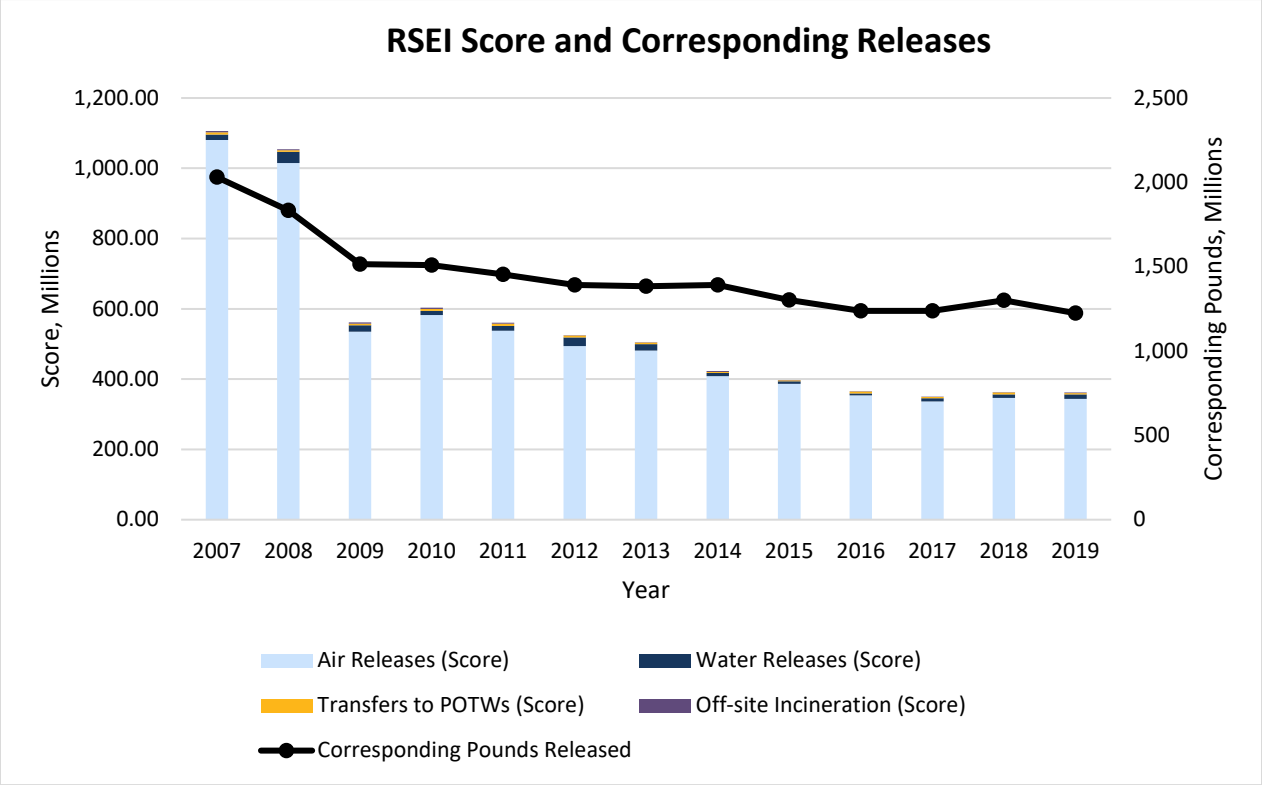
Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2007 to 2019:

- The overall RSEI Hazard estimate decreased by 66%, while corresponding pounds released decreased by 40%. Thus, in recent years, TRI-reporting facilities are not only releasing fewer pounds of TRI chemicals, they may be releasing proportionally fewer pounds of the more toxic TRI chemicals relative to the less toxic TRI chemicals.
- The decrease in the RSEI Hazard estimate from 2008 to 2009 was driven by a large decrease in chromium releases to air from three facilities.

Risk-Screening Trend

EPA's RSEI model also provides risk "scores" that represent relative human health risk from long-term exposure to TRI chemicals. These scores can be compared to RSEI-generated risk scores from other years. RSEI Scores are different from RSEI Hazard estimates in that RSEI Scores consider the location of the release, chemical fate and transport throughout the environment, and the route and extent of potential human exposure. The following graph shows the trend in the RSEI Score compared to the trend in the corresponding pounds of TRI chemical releases that are included in the RSEI model. Modeled releases include on-site releases to air and water, and off-site transfers to POTWs or incineration.



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

From 2007 to 2019:

- The overall RSEI Score estimate decreased by 67%, while corresponding pounds released decreased by 40%.
- Of the types of releases modeled by RSEI, air releases, by far, contributed the most to the RSEI Scores.

- RSEI Scores for releases to water have increased in recent years, due in part to increased releases of mercury to water.

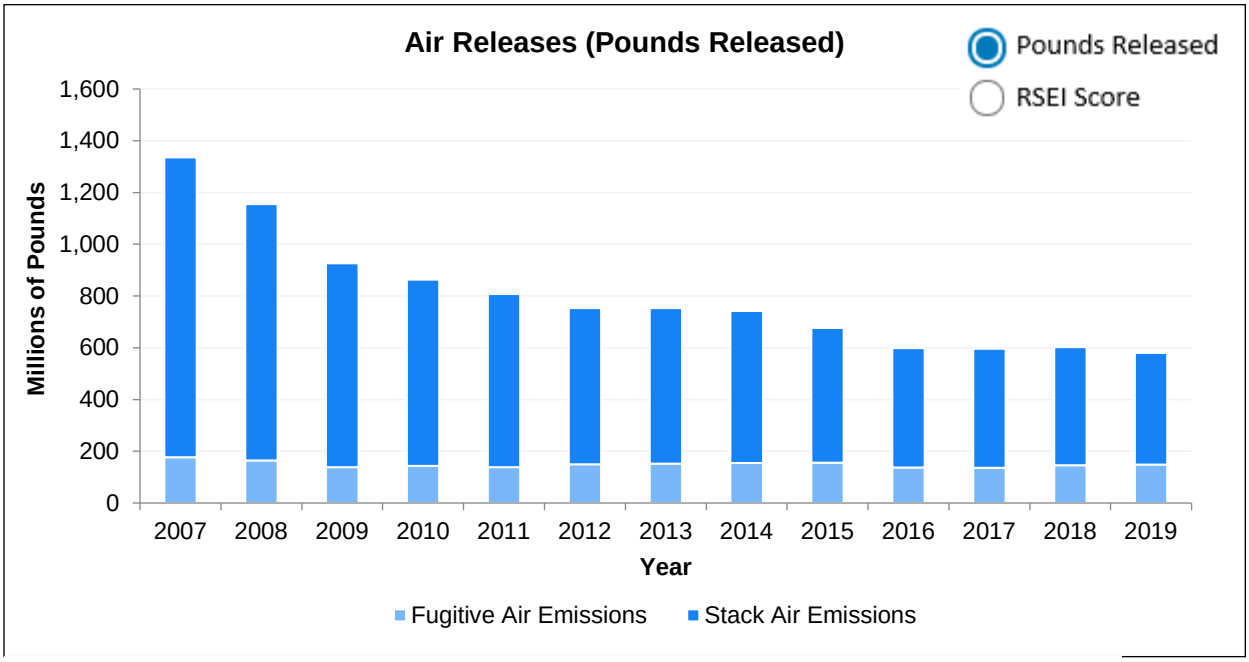
RSEI Dashboard

- 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 RSEI information for a specific chemical or location of interest.

Air Releases

Emissions of TRI chemicals to air continue to decline, serving as a primary driver of decreased total releases. Releases to air include both fugitive air emissions and stack air emissions.

This graph shows the trend in the pounds of chemicals released to air. EPA regulates air emissions under the Clean Air Act, which requires 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 2007 to 2019:

- Releases to air decreased by 57% (-756 million pounds).
  - Since 2007, hydrochloric acid, sulfuric acid, hydrogen fluoride, methanol, toluene, and xylene had the greatest reductions in releases to air.
  - The 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

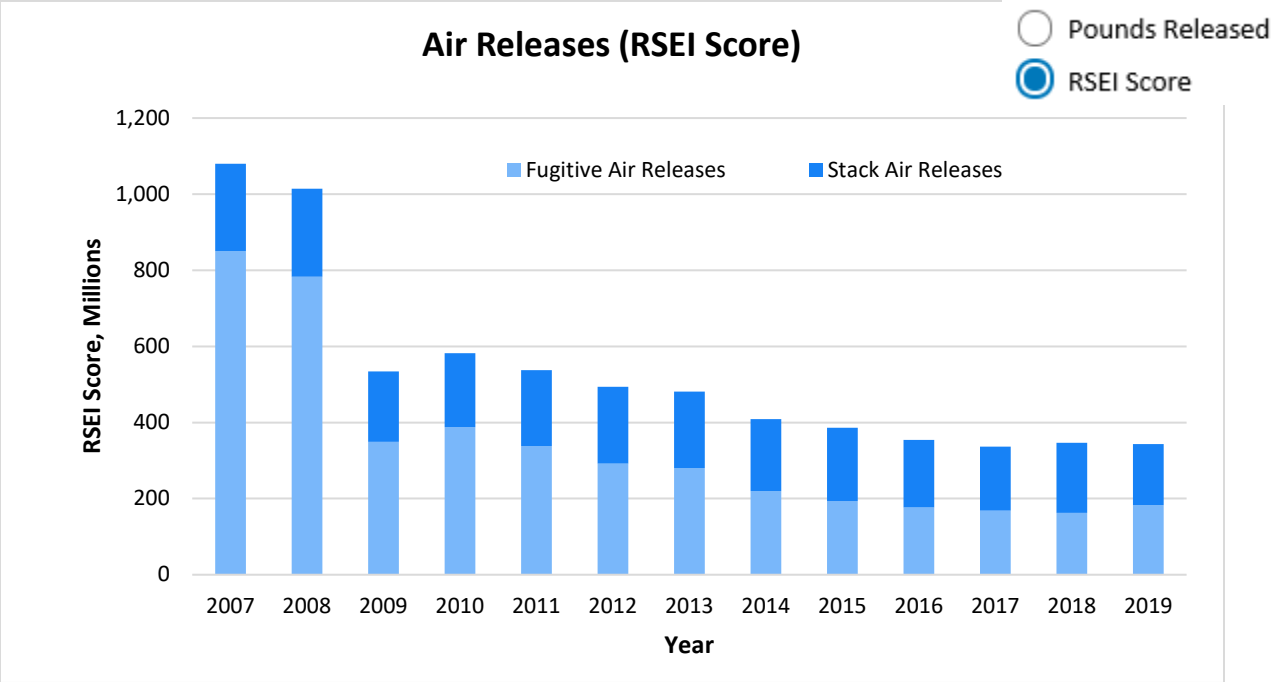
or oil to entirely using other fuel sources (such as natural gas) are not required to report to TRI.

- 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 2019:

- The TRI chemicals released in the largest quantities were ammonia and methanol.
- Releases of TRI chemicals to air decreased by 3.7% since 2018.

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



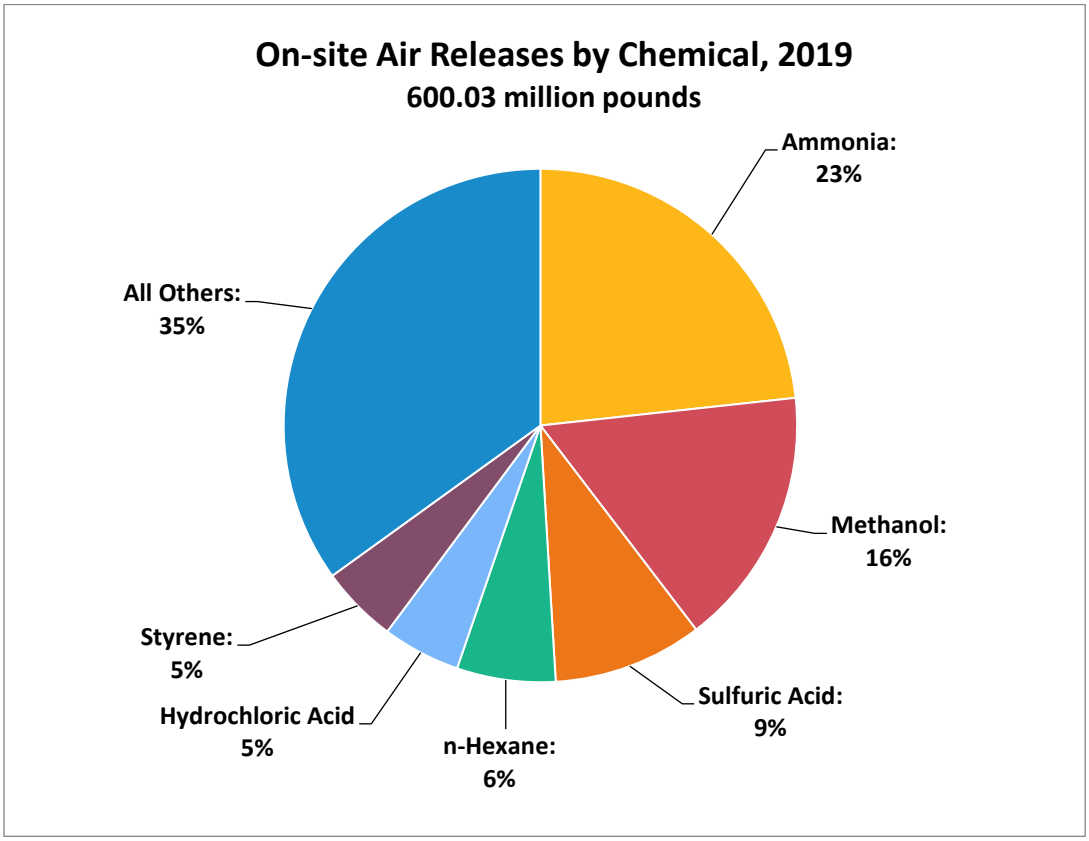
Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

- Stack air releases reported to TRI are considerably higher in pounds than fugitive air releases, but their relative contributions to the RSEI Score have been similar in recent years. This is because chemicals released through stacks tend to get dispersed over a wider area than fugitive air releases, resulting in lower average concentrations, and as a result, surrounding populations have a lower potential to be exposed to TRI chemicals released to air through stacks compared to fugitive emissions.
- For a complete, step-by-step description of how RSEI models and derives RSEI Scores 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, RSEI Version 2.3.8.
- For general information on how RSEI Scores are estimated, see Hazard and Potential Risk of TRI Chemicals.

Air Releases by Chemical and Industry

Air Releases by Chemical

This pie chart shows which TRI chemicals were released to air in the greatest quantities during 2019.



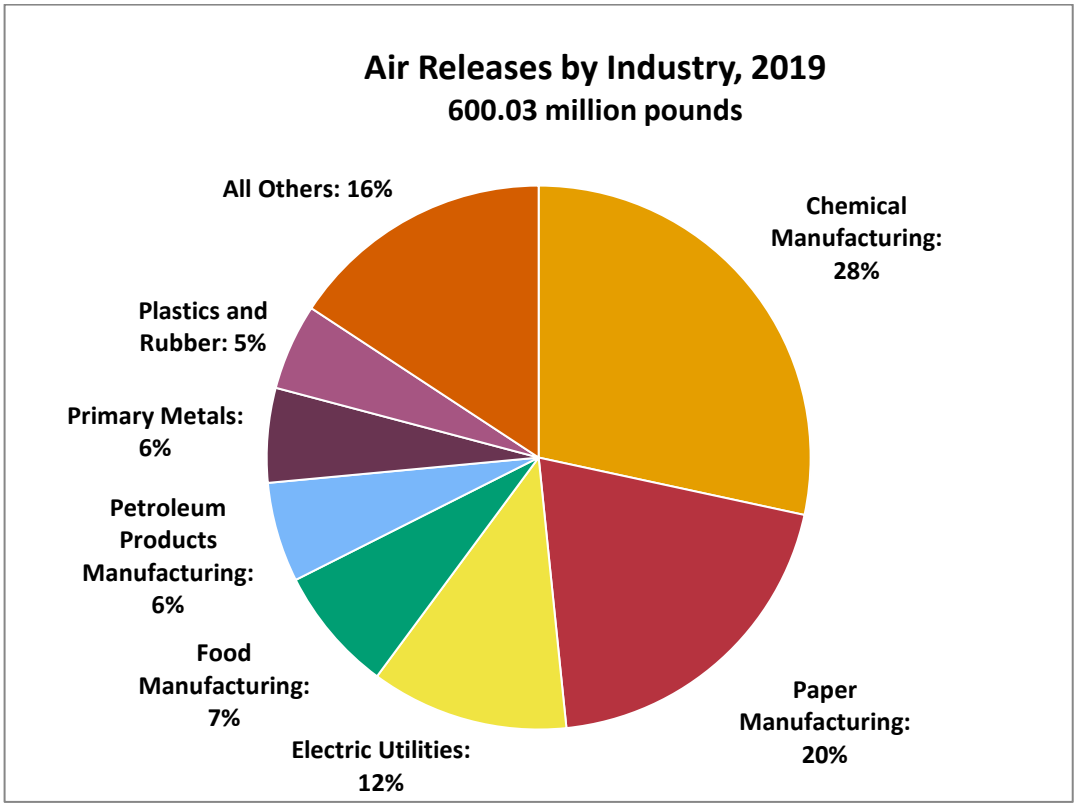
Note: Percentages do not sum to 100% due to rounding.

- Facilities that manufacture nitrogen-based fertilizers accounted for more than one third of the quantities of ammonia released to air, as reported to TRI for the past eight years.
- Releases of methanol to air were primarily from facilities in the paper manufacturing sector and have decreased by 26% since 2007.
- Air releases of *n*-hexane were primarily from food manufacturing facilities. Air releases of *n*-hexane have increased by 6% since 2007.

- In 2019, 79% of sulfuric acid and 29% of hydrochloric acid emissions to air were reported by facilities in the electric utilities sector. The quantities of these two chemicals released to air by electric utilities have decreased considerably since 2007. One reason is the increase in the use of natural gas as a fuel for electricity generation. Power plants that combust only fuels other than coal or oil, such as natural gas, are not required to report to TRI.

Air Releases by Industry

This pie chart shows the TRI-covered industry sectors that reported the largest releases of TRI chemicals to air during 2019.



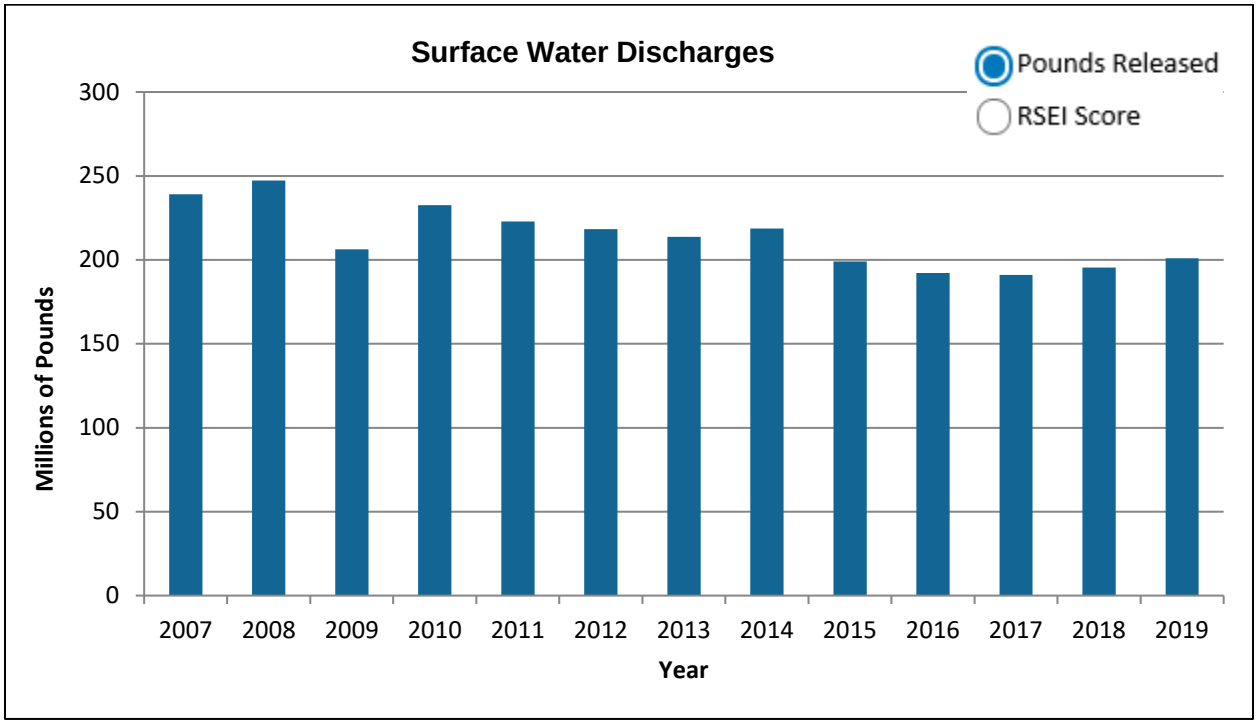
- The chemical manufacturing, paper manufacturing, and electric utility sectors accounted for the largest releases of TRI chemicals to air during 2019, although air releases of TRI chemicals by these industries have decreased since 2018:
    - Chemical manufacturing: 2.2 million pound decrease (-1%)
    - Paper manufacturing: 4.1 million pound decrease (-3%)

- Electric utilities: 10.5 million pound decrease (-13%)

Water Releases

Releases of TRI chemicals to water typically occur as direct discharges to streams or other water bodies. Surface water discharges are often regulated by other programs and require permits such as Clean Water Act National Pollutant Discharge Elimination System (NPDES) permits.

The following graph shows the trend in the pounds of TRI chemical waste discharged to water bodies.



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

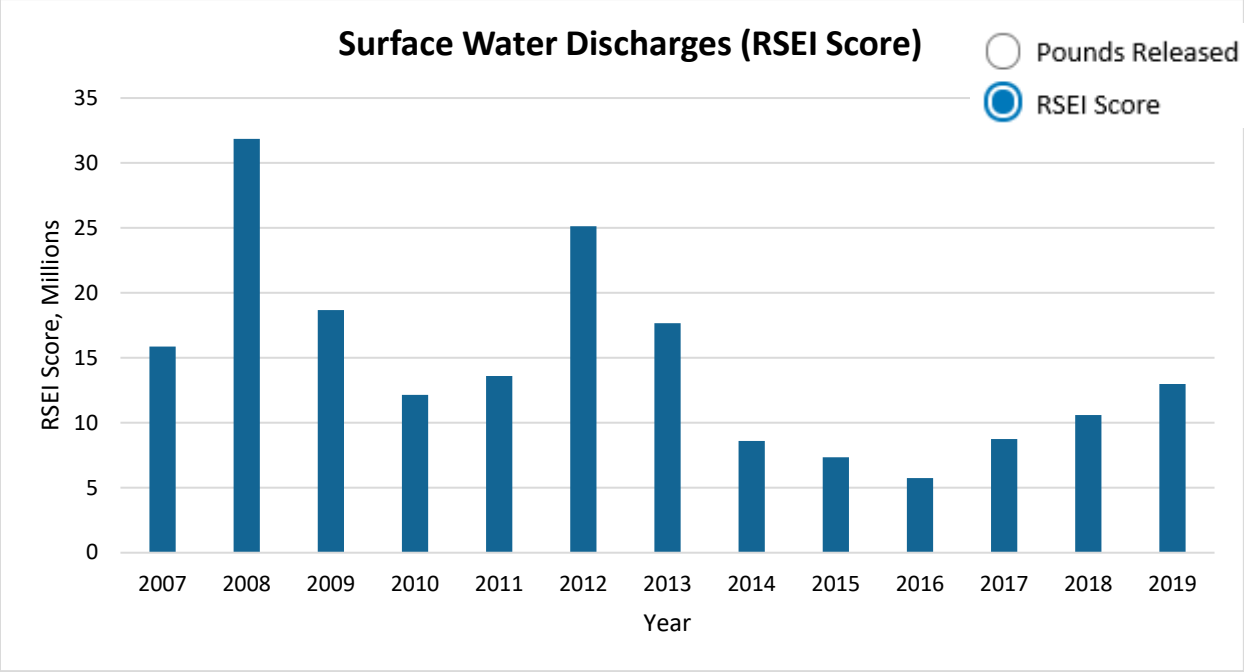
From 2007 to 2019:

- Discharges of TRI chemicals to surface water decreased by 38 million pounds (-16%). Most of this decline was due to reduced releases of nitrate compounds to water.
    - 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 pounds of nitrate compounds are released to water than any other TRI chemical.

In 2019:

- Nitrate compounds alone accounted for 89% of the total quantity of all TRI chemicals discharged to surface waters.

The following graph shows the trend in the RSEI Scores for TRI chemicals released to water bodies.

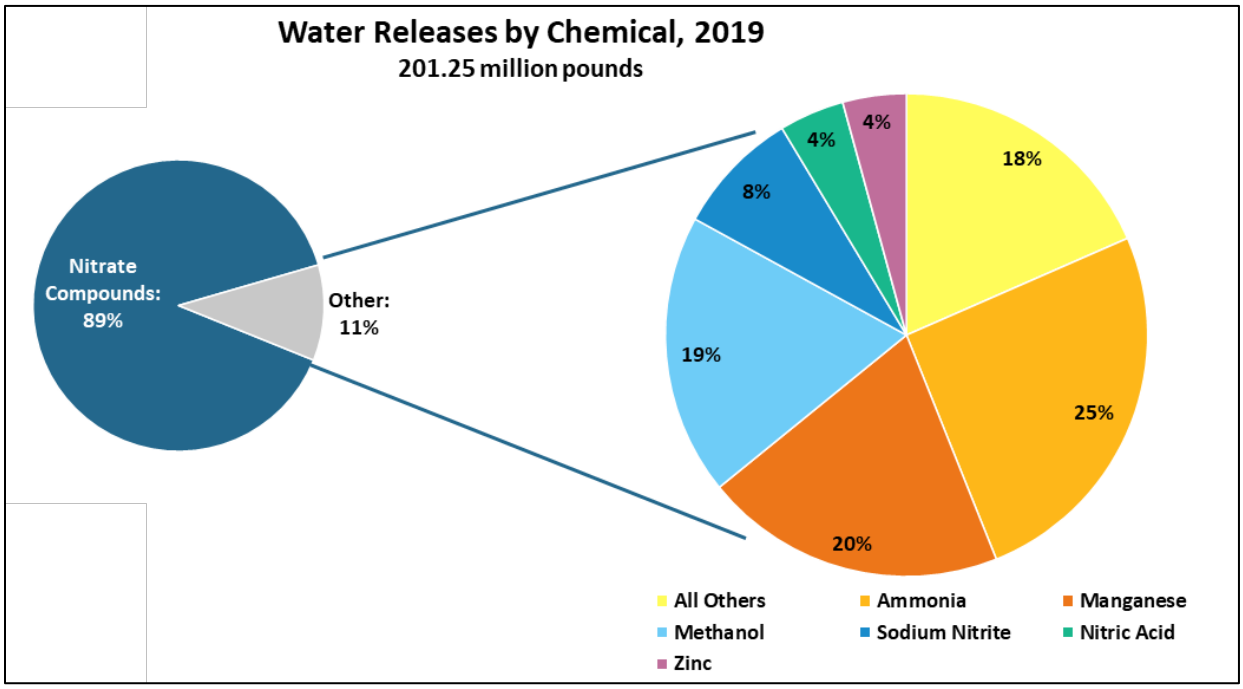


- The biggest contributor to RSEI Scores for releases to water from 2007 to 2018 was arsenic compounds. For 2019, the largest contributor to RSEI Scores for releases to water was mercury compounds.
- The high RSEI Score for discharges to water in 2008 includes a large one-time release of arsenic compounds due to a coal fly ash slurry spill, and a release of benzidine, which is highly toxic (benzidine is known to cause cancer in humans).
- The increase in RSEI Score for releases to water beginning in 2017 is driven in part by an increase in discharges of mercury compounds to water by a mining facility in Florida.

- For a complete, step-by-step description of how RSEI derives RSEI Scores 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, RSEI Version 2.3.8.
- 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 to water bodies in the largest quantities during 2019.



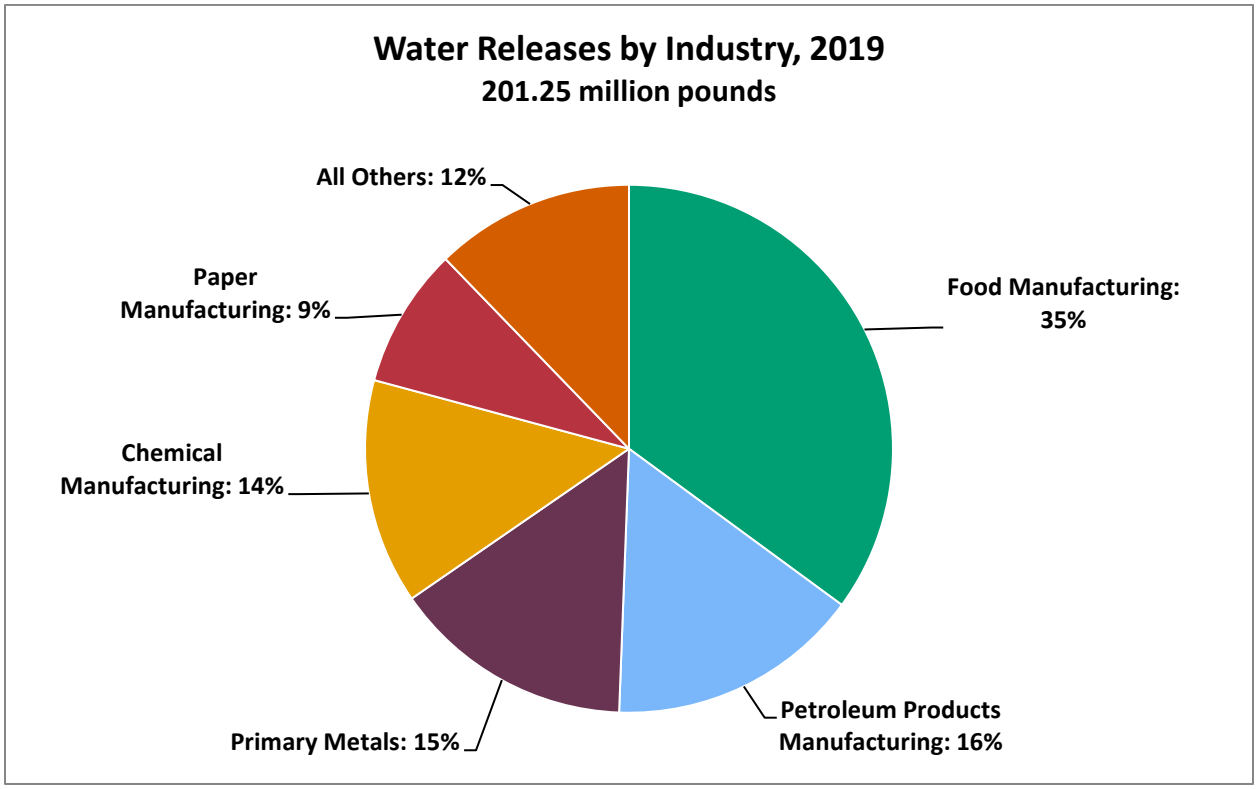
Note: 1) In this chart, metals are combined with their metal compounds, although metals and compounds of the same metal are listed separately on the TRI list (e.g. manganese is listed separately from manganese compounds). 2) Percentages do not sum to 100% due to rounding.

- Nitrate compounds accounted for 89% of the total quantity of TRI chemicals released to water in 2019. Nitrate compounds dissolve in water and are commonly formed as part of facilities' on-site wastewater treatment processes. The food manufacturing sector contributed 39% of total nitrate compound releases to water, due to the treatment required for biological materials in wastewater, such as from meat processing facilities.
    - While nitrate compounds are less toxic to humans than many other TRI chemicals, 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.

- Ammonia, manganese compounds, and methanol were the chemicals released in the next-largest quantities, and, in terms of combined mass, accounted for 7% of the chemicals released to water.

Water Releases by Industry

This pie chart shows the TRI-covered industry sectors that reported the greatest releases of TRI chemicals to water bodies during 2019.



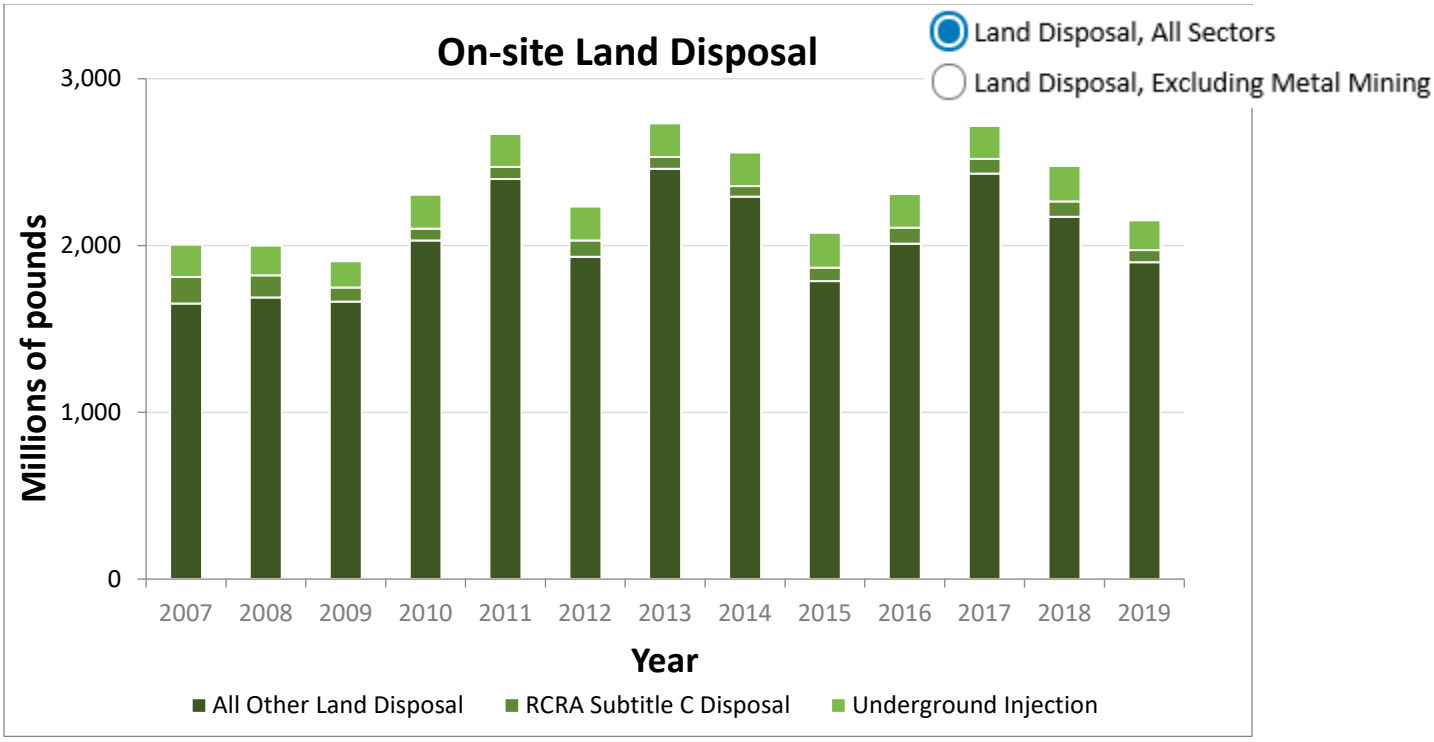
Note: Percentages do not sum to 100% due to rounding.

- The food manufacturing sector accounted for 35% of the total quantity of TRI chemicals released to water during 2019, which was similar to its contribution over the past 10 years.
    - Nitrate compounds accounted for 99% of the total quantity of TRI chemicals released to water from the food manufacturing sector. Nitrate compounds are relatively less toxic to humans than many other TRI chemicals discharged to 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, or to other types of containment. Land disposal of chemicals is often regulated by EPA under the Resource Conservation and Recovery Act (RCRA).

This graph shows the trend in chemicals reported to TRI that were disposed of to land on site. 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 2007 to 2019:

- On-site land disposal increased by 7% (from 2.0 to 2.2 billion pounds).
- Recent fluctuations were primarily due to changes in TRI chemical quantities disposed of on site to land by metal mines.

- "All Other Land Disposal" in the figure includes disposal: in landfills and surface impoundments that are not regulated under RCRA Subtitle C; to soil (land treatment/application farming); and any other land disposal. Most of the TRI chemical quantities reported as "other land disposal" were from the disposal of TRI chemicals contained in waste rock at metal mines.

Helpful Concepts

What is underground injection?

Underground injection involves placing fluids underground in porous formations through wells.

What is RCRA Subtitle C disposal?

The RCRA Subtitle C Disposal category in TRI includes disposal to landfills and surface impoundments authorized to accept hazardous waste under the Resource Conservation and Recovery Act (RCRA). RCRA design standards include a double liner, a leachate collection and removal system, and a leak detection system. Operators must also comply with RCRA inspection, monitoring, and release response requirements.

In 2019:

Trends in land disposal were largely driven by the metal mining sector, which accounted for 69% of land disposal quantities. Select the “Land Disposal, Excluding Metal Mining” button to view the land disposal trend without data from metal mines.

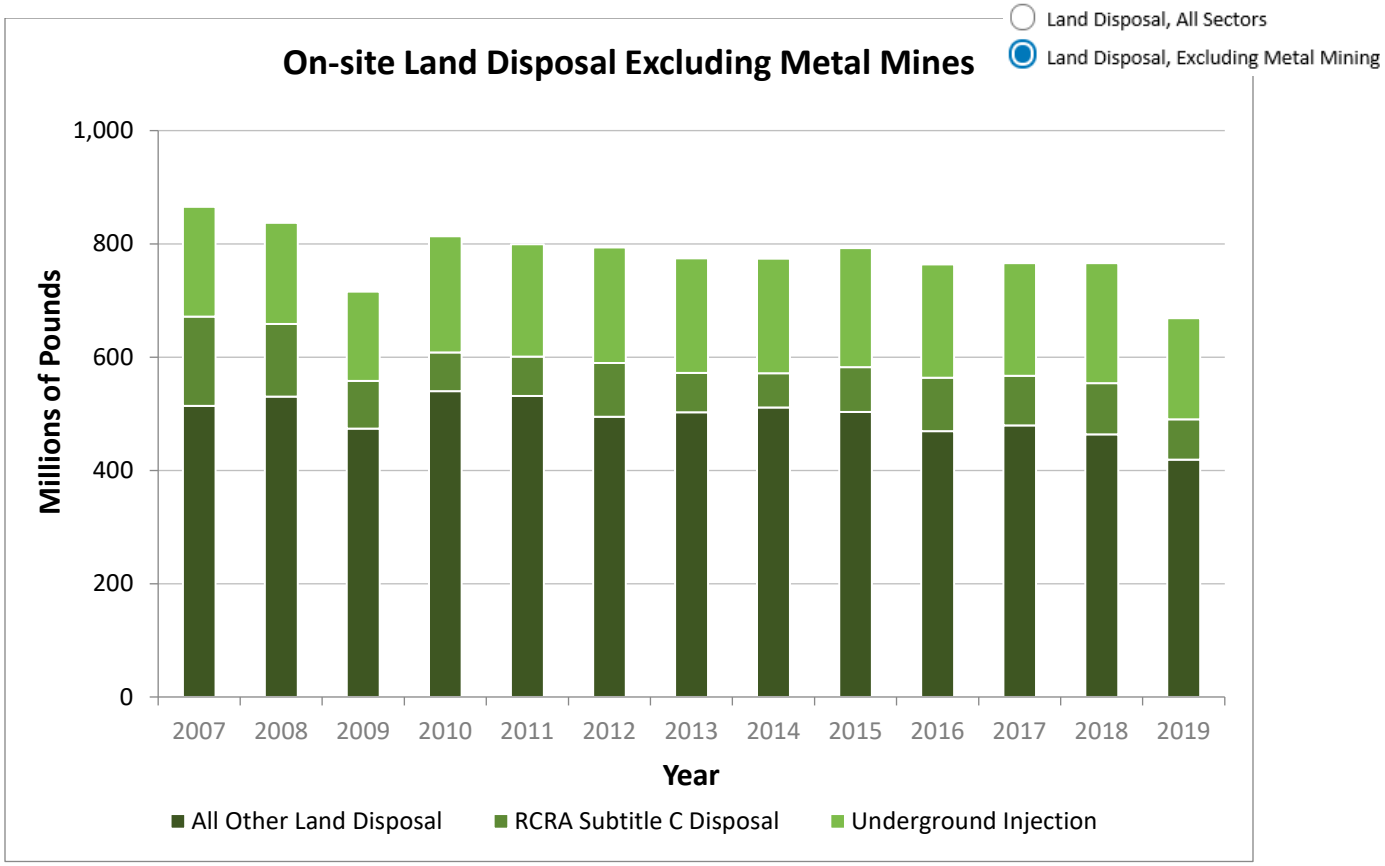
- Most of the land disposal quantities from the metal mining sector were made up of either lead compounds (39%) or zinc compounds (31%).

Metal mining facilities typically handle large volumes of material. In this sector, even a small change in the chemical composition of the mineral deposit being mined can lead to big changes in the amount of TRI-listed chemicals reported. Besides production volume, one factor commonly 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 trend in chemicals reported to TRI that were disposed of to land on site, excluding quantities reported by the metal mining sector. The metal mining sector accounts for most of the TRI chemical quantities disposed of to land.



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

From 2007 to 2019:

- Total on-site land disposal for all industries other than metal mining decreased by 23%.
- The decrease in land disposal for industries other than metal mining was driven by reduced releases to land from electric utilities, chemical manufacturing facilities, and hazardous waste management facilities.

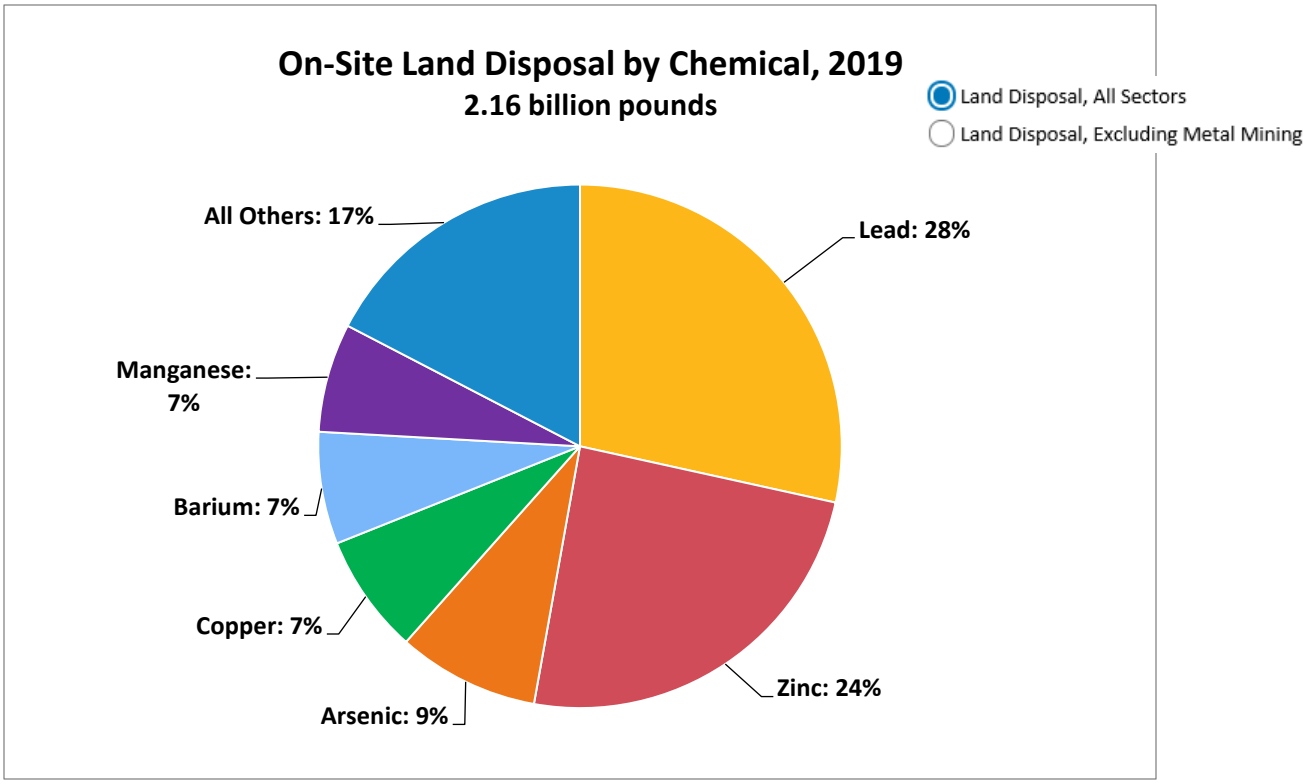
In 2019:

- Excluding the quantities of TRI chemicals disposed of on site to land at metal mines, the chemicals disposed of to land in the largest quantities were: barium and barium compounds (17%), manganese and manganese compounds (13%), and zinc and zinc compounds (10%).

- Excluding the quantities of TRI chemicals disposed of on site to land at metal mines, most land disposal quantities were reported by the chemical manufacturing, electric utilities, primary metals, and hazardous waste management sectors.

Land Disposal by Chemical

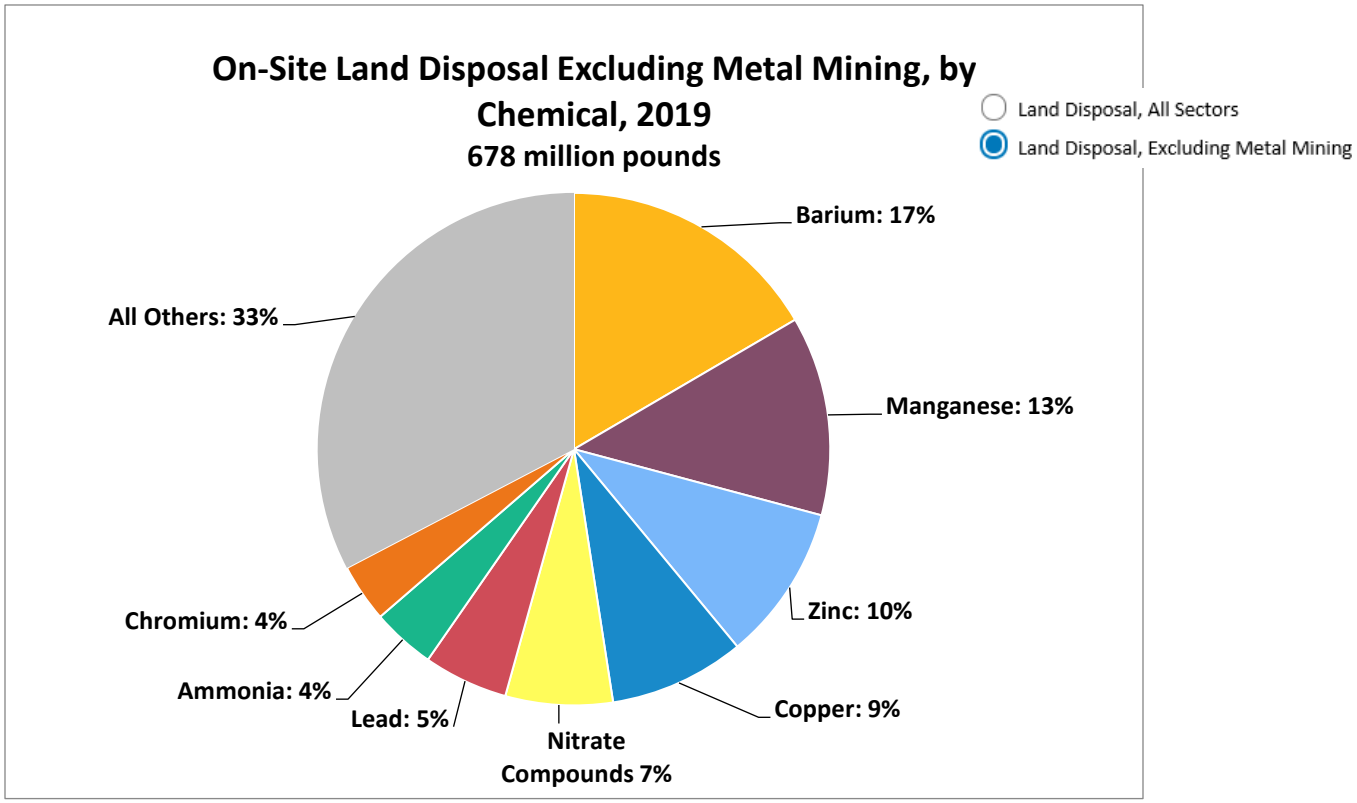
This pie chart shows the chemicals disposed of to land on site in the greatest quantities during 2019. The metal mining sector accounts for most of this disposal. To view the chemicals disposed of to land by sectors other than metal mining, toggle to the "Land Disposal, Excluding Metal Mining" chart.



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). Percentages do not sum to 100% due to rounding.

The metal mining sector alone was responsible for 94% of the lead and lead compounds and 87% of the zinc and zinc compounds disposed of to land in 2019. Annual fluctuations occur in land disposal quantities reported by metal mines because even a small change in the chemical composition of the mineral deposit being mined can lead to big changes in the amount of TRI-listed chemicals reported nationally.

This pie chart shows the chemicals disposed of to land on site in the greatest quantities during 2019, excluding quantities disposed of by facilities in the metal mining sector.



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.

From 2007 to 2019:

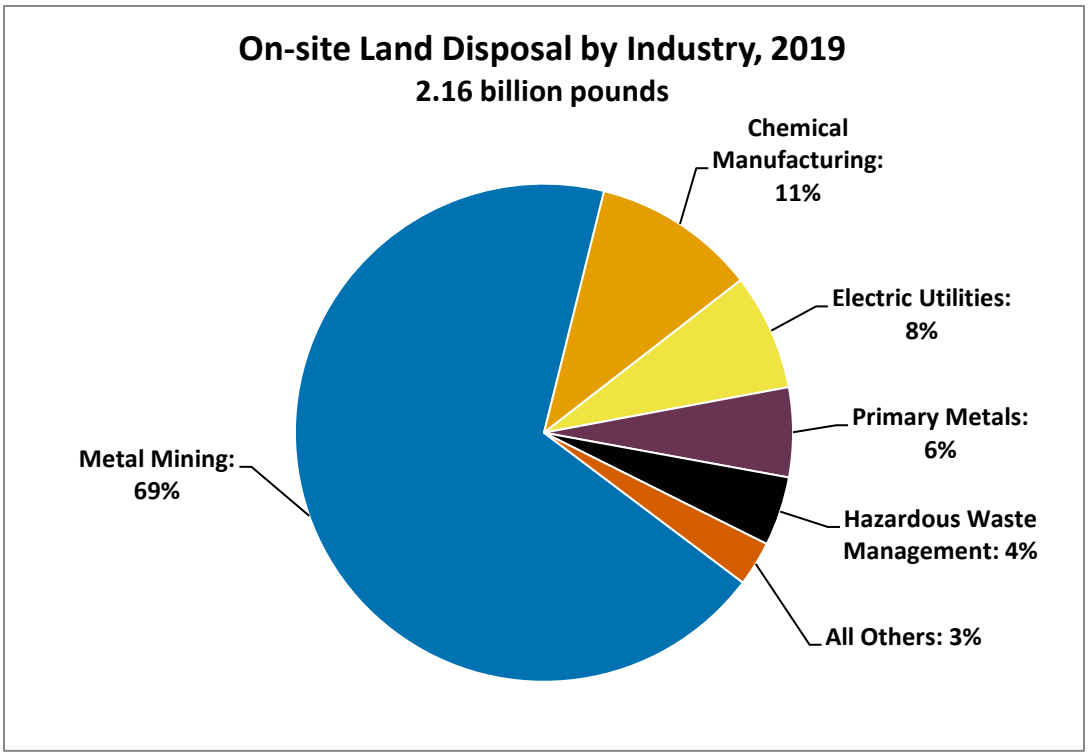
- Barium: Releases decreased 40%.
- Manganese: Releases decreased 23%.
- Zinc: Releases decreased 55%.

In 2019:

- 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.

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 2019.



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

- The metal mining sector accounted for most of the TRI chemicals disposed of to land in 2019, mostly due to TRI chemicals contained in waste rock.
- 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 Toxics Release Inventory (TRI) chemicals that are of special concern due to their potential effects on human health and the environment: 1) persistent bioaccumulative toxic (PBT) chemicals; and 2) known or suspected human carcinogens.

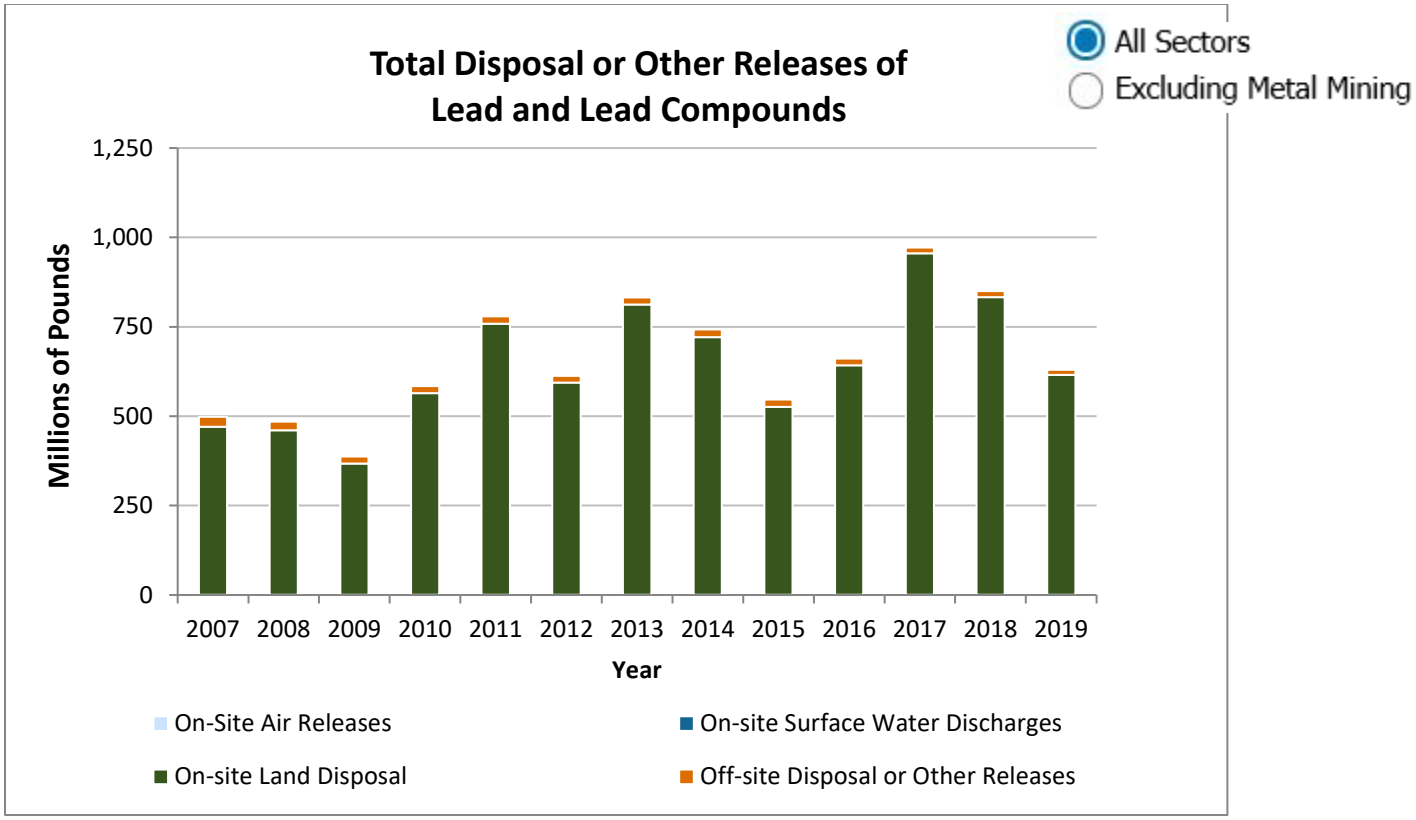
Chemicals designated as PBTs are toxic and remain in the environment for a long time where they tend to build up in the tissues of aquatic or other organisms throughout the food web. These organisms serve as food sources for other organisms, including humans, that are sensitive to the toxic effects of 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. This section focuses on the following PBT chemicals: lead and lead compounds; mercury and mercury compounds; and dioxin and dioxin-like compounds.

There are also chemicals on the TRI chemical list that the Occupational Safety and Health Administration (OSHA) includes on its list of carcinogens. This section presents the trend in air emissions for the OSHA carcinogens reported to TRI and one OSHA carcinogen, ethylene oxide, is highlighted individually. A list of the TRI carcinogens can be found on the TRI basis of OSHA carcinogens webpage.

Lead Releases Trend

This graph shows the 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.



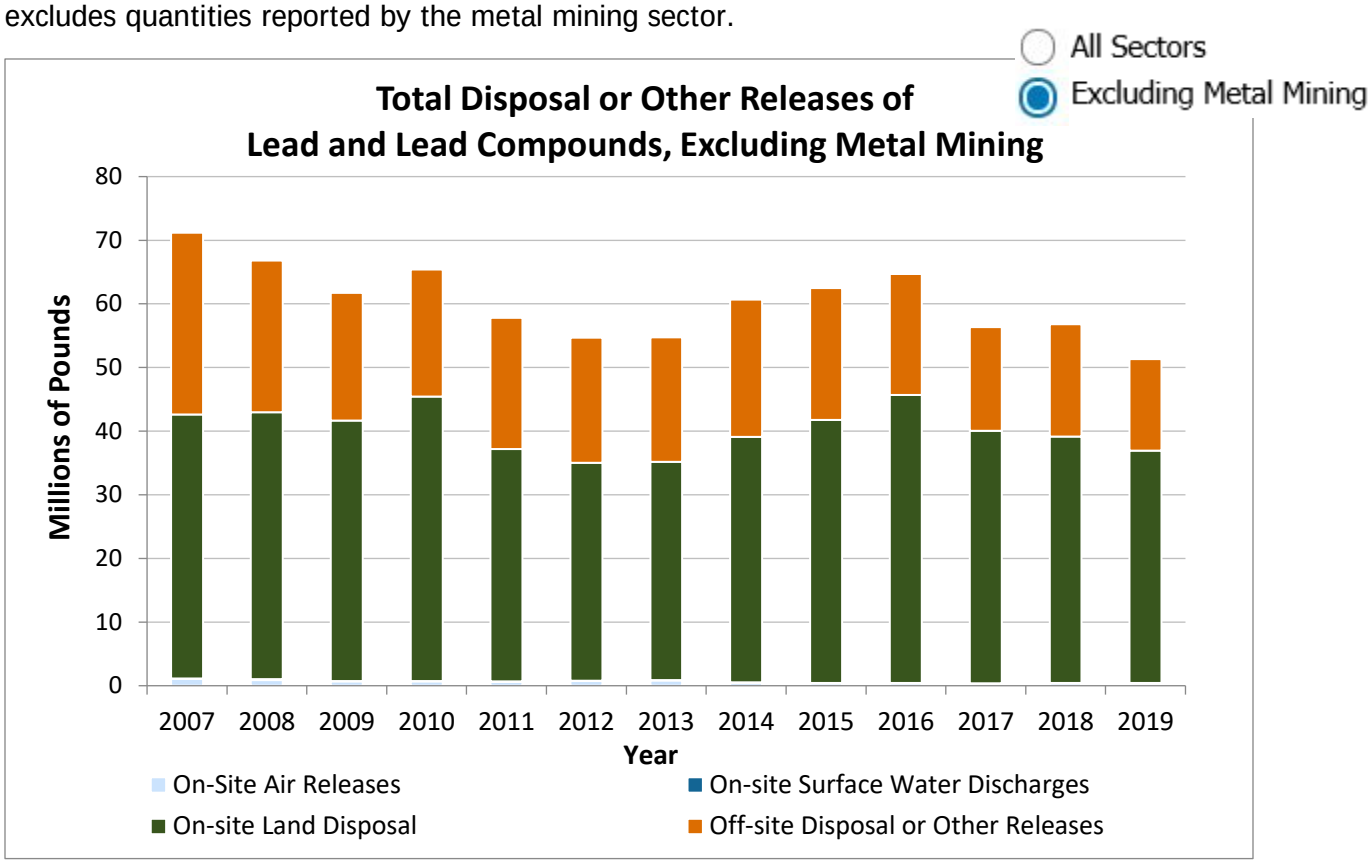
From 2007 to 2019:

- Releases of lead and lead compounds rose and fell between 2007 and 2019, with an overall increase of 26%.
- The metal mining sector accounts for most of the lead and lead compounds disposed of on site to land, driving the overall trend. For 2019, for example, metal mines reported 94% of total lead and lead compounds disposed of to land on site.

From 2018 to 2019:

- Total releases of lead and lead compounds decreased by 26% (221 million pounds), driven by a 215-million-pound decrease in releases of lead compounds from the metal mining sector.

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

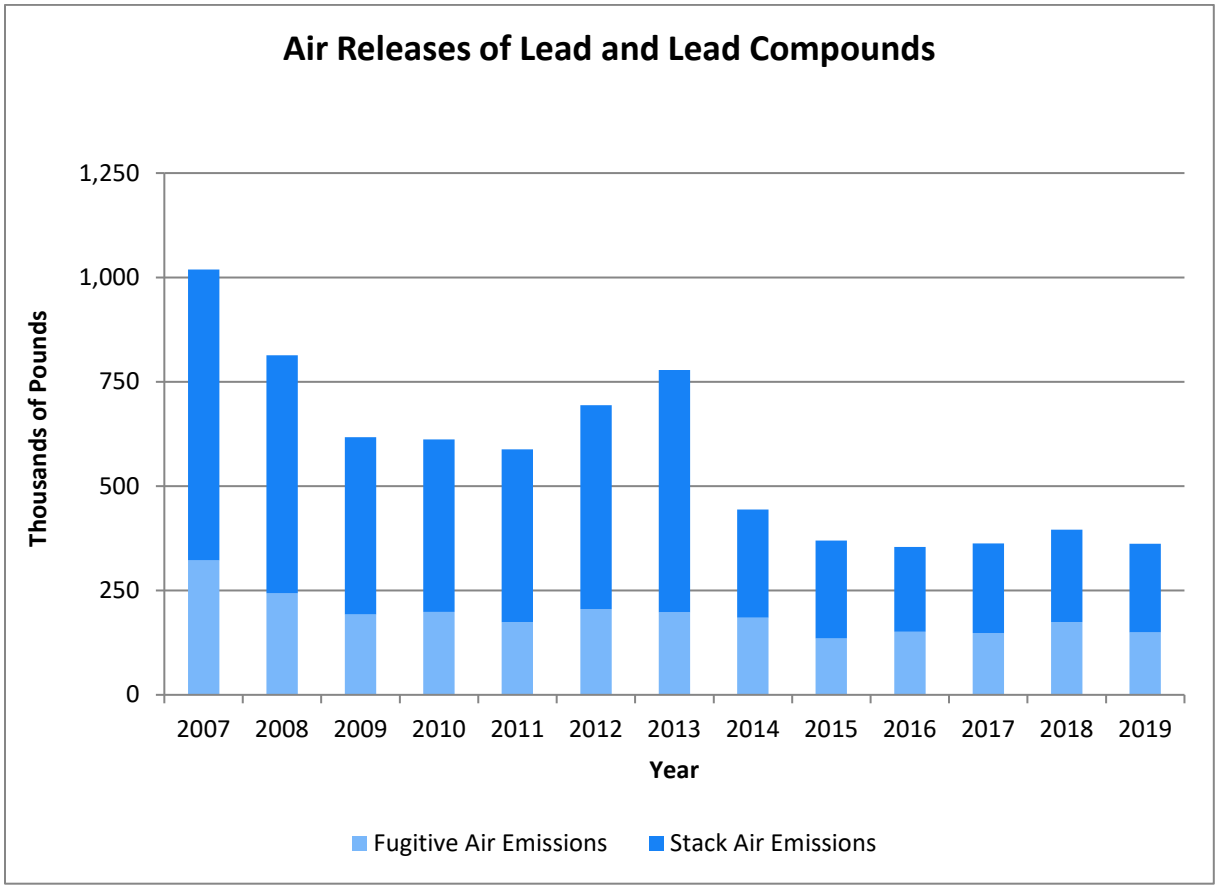


From 2007 to 2019:

- Among sectors other than metal mining, releases of lead and lead compounds have decreased by 28% (19.7 million pounds).
- Among sectors other than metal mining, most releases of lead and lead compounds were from the primary metals and hazardous waste management sectors.

Lead Air Releases Trend

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



From 2007 to 2019:

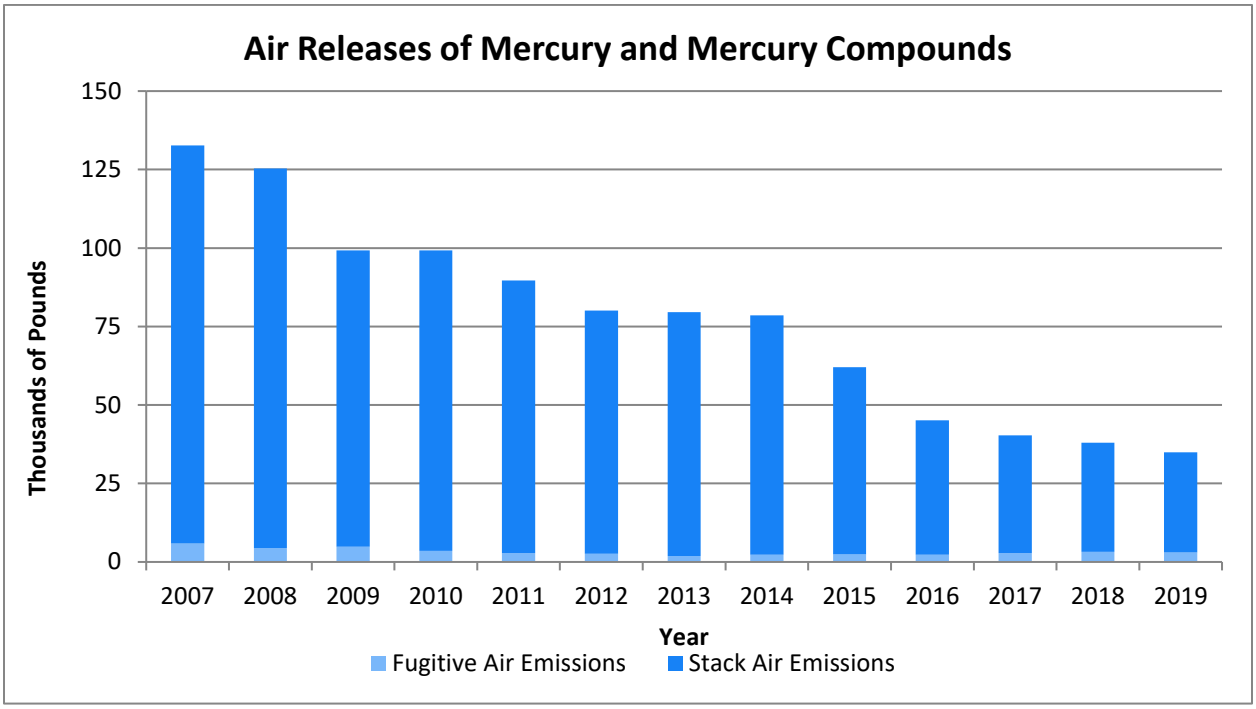
- Air releases of lead and lead compounds decreased by 64%. The primary metals and electric utilities industry sectors have driven this decrease.
- The primary metals sector, which includes iron and steel manufacturers and smelting operations, reported the greatest quantities of releases of lead and lead compounds to air.

From 2018 to 2019:

- Air releases of lead and lead compounds decreased by 9%. This is largely due to a single facility in the primary metals sector, although air emissions of lead and lead compounds decreased in most sectors.
- In 2019, 41% of air releases of lead were from the primary metals industry sector.

Mercury Air Releases Trend

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



From 2007 to 2019:

- Releases of mercury and mercury compounds to air decreased by 73%.
- Electric utilities drove the decline in mercury air emissions, with a 91% reduction (-86,000 pounds).

From 2018 to 2019:

- Releases of mercury and mercury compounds to air decreased by 6%.
- The primary metals sector, which includes iron and steel manufacturers and smelting operations, accounted for 37% of the air emissions of mercury and mercury compounds reported to TRI for 2019.

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, or 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, as indicated by 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.

Helpful Concepts

Toxic Equivalent Factor (TEF)

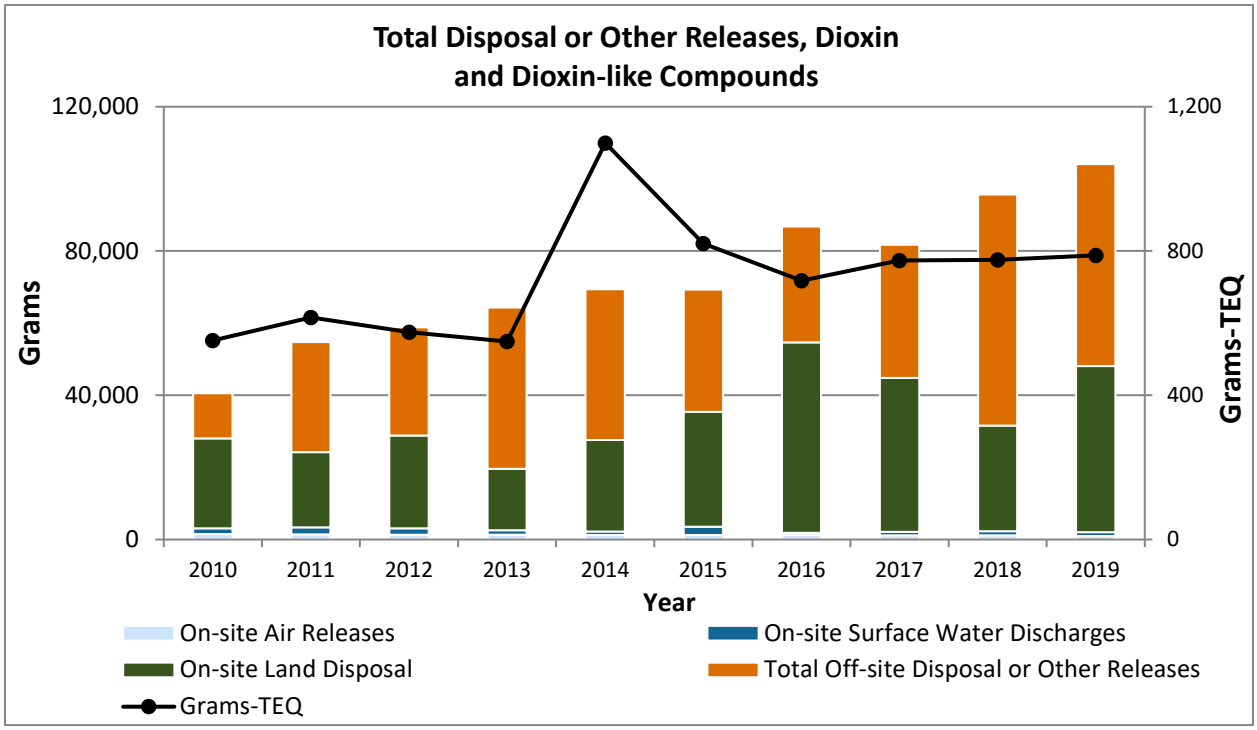
Each dioxin congener is assigned a TEF that provides that compound's toxicity relative to the most toxic compound in the dioxin and dioxin-like compounds category.

Toxic Equivalency (TEQ)

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

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 dioxins releases and are useful when comparing disposal or other 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 dioxins disposed of or otherwise released by TRI-reporting facilities from 2010 to 2019. Note that the dioxins chemical category is reported to TRI in grams while all other TRI chemicals are reported in pounds. A shorter timeframe is presented for the dioxins release trend than for other trend graphs because of the limited availability of TEQ information prior to 2010.



From 2010 to 2019:

- Dioxin releases increased by 157%. This increase was largely driven by three facilities that together released 67% of all TRI-reported dioxins.
    - Increases in off-site releases of dioxins were largely driven by the same three facilities, two basic organic chemical manufacturing facilities and one smelting and refining facility.
    - Toxicity-equivalents (grams-TEQ) increased by 43%, indicating that releases of the less potent dioxin congeners increased more than the releases of the more potent dioxin congeners from 2010 to 2019.

From 2018 to 2019:

- Releases of dioxins increased by 9%.
    - On-site disposal to land increased by 57% and was driven by two facilities. One of these facilities is in the primary metals sector and regularly reports large year-to-year variance in its releases of dioxins. The other is a hazardous waste

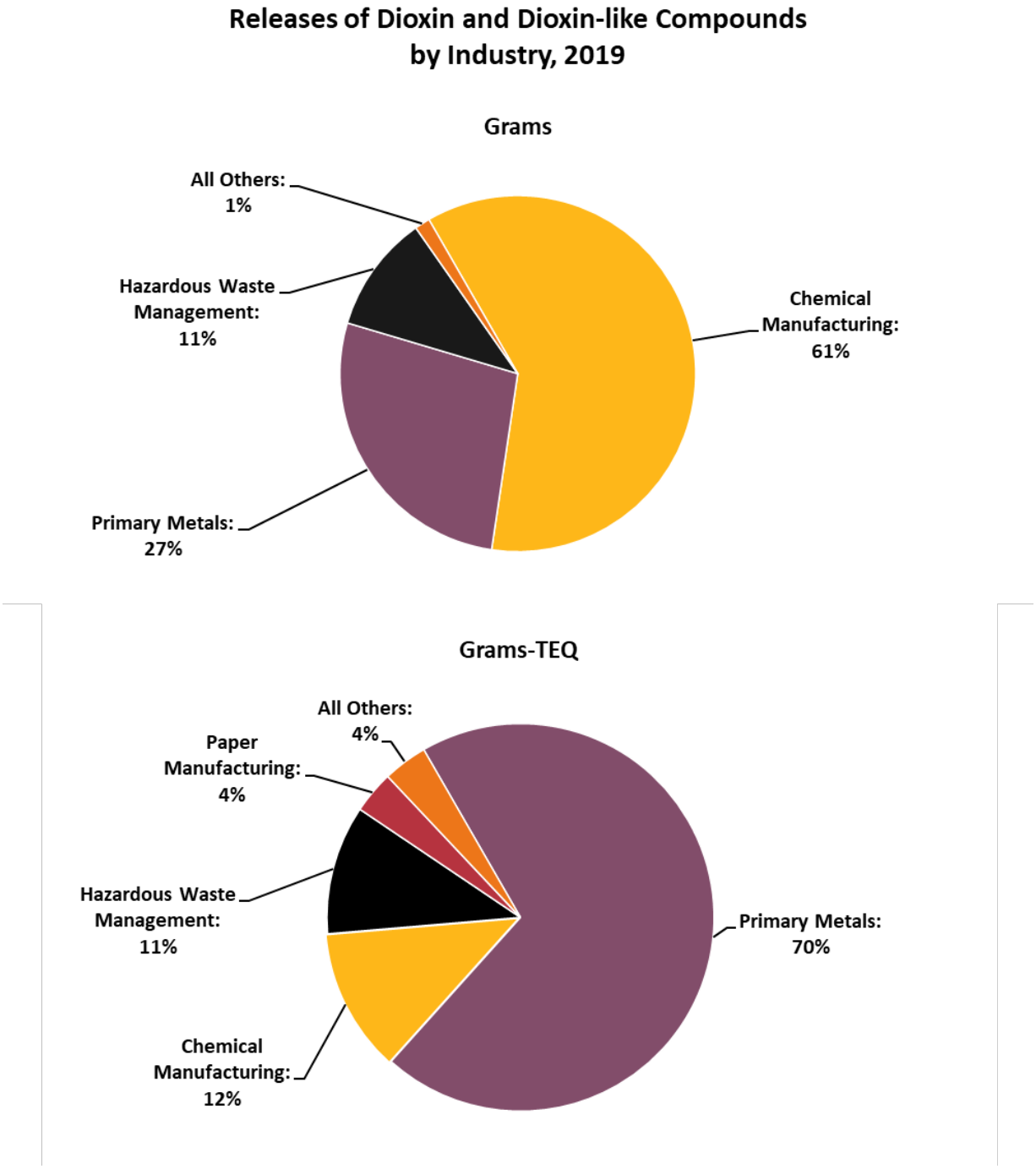
management facility, which reported receiving a dioxin-contaminated debris stream in 2019.

  - Toxicity-equivalents (grams-TEQ) increased by 2%.

- In 2019, most of the TRI-reported dioxin quantity released was disposed or otherwise released off site (54%) or disposed of on site to land (44%).

Dioxins Releases by Industry

The following two pie charts show: 1) the TRI-covered industry sectors that reported the largest releases of dioxin and dioxin-like compounds in grams, compared to 2) the industry sectors that reported the greatest releases of grams in toxicity equivalents (grams-TEQ). Note that only data from those TRI reports that included the congener detail for calculating grams-TEQ are included in these charts.



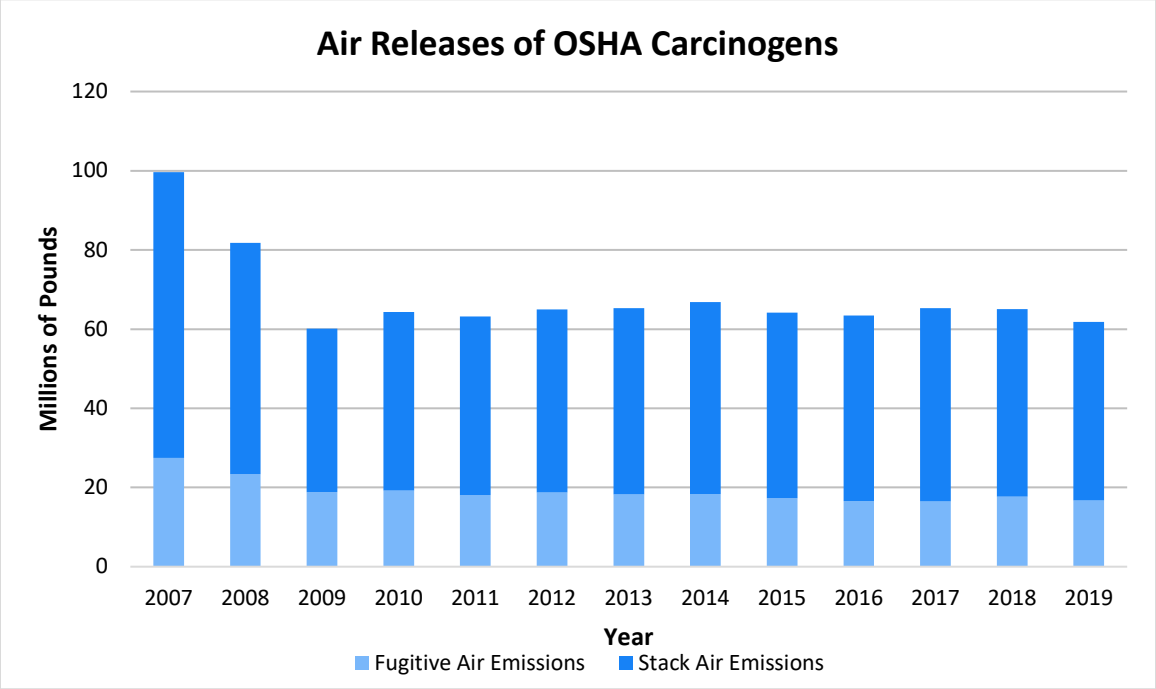
Note: Percentages do not sum to 100% due to rounding.

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

- The chemical manufacturing industry accounted for 61% and the primary metals sector for 27% of total grams of dioxins released.
- However, in terms of toxicity equivalents the primary metals sector accounted for 70% and the chemical manufacturing sector for 12% of the total grams-TEQ.

Occupational Safety and Health Administration (OSHA) Carcinogens Air Releases

Among the chemicals that are reportable to the TRI Program, some are also included on OSHA's list of carcinogens. EPA refers to these chemicals as TRI OSHA carcinogens. This graph shows the trend in the pounds of TRI-reported OSHA carcinogens released to air.



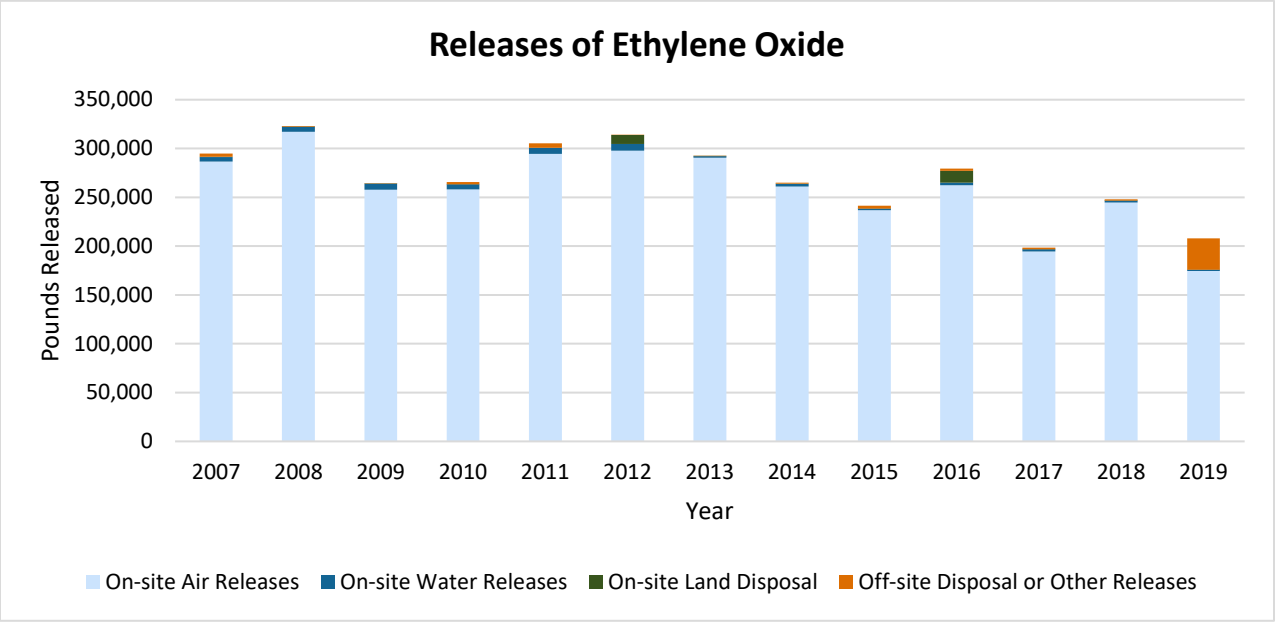
Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2007 to 2019:

- Releases of these carcinogens to air decreased by 38%.
- The long-term decreases in releases of OSHA carcinogens to air were driven by decreases in releases of many chemicals across multiple sectors. Almost every TRI-covered industry sector decreased its releases of carcinogens to air from 2007 to 2019.
- In 2019, releases of OSHA carcinogens to air consisted primarily of styrene (47% of the air releases of all OSHA carcinogens), acetaldehyde (12%) and formaldehyde (8%).

Ethylene Oxide Releases Trend

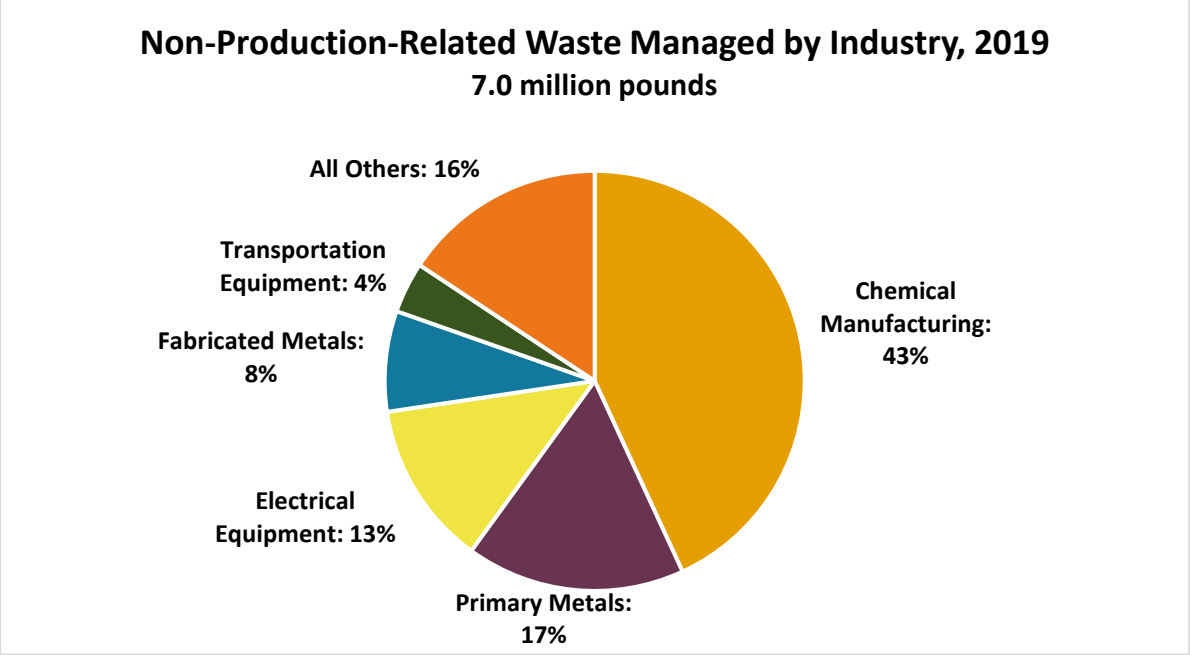
In 2019, EPA announced a suite of actions to address emissions of ethylene oxide, an OSHA carcinogen, from some types of industrial facilities. The figure below presents the trend in releases of this chemical, as reported to TRI.



- From 2007 to 2019, releases of ethylene oxide decreased by 86.9 million pounds (-29%), driven by reductions in releases to air.
- For 2019, the increase in off-site transfers was driven by one hazardous waste management facility. This facility originally claimed it transferred over 30,000 pounds of ethylene oxide off site for disposal in landfills. EPA questioned this claim, and the facility indicated that the quantity transferred off site was not exclusively ethylene oxide gas, and the quantity of ethylene oxide manufactured, processed, or otherwise used in 2019 was less than the TRI threshold quantity. The facility indicated that they intend to withdraw their TRI report for ethylene oxide. As of January 4th, 2021, the facility has not done so.
- For 2018, one chemical manufacturer in Texas reported a one-time (not production-related) air release of ethylene oxide. This release drove an increase in total releases of ethylene oxide from 2017 to 2018 and drove the decrease in total releases of ethylene oxide from 2018 to 2019.

Non-Production-Related Waste

Non-production-related waste refers to quantities of Toxics Release Inventory (TRI) chemicals disposed of or released, or transferred off site, as the result of one-time events, rather than due to standard production activities. These events may include remedial actions, catastrophic events such as natural disasters, or other one-time events not associated with normal production processes. Non-production-related waste is included in a facility's total disposal or other releases but is not included in its production-related waste managed. The following graph shows the quantities of non-production-related waste reported to TRI for 2019.



- For 2019, 551 facilities reported a total of 7.0 million pounds of one-time, non-production-related releases of TRI chemicals. This represents 0.02% of total waste managed in 2019.
- Non-production-related waste from all facilities was below 35 million pounds every year since 2007, except for 2013 when one facility reported a one-time release of 193 million pounds.