2021 TRI National Analysis

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Introduction to the 2021 TRI National Analysis

Industries and businesses in the U.S. use many chemicals to make the products we depend on, such as pharmaceuticals, computers, paints, clothing, and automobiles. While most chemicals on the Toxics Release Inventory (TRI) chemical list are managed by facilities in ways that minimize releases into the environment, releases still occur as part of normal business operations.

It is your right to know what TRI chemicals are being used in your community, how the chemical waste is managed—including through environmental releases—and whether these quantities have changed over time.

The TRI tracks how industries manage certain toxic chemicals. Information facilities report each year to the EPA provides insights into how chemicals are managed by facilities conducting industrial activities such as manufacturing, metal mining, generation of electric power, and hazardous waste management. TRI data are publicly available. For calendar year 2021, more than 21,000 facilities reported to the TRI Program.

Each year, in support of its mission to protect human health and the environment, EPA analyzes the most recent TRI data, conducts comparative analyses with TRI data for previous years, and publishes its findings in the TRI National Analysis.

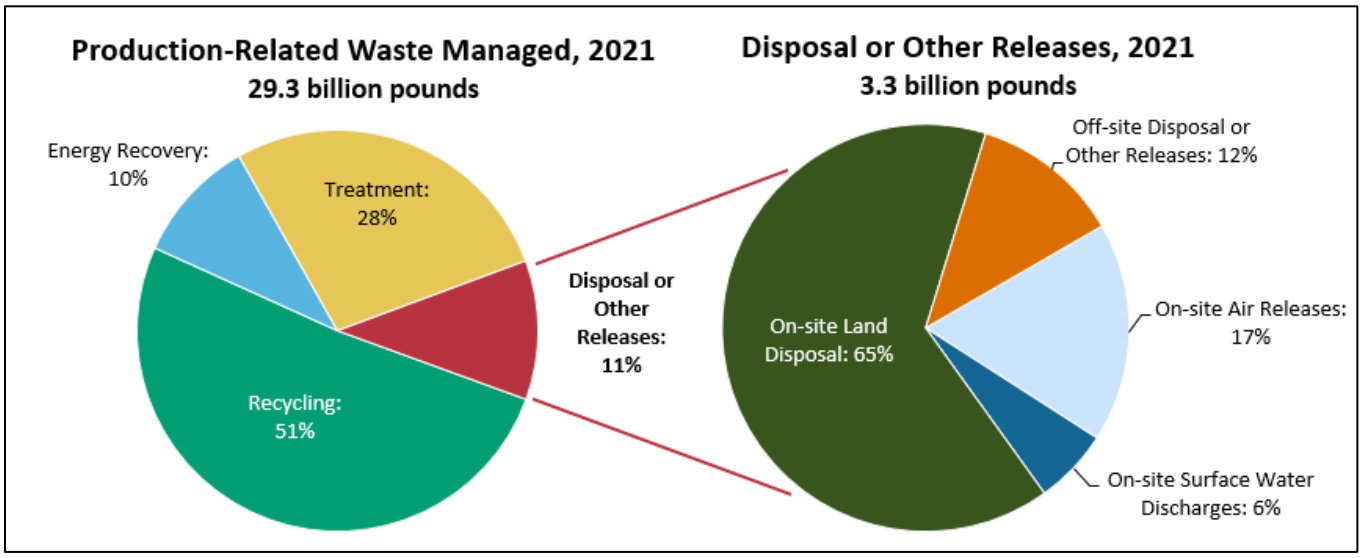
TRI Reporting

Under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) and the Pollution Prevention Act (PPA), facilities that meet TRI reporting requirements must report details about their pollution prevention and waste management activities, including releases, of TRI-listed chemicals that occurred during the calendar year to EPA's TRI Program by July 1 of the following year.

Watch a short video about the TRI Program and your right to know.

Overview of the 2021 TRI data

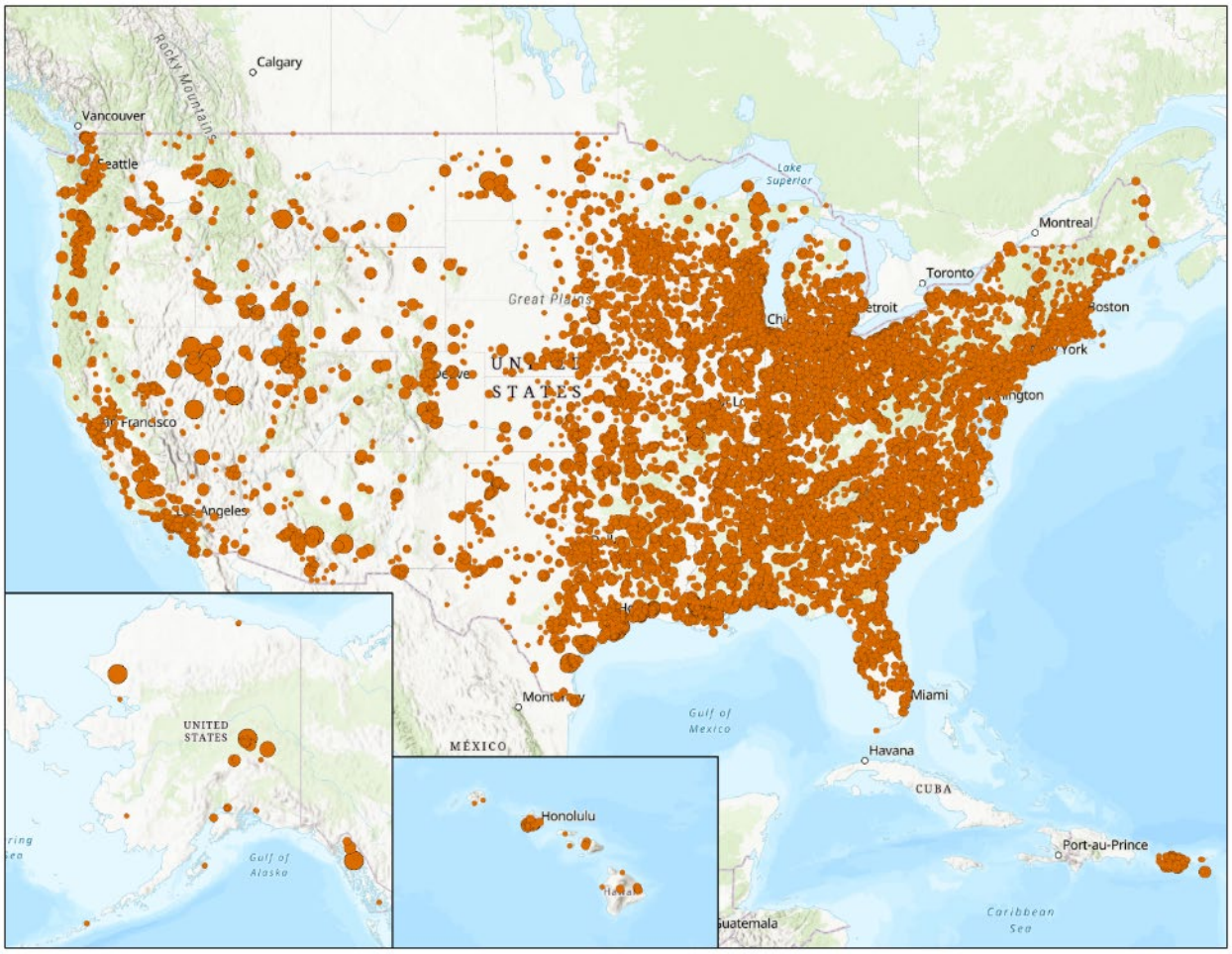
The two pie charts below summarize the most recent TRI data: the chart on the left shows the total amount of production-related waste managed through recycling, energy recovery, treatment, and disposal or other releases. The chart on the right shows the proportions of TRI chemical waste released to air, water, and land, and transferred off-site for disposal.



Note: To avoid double counting, the Disposal or Other Releases pie chart on the right excludes quantities of TRI chemicals that are transferred off site from a TRI-reporting facility and subsequently released on site by a receiving facility that also reports to TRI.

- Facilities reported managing 29.3 billion pounds of TRI-listed chemicals as production-related waste during 2021. Production-related waste managed is the quantity of TRI chemicals in waste resulting from routine operations. Facilities manage this waste through recycling, combustion for energy recovery, treatment, and disposing of or otherwise releasing the waste into the environment.
    - Of this total, 89% was recycled, combusted for energy recovery, or treated, while 11% was disposed of or otherwise released into the environment.
- For TRI chemicals in waste that was disposed of or otherwise released, facilities report the quantities of these releases and whether the releases were to the air, water, or land. Most releases of TRI chemicals occur on site at facilities. However, waste containing TRI chemicals may also be shipped off site for disposal, such as to a landfill. As shown in the pie chart on the right, most TRI chemical waste was disposed of to land, which includes landfills, underground injection, and other land disposal practices.

Where are the Facilities that Reported to TRI for 2021 Located?



Click on any of the locations to see a facility's TRI information.

View Larger Map

TRI Data Considerations

As with any dataset, there are multiple factors to consider when reviewing results or using Toxics Release Inventory (TRI) data. Key factors associated with the data presented in the TRI National Analysis are summarized below; for more information see *Factors to Consider When Using Toxics Release Inventory Data*.

- **Covered chemicals and sectors.** TRI does not include information from all facilities or industry sectors that may manage TRI chemicals in waste, nor does it cover every chemical. The complete TRI chemical list and a list of the sectors covered by the TRI Program are available on the TRI website.
- **Reporting thresholds.** Facilities in covered sectors that manufacture, process, or otherwise use TRI-listed chemicals at or above listed threshold quantities and employ at least ten full-time equivalent employees are required to report to the TRI Program. For most TRI chemicals, the threshold quantities are 25,000 pounds of the chemical manufactured or processed, or 10,000 pounds of the chemical otherwise used during a calendar year.
- **TRI trends**. The TRI chemical list has changed over the years. To make sure year-to-year data are optimized for comparison, trend graphs in the TRI National Analysis include only chemicals that were reportable for the entire time period presented. Results that focus only on the year 2021 include all chemicals reportable for 2021. Thus, quantities mentioned in a single-year analysis of 2021 data may differ slightly from quantities shown for 2021 in a multi-year trend analysis.
- **Risk.** TRI data can be a useful starting point to evaluate whether chemical releases may pose potential risks to human health and the environment. However, the quantity of a chemical release alone is not necessarily an indicator of exposure to the chemical, or the potential health or environmental risks posed by the chemical. In particular, note that:
  - Chemicals on the TRI list vary in toxicity; and
  - The extent of exposure to a chemical depends on many factors such as where the chemical is released, how it is released (i.e., to the air, water, or land), the chemical's properties, and what happens to the chemical in the environment.

TRI Reporting is Required

TRI reporting is required for facilities that meet the reporting criteria under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). EPA investigates cases of EPCRA non-compliance and may issue civil penalties, including monetary fines. Since the TRI Program's creation, EPA has taken more than 3,500 TRI-related enforcement actions. For more information, see the TRI Compliance and Enforcement webpage.

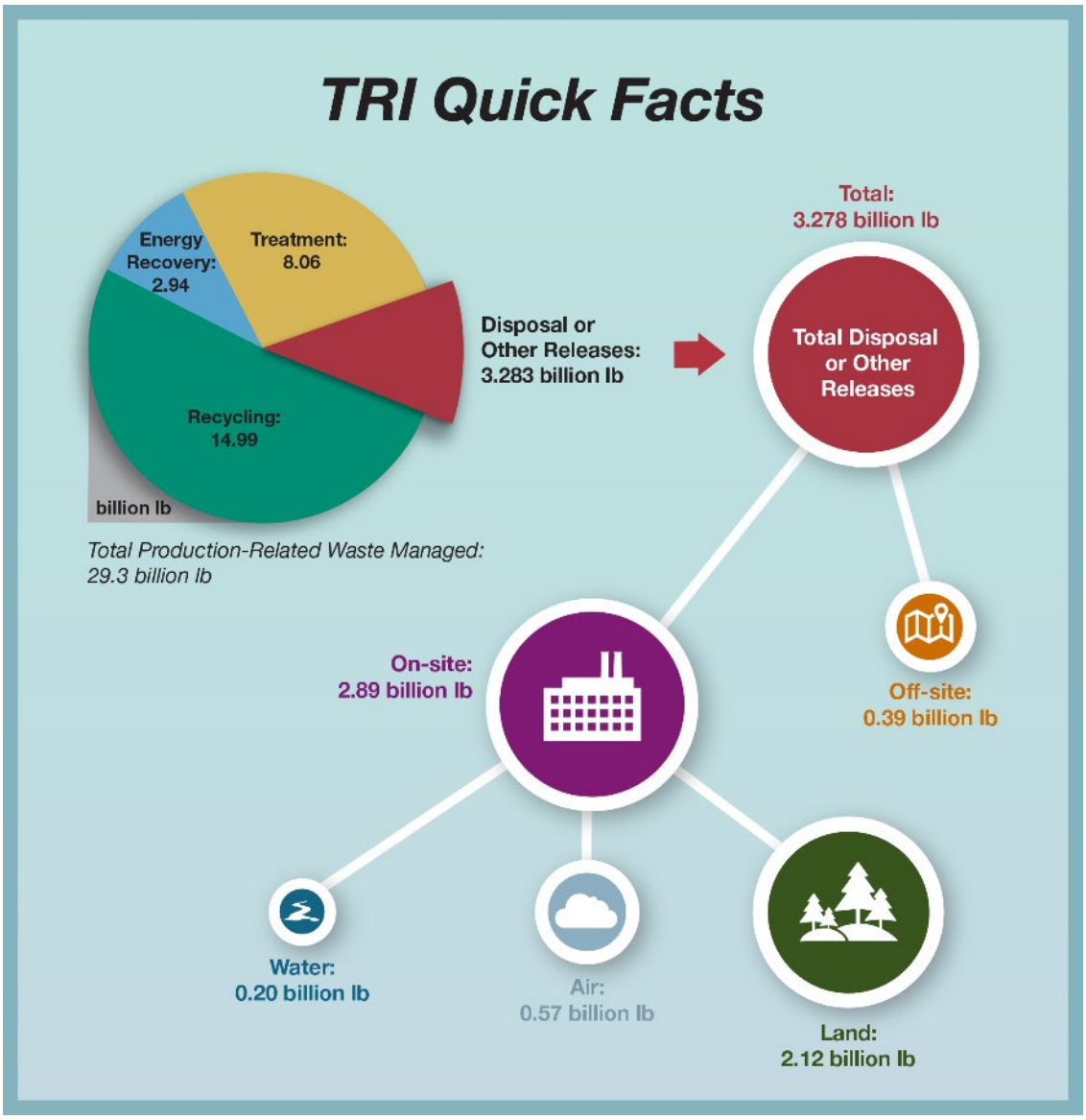
For more information on the use of TRI data in exposure and risk evaluations, see the TRI and Estimating Potential Risk webpage and Potential Risks from TRI Chemicals in the Releases section.

- **COVID-19.** The COVID-19 public health emergency that began in early 2020 impacted U.S. industrial operations, possibly affecting the quantities of TRI wastes managed. For 2020 and 2021, many facilities submitted comments on how COVID-19 impacted their facility-wide operations, waste management activities, and pollution prevention activities.
- **Data quality.** Facilities use their best available data to determine the quantities of chemicals they report to TRI. Each year, EPA conducts an extensive data quality review that includes contacting facilities about potential errors in reported information. This data quality review process helps ensure that the TRI National Analysis is based on accurate and complete information.
- **Late submissions, revisions, and withdrawals.** TRI reporting forms submitted to EPA or revised after the July 1 reporting deadline may not be processed in time to be included in the National Analysis. After EPA's data quality review, the TRI data are frozen in October and this dataset is used to develop the National Analysis. Any revisions, late submissions, or withdrawals made after this date are not reflected in the National Analysis but are incorporated into the TRI dataset during the spring data refresh and will be reflected in the next year's National Analysis.

Impact of Late Submissions and Revisions on the 2020 National Analysis

EPA compared the data used for the 2020 National Analysis to the updated version of these data from October 2022 used to develop the 2021 National Analysis. This allowed EPA to assess how late submissions and revisions to submitted data might have changed the information presented in the 2020 National Analysis, had they been included in the dataset. National waste management and release quantities were both <0.1% different than what was shown in the 2020 National Analysis.

Quick Facts for 2021



In this figure, the value for "Disposal or Other Releases" in the production-related waste managed pie chart (3.283 billion lb) is greater than the value for "Total Disposal or Other Releases" (3.278 billion lb). There are several reasons why these quantities differ slightly, including:

- **Double counting.** Total disposal or other releases (3.278 billion-pound value in the figure) removes "double counting" that occurs when a facility reports transfers of TRI chemicals in waste to another TRI-reporting facility. For example, when Facility A transfers a chemical off site for disposal to Facility B, Facility A reports the chemical as transferred off site for disposal while Facility B reports the same chemical as disposed of on site. In processing the data, the TRI Program recognizes that this is the same quantity of the chemical and

includes it only once in the total disposal or other releases metric. The production-related waste managed metric in TRI, however, considers all instances where the TRI chemical in waste is managed (first as a quantity sent off site for disposal and next as a quantity disposed of on site), and includes both the off-site transfer and the on-site disposal. Typically, double counting accounts for most of the difference between the two release quantities in the TRI Quick Facts figure.

- **Non-production related waste**. Non-production-related waste refers to TRI chemical waste that results from one-time events, rather than standard production activities. These events may include remedial actions, catastrophic events, or other 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.

For more information on TRI, the chemicals and industry sectors it covers, the reporting requirements, and to access TRI data, visit the TRI website.

Pollution Prevention

Pollution prevention, also known as "P2" or "source reduction," is any practice that reduces or eliminates pollution at its source prior to waste management. With less waste being created, the likelihood of impacts to human health and the environment is reduced. Additionally, it is often less expensive for facilities to prevent pollution from being created than to pay for control, treatment, or disposal of wastes.

Under the Pollution Prevention Act of 1990 (PPA), facilities that report to the Toxics Release Inventory (TRI) Program are required to include information on any newly implemented P2 activities. Many facilities also choose to include optional details that further describe their P2 actions. As a result, TRI serves as a robust tool for identifying effective P2 practices and highlighting pollution prevention successes.

2021 Highlights

- TRI facilities implemented 3,490 new source reduction activities to reduce pollution at its source, an increase of 24% from 2020.
- TRI source reduction codes changed for 2021 reporting. Facilities now choose from a streamlined and updated set of 24 codes to describe their source reduction activities.

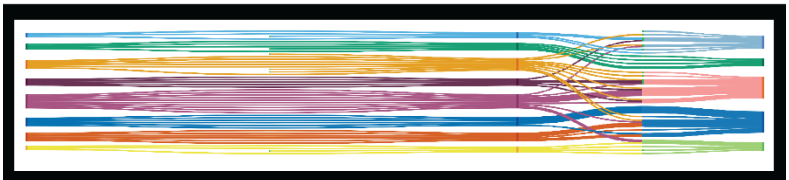
As with any dataset, there are many factors to consider when using TRI data. Find a summary of key factors associated with data used in the National Analysis in the Introduction. For more information see *Factors to Consider When Using Toxics Release Inventory Data*.

POLLUTION PREVENTION REPORTING IN REVIEW

OVER THREE DECADES OF P2 REPORTING TO TRI

The **Pollution Prevention Act of 1990** requires facilities to report **newly implemented source reduction activities** to the TRI. Source reduction activities **eliminate, prevent, or reduce the generation of toxic waste**.

Facilities report P2 activities by selecting from a list of pre-defined descriptions also referred to as **source reduction codes.**



1991
Facilities report their newly implemented source reduction activities to TRI for the first time.
43 CODES

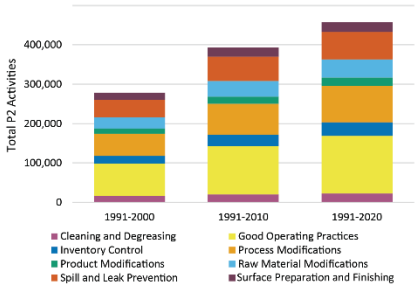
2012
Six codes are added to capture the implementation of green chemistry at facilities.
49 CODES

2021
The codes are updated and streamlined. Ten codes track green chemistry and engineering.
24 CODES

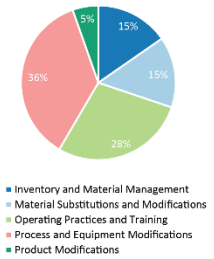
TRI is currently the **most comprehensive** P2 Resource available at EPA.

457,939

SOURCE REDUCTION ACTIVITIES WERE IMPLEMENTED BETWEEN 1991 AND 2020



IN TOTAL, 3,490 NEW SOURCE REDUCTION ACTIVITIES WERE IMPLEMENTED IN 2021.



Facilities reported **process and equipment modifications** the most, followed by improvements to **operating practices and training.**

TOP POLLUTION PREVENTION

BY INDUSTRY
% of facilities w. P2 since 1991

- **PAPER** 60%
- **ELECTRONICS** 58%
- **CHEMICALS** 54%

BY CHEMICAL
No. of P2 activities since 1991

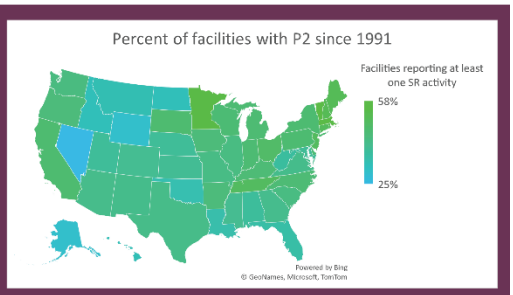
- **TOLUENE** 32,125
- **XYLENE** 29,324
- **LEAD & LEAD COMPOUNDS** 25,218

INNOVATION

from industry is needed to find new substitutions and process modifications. These types of source reduction activities are the most effective ways to reduce the generation of pollution.

Use the resources below to learn more.

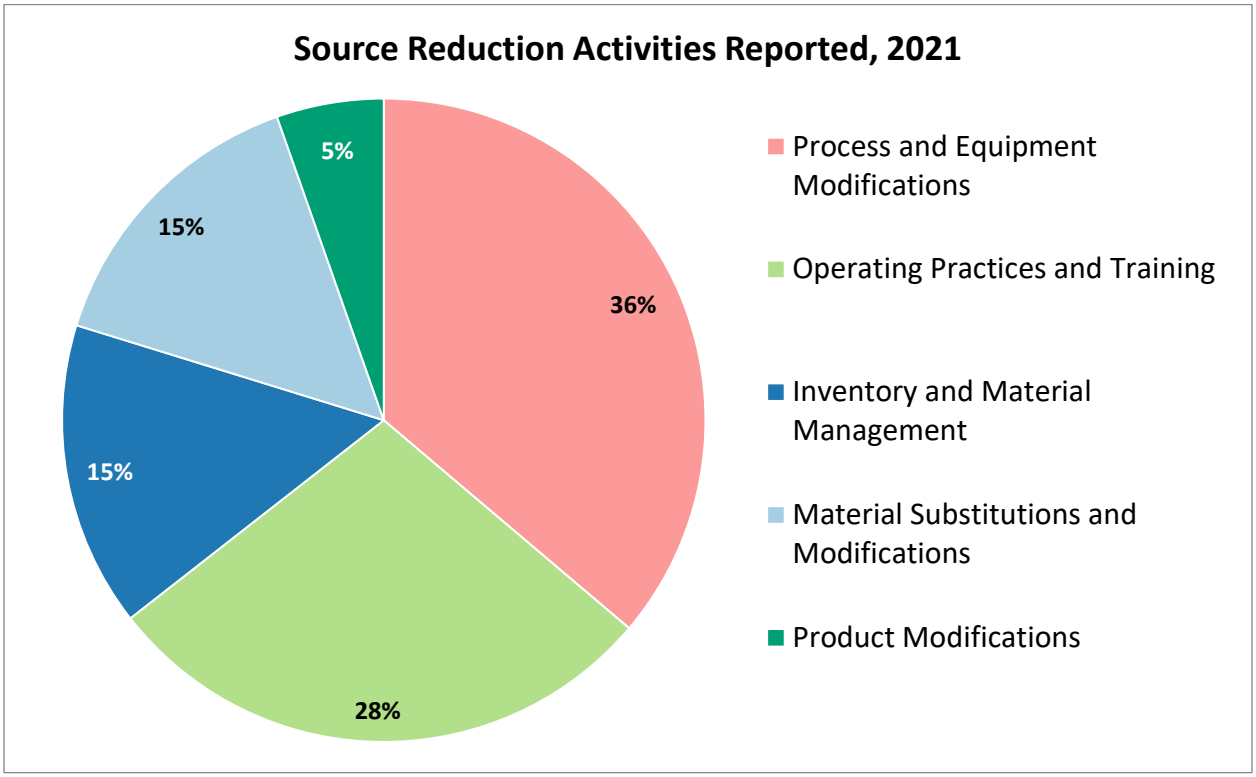
MINNESOTA, VERMONT, AND MASSACHUSETTS
have the highest percentages of facilities that have implemented at least one source reduction activity from 1991 to 2021. States with higher implementation rates of source reduction at facilities often have very active state P2 programs.



Need P2 assistance? The EPA runs the **Pollution Prevention Grants program**, which offers funding to state and tribal organizations that provide technical assistance to facilities. Contact your state P2 coordinators to learn more about available opportunities.

Source Reduction Activities

The Pollution Prevention Act of 1990 requires facilities to report to TRI source reduction activities that they initiated or completed during the reporting year. Source reduction information can help facilities learn from each other's best practices and potentially lead to better environmental stewardship and implementation of more P2 actions. When reporting source reduction activities to TRI, facilities choose from 24 types of activities grouped into the five categories shown in the graph below. For more information, see the TRI Source Reduction Reporting Fact Sheet.



Note: 1) Percentages do not sum to 100% due to rounding. 2) Facilities report their source reduction activities by selecting from a list of 24 codes that describe their activities. These codes fall into one of five categories listed in the graph legend and are defined in the *TRI Reporting Forms and Instructions*.

- In 2021, 1,630 facilities (8% of all facilities that reported to TRI) implemented a combined 3,490 new source reduction activities.
- The most reported source reduction category was Process and Equipment Modifications.
    - For example, an aircraft parts manufacturer optimized their pipe cleaning process which led to decreased ethylene waste. [Click to view facility details in the TRI P2 Search Tool]

- Facilities also report the method they used to identify the source reduction activity. The most reported methods for identifying source reduction opportunities were Participative Team Management and Internal Pollution Prevention Audits.

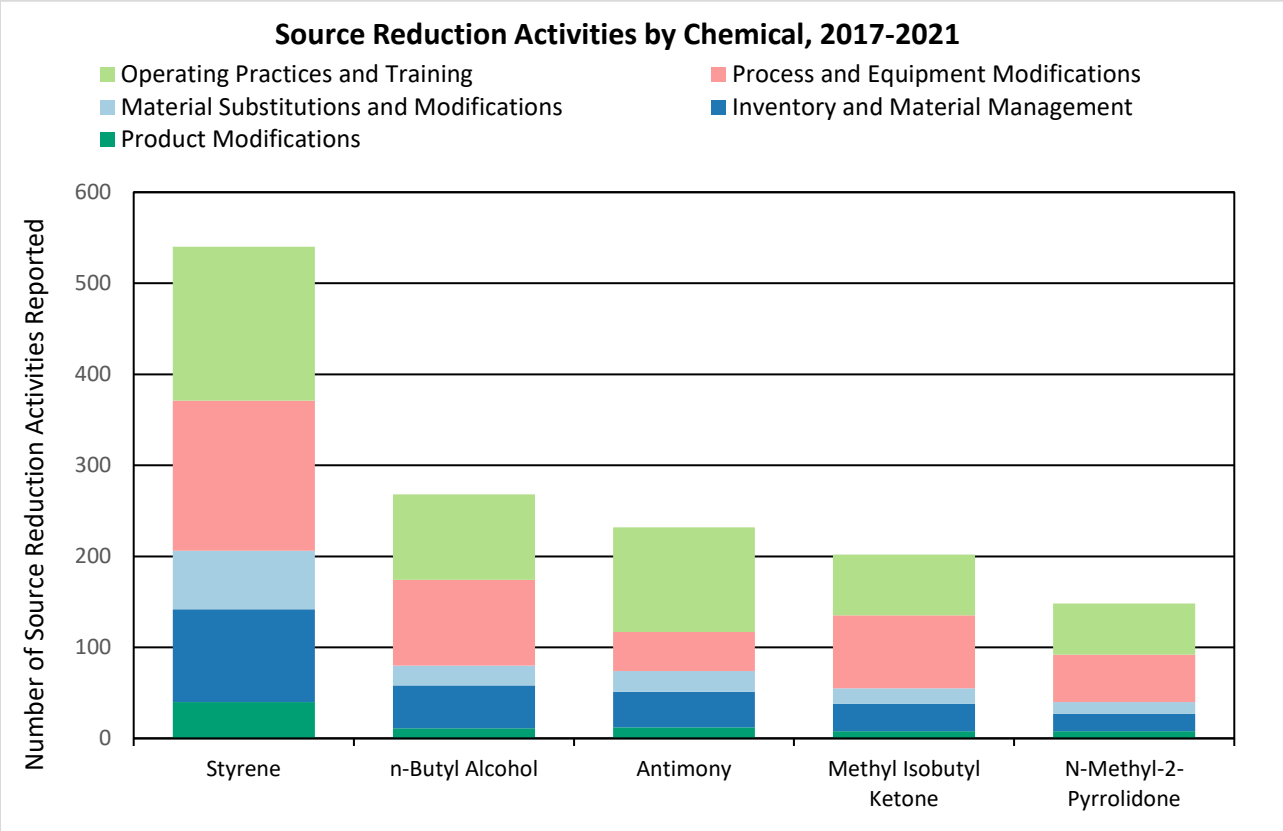
Additional Resources

- See the TRI P2 Data Overview Factsheet for more information on source reduction reporting in recent years.
- Facilities may have implemented source reduction activities in earlier years that are ongoing or have been completed. To see details about these activities, use the TRI P2 Search Tool.
- Facilities interested in exploring source reduction opportunities can reach out to their EPA Regional P2 Coordinator to arrange a free, confidential P2 assessment with a third-party P2 expert. Visit the P2 Resources for Business webpage for more information.
    - EPA's Pollution Prevention Grants provide technical assistance to businesses to help them implement P2.
    - Use the P2 Technical Assistance Resources tool to find resources in your area.
- The TRI Source Reduction Reporting Guide provides examples of source reduction activities and opportunities at facilities.
- The TRI Green Chemistry and Green Engineering webpage has more information about green chemistry and examples of green chemistry activities that facilities have reported to TRI.
- EPA partners with the American Chemical Society's Green Chemistry Institute® to present Green Chemistry Challenge Awards to organizations that have advanced green chemistry.
- The Solvent Substitutions Reported to TRI webpage provides information about specific substitutions reported to TRI from hazardous solvent chemicals to less hazardous solvents or solvent-free processes.

Source Reduction Activities by Chemical and Industry

Source Reduction Activities by Chemical

This figure shows the number of source reduction activities for the chemicals with the highest source reduction reporting rates over the last five years by the type of activity.



Note: 1) Limited to chemicals with at least 100 reports of source reduction activities from 2017 to 2021. 2) In this figure, antimony is combined with antimony compounds, although metals and compounds of the same metal are listed separately on the TRI list. 3) Facilities report their source reduction activities by selecting from a list of 24 codes that describe their activities. These codes fall into one of five categories listed in the graph legend and are defined in the *TRI Reporting Forms and Instructions*.

From 2017 to 2021:

- Facilities reported 16,859 source reduction activities for more than 240 chemicals and chemical categories.
- Chemicals with the highest source reduction reporting rates included styrene, *n*-butyl alcohol, antimony and antimony compounds, methyl isobutyl ketone, and N-methyl-2-pyrrolidone.
- The types of source reduction activities implemented for these chemicals varies depending on the chemicals' characteristics and how they are used. For example:

- **Process and Equipment Modifications,** including optimizing reaction conditions and modifying equipment, layout, or piping, can help reduce the amount of solvents such as *n*-butyl alcohol needed for a process.
- **Material Substitutions and Modifications** include the use of alternative materials in the manufacturing process, such as replacing styrene, a chemical used to make plastics, and replacing antimony compounds, which are used as a component of flame retardants, batteries, and electronics.

Facilities may also report additional details about their source reduction activities in an optional text field of the TRI reporting form.

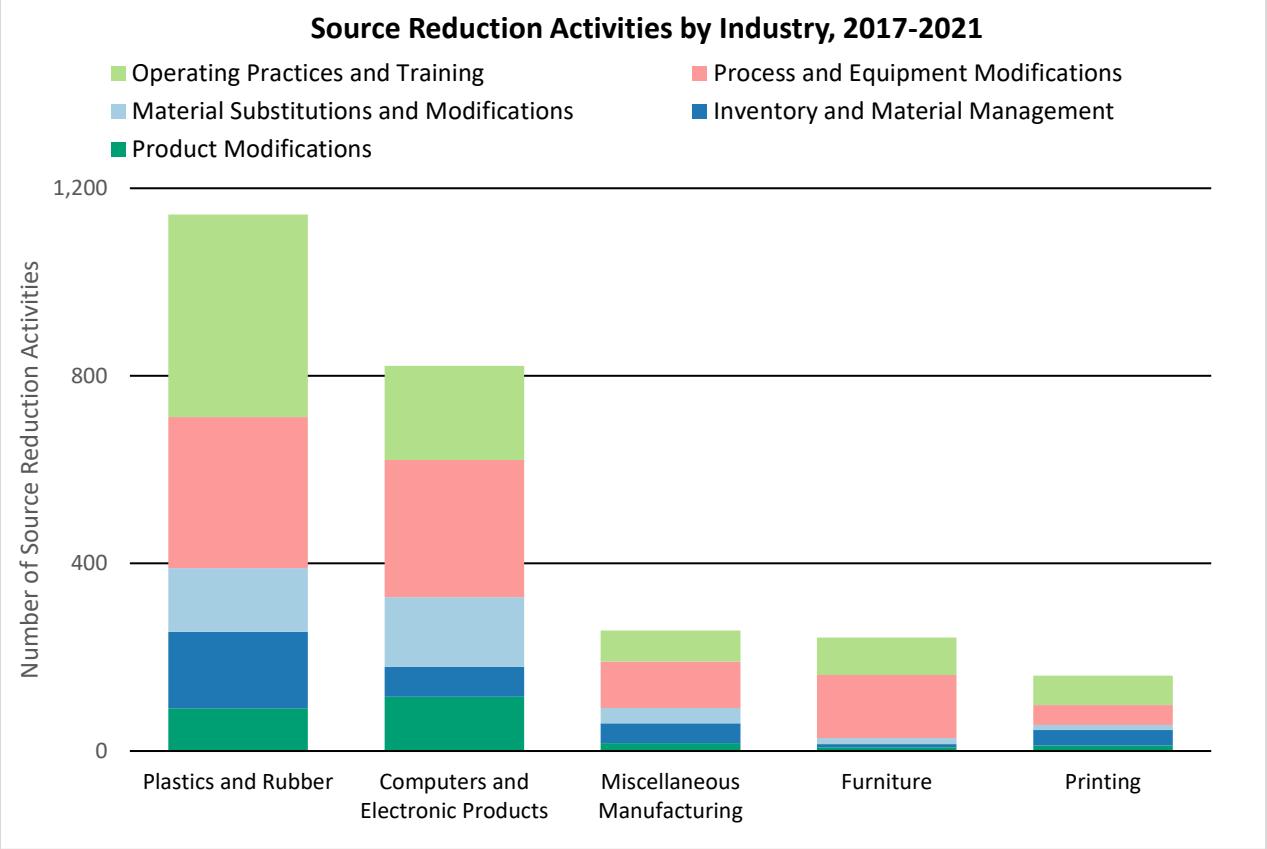
Examples of optional source reduction information for 2021:

- **Styrene**: A plastics plumbing fixture manufacturer updated several production lines to replace a styrene-based resin with a dicyclopentadiene (DCPD)-based thermoset resin. Emissions from the DCPD resins are much lower than those from styrene-based resins and DCPD is not a hazardous air pollutant. [Click to view facility details in the TRI P2 Search Tool]
- **Antimony and antimony compounds**: A motor vehicle brake system manufacturer used alternative filler materials in its process which helped reduce the facility's antimony usage. [Click to view facility details in the TRI P2 Search Tool]
- ***n*-Butyl alcohol**: A kitchen cabinet manufacturer worked with their vendors to identify coatings containing fewer hazardous air pollutants, including *n*-butyl alcohol. [Click to view facility details in the TRI P2 Search Tool]

You can compare facilities' waste management methods and trends for any TRI chemical by using the TRI P2 Search Tool.

Source Reduction Activities by Industry

This figure shows the number of source reduction activities reported by the industries with the highest source reduction reporting rates over the last five years.



Note: 1) Limited to industries with at least 100 source reduction activities reported from 2017 to 2021. 2) Facilities report their source reduction activities by selecting from a list of codes that describe their activities. These codes fall into one of five categories listed in the graph legend and are defined in the *TRI Reporting Forms and Instructions*.

From 2017 to 2021:

- The five industry sectors with the highest source reduction reporting rates were plastics and rubber products manufacturing, computers and electronic products manufacturing, miscellaneous manufacturing, furniture manufacturing, and printing.
- For most sectors, Process and Equipment Modifications were the most frequently reported types of source reduction activity. Other commonly reported source reduction activities varied by sector. For example, computers and electronic products manufacturers frequently reported Material Substitutions and Modifications, often associated with the elimination of lead-based solder.

Facilities may also report additional details to TRI about their source reduction activities, as shown in the following examples.

Examples of optional source reduction information for 2021:

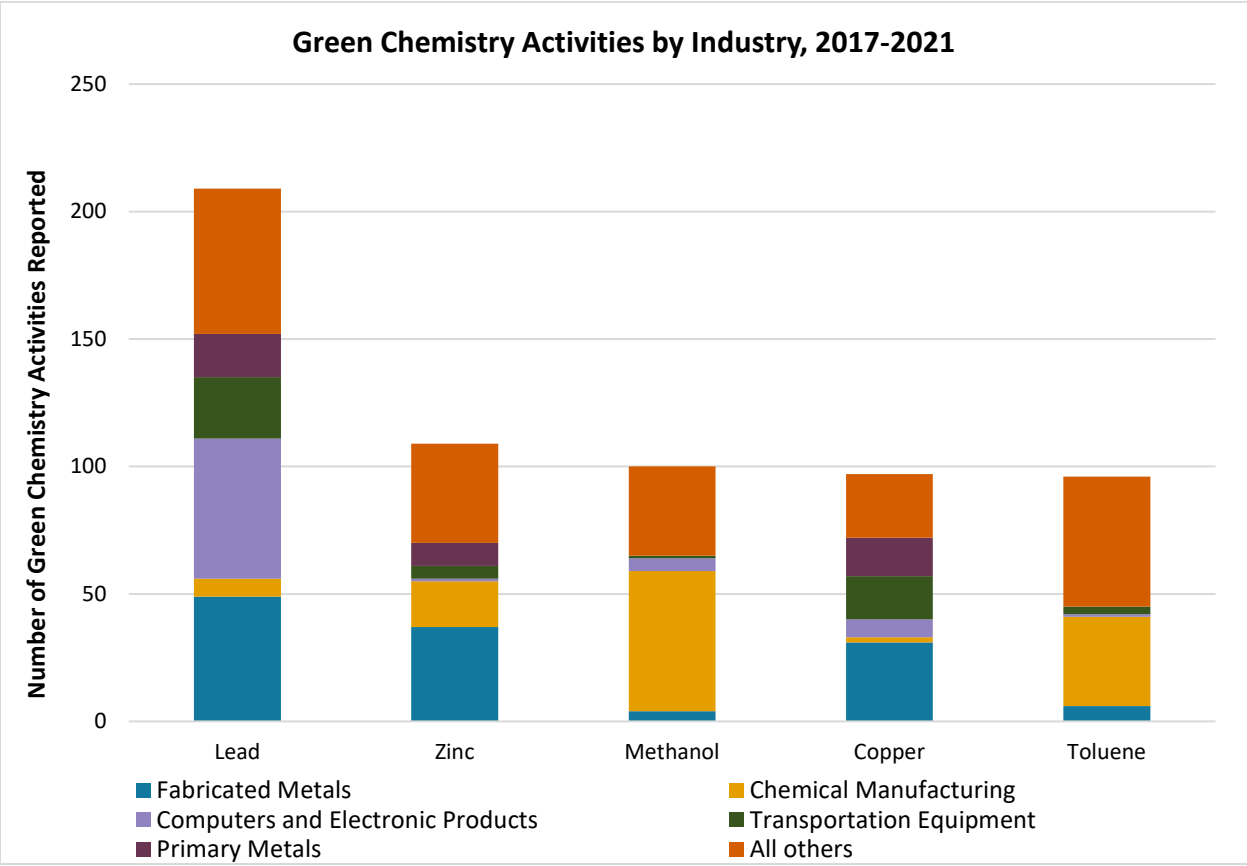
- **Plastics and Rubber Products Manufacturing:** A plastic products manufacturer changed from a styrene monomer to a non-styrene monomer as parts of the company move towards zero-styrene raw materials. [Click to view facility details in the TRI P2 Search Tool]
- **Furniture Manufacturing**: A wood cabinet manufacturer reduced its use of 1,2,4-trimethylbenzene by adding a straight-line machine which is more efficient than hand spraying. [Click to view facility details in the TRI P2 Search Tool]
- **Printing**: A commercial gravure printer scheduled print jobs in efficient blocks to reduce toluene waste from changeovers. [Click to view facility details in the TRI P2 Search Tool]

You can view all reported pollution prevention activities and compare facilities' waste management methods and trends for any TRI chemical by using the TRI P2 Search Tool.

Green Chemistry Activities

Green chemistry is the design of chemicals, products, and processes that use safer inputs, minimal energy, and minimize the creation of waste. Advancements in green chemistry allow industry to prevent pollution in innovative ways such as by designing or modifying manufacturing processes to optimize use of resources and reduce the creation of chemical waste.

Ten of the TRI source reduction codes that facilities can choose from are specific to green chemistry activities, although green chemistry practices may also fit under other codes. The figure below shows the chemicals with the highest green chemistry reporting rates over the last five years by sector. Several examples follow the figure.



Note: In this figure, the metals (lead, zinc, and copper) are combined with their metal compounds, although metals and compounds of the same metal are listed separately on the TRI list.

- Since 2017, facilities have reported 2,041 green chemistry activities for 155 TRI chemicals and chemical categories.
    - The chemical manufacturing and fabricated metals manufacturing sectors reported the highest number of green chemistry activities.

- Chemical manufacturers used green chemistry to reduce or eliminate their use of TRI solvent and reagent chemicals, such as methanol and toluene. For example:
    - A pharmaceutical preparation manufacturer substituted methanol with ethanol, which is not a TRI-reportable substance, in several on-site cleaning processes. [Click to view facility details in the TRI P2 Search Tool]
- Fabricated metal producers and transportation equipment manufacturers applied green chemistry techniques to reduce or eliminate their use of metals. For example:
    - A fabricated metal parts manufacturer made tooling changes to reduce the amount of copper-containing stainless steel scrap produced as waste. [Click to view facility details in the TRI P2 Search Tool]

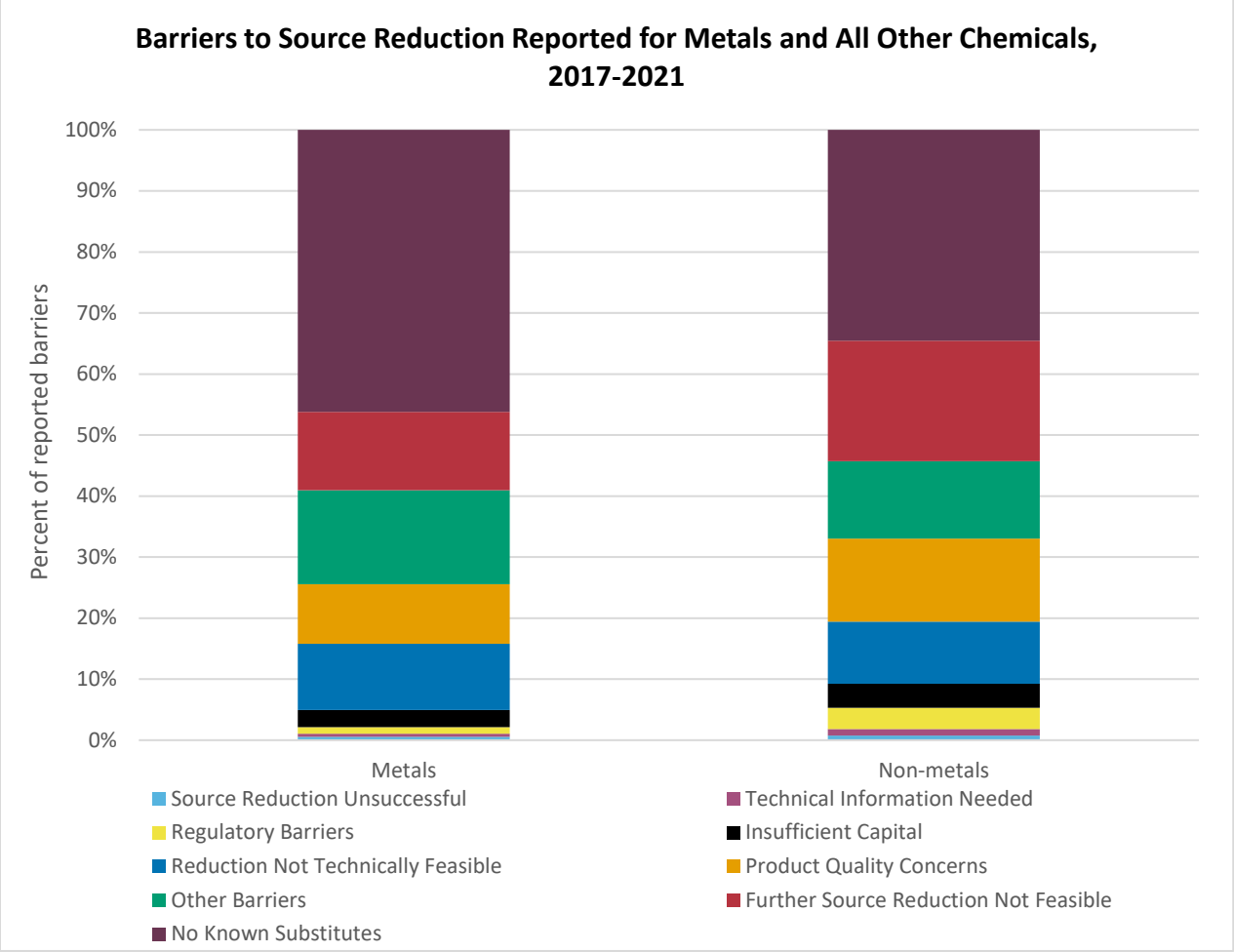
Additional Resources

Source reduction practices such as green chemistry that prevent or reduce the creation of chemical wastes are preferred to downstream pollution control technologies or waste management activities. These resources have more information on green chemistry:

- EPA's TRI Toxics Tracker: green chemistry examples for a specific chemical and/or industry.
- EPA's Green Chemistry program: information about green chemistry and EPA's efforts to facilitate its adoption.
- EPA's Safer Choice program: information about consumer products with lower hazard.
- For more details on the types of green chemistry activities reported to TRI and trends in green chemistry reporting, see *The Utility of the Toxics Release Inventory (TRI) in Tracking Implementation and Environmental Impact of Industrial Green Chemistry Practices in the United States*.
- Solvent Substitutions Reported to TRI: information about specific substitutions reported to TRI from hazardous solvent chemicals to less hazardous solvents or solvent-free processes.

Reported Barriers to Source Reduction

Facilities have the option to inform EPA of barriers that prevented them from implementing new source reduction activities. Analyzing the barriers to source reduction reported by facilities helps identify where more research is needed, for example, to address technological challenges or develop viable alternatives. It may also allow for better communication between those with knowledge of source reduction practices and those seeking additional assistance. This figure shows the types of barriers facilities reported for metals and for all other (non-metal) TRI chemicals.



Note: Facilities have the option to report barriers to source reduction by selecting from nine codes. These codes are defined in the *TRI Reporting Forms and Instructions*.

From 2017 to 2021:

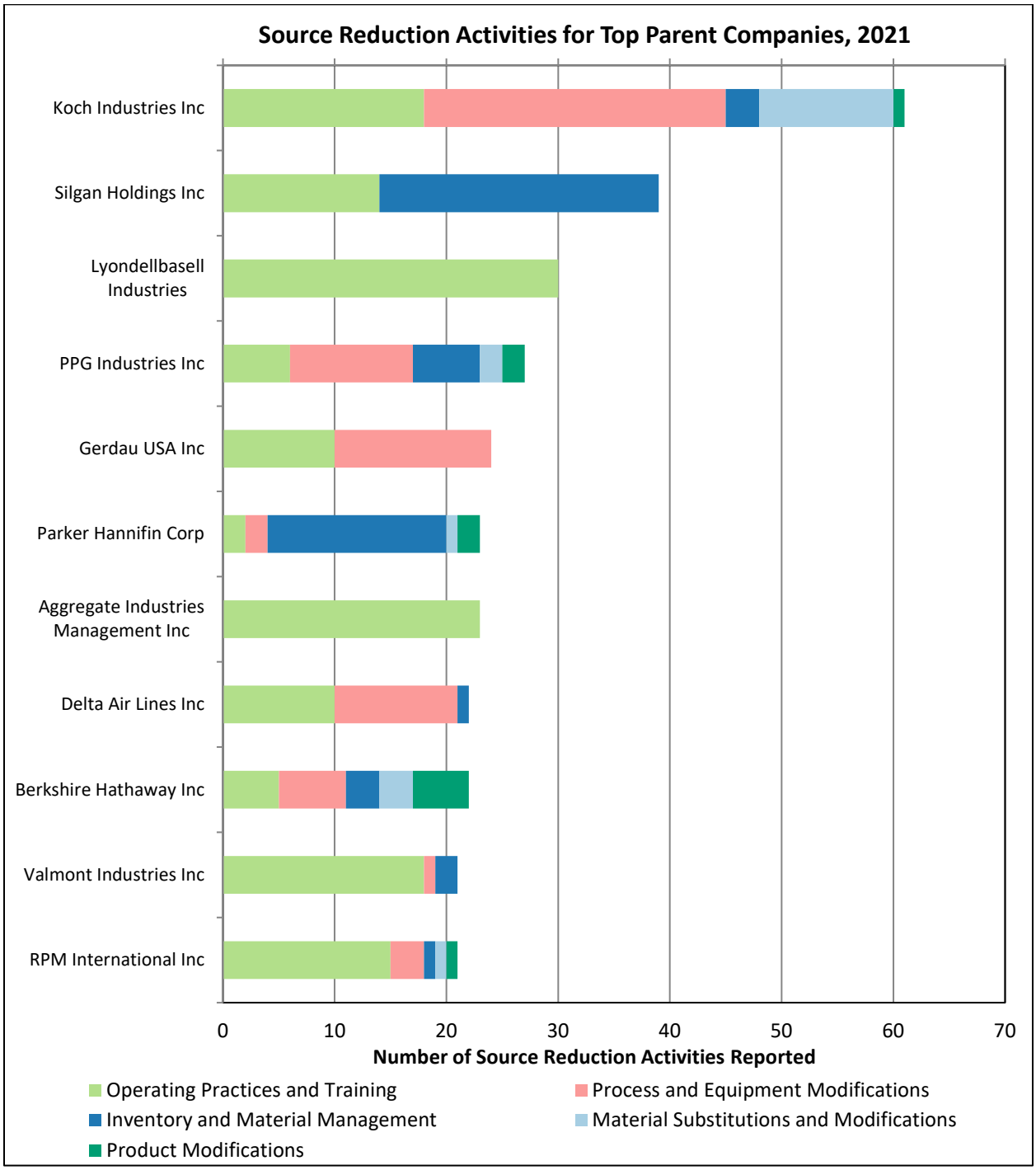
- Facilities reported barriers to implementing source reduction for 311 TRI chemicals and chemical categories.

- No Known Substitutes was the most frequently reported barrier for both metals and non-metals.
    - Excluding metals, the nitrate compounds category was the chemical for which No Known Substitutes was most reported. Facilities often report that nitrate compounds are produced during sanitization or waste treatment processes for which there are no alternatives.
- For the No Known Substitutes barrier for metals, many facilities reported the presence of the TRI metal in their raw materials (e.g., metal alloys) as the reason they could not implement source reduction activities. Examples include:
    - An HVAC and refrigeration equipment manufacturer reported that cast iron contains small amounts of lead and cannot be substituted in their products. [Click to view facility details in the TRI P2 Search Tool]
    - A fats and oils refining and blending facility reported that there are no alternatives to the nickel catalyst required to perform a hydrogenation reaction on vegetable fatty acids. [Click to view facility details in the TRI P2 Search Tool]
- Further Source Reduction Not Feasible was the next most common barrier for both metals and non-metals. Facilities select this barrier code when additional reductions do not appear feasible. For example:
    - A paint and coating manufacturer reformulated a product line to contain less methanol but reported that further source reduction is not feasible due to substitution limitations and supply chain issues relating to COVID-19. [Click to view facility details in the TRI P2 Search Tool]
- You can view source reduction barriers for any TRI chemical by using the TRI P2 Search Tool.

Source Reduction Activities by Parent Company

Facilities are required to report their parent company information to TRI for each reporting year. For TRI reporting, a parent company is defined as the highest-level company, located in the United States, that directly owns at least 50% of the company's voting stock. EPA groups facilities by parent company to assess waste management at the parent company level and identify companies and industries that regularly implement source reduction activities.

The figure below shows the parent companies whose facilities implemented the most source reduction activities for 2021. Facilities outside of the manufacturing sector, such as electric utilities and coal and metal mines, are not included in this chart because those facilities' activities do not lend themselves to the same source reduction opportunities as the activities at manufacturing facilities.



Notes: 1) This figure uses EPA's standardized parent company names. 2) To view facility counts by parent company, hover over the bar graph.

Operating Practices and Training, such as improving maintenance or scheduling and installing quality monitoring systems, were the most reported types of source reduction activities for these parent companies. Process and Equipment Modifications were also commonly reported.

Some of the facilities in these parent companies submitted additional text in their TRI reporting forms to describe their pollution prevention activities. Examples include:

- A basic organic chemical manufacturing facility owned by Koch Industries Inc. implemented a new technology that significantly lowered the use of benzene. [Click to view facility details in the TRI P2 Search Tool]
- A rubber products manufacturing facility owned by Parker Hannifin Corp implemented a new process to shut off water refilling valves during off-shifts to eliminate unnecessary refilling and reduce waste generation. [Click to view facility details in the TRI P2 Search Tool]

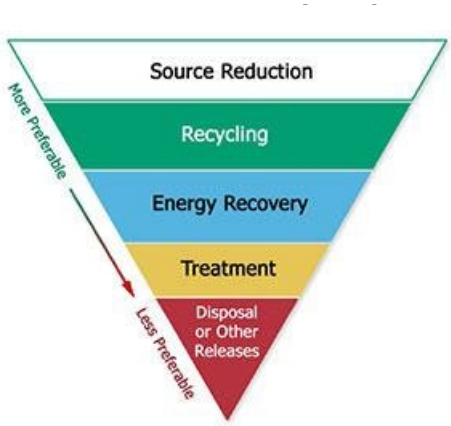
You can find P2 activities reported by a specific parent company and compare facilities' waste management methods and trends for any TRI chemical by using the TRI P2 Search Tool.

Waste Management

Each year, the Toxics Release Inventory (TRI) Program receives information from more than 21,000 facilities on the quantities of TRI-listed chemicals they recycle, combust for energy recovery, treat, and dispose of or otherwise release as part of their normal operations. These quantities are collectively referred to as production-related waste managed or 'waste managed'.

Looking at waste managed over time helps track facilities' progress in reducing the amount of chemical waste they manage. Additionally, these trends show if facilities are shifting toward waste management practices that are preferable to disposing of or otherwise releasing waste into the environment.

EPA encourages facilities to first reduce or eliminate the use of TRI-listed chemicals and the creation of chemical waste through source reduction. For waste that is generated, the preferred management method is recycling, followed by combustion for energy recovery, treatment, and, as a last resort, safe disposal or release of chemical waste into the environment. This order of preference, called the Waste Management Hierarchy, is consistent with the national policy established by the Pollution Prevention Act (PPA) of 1990.



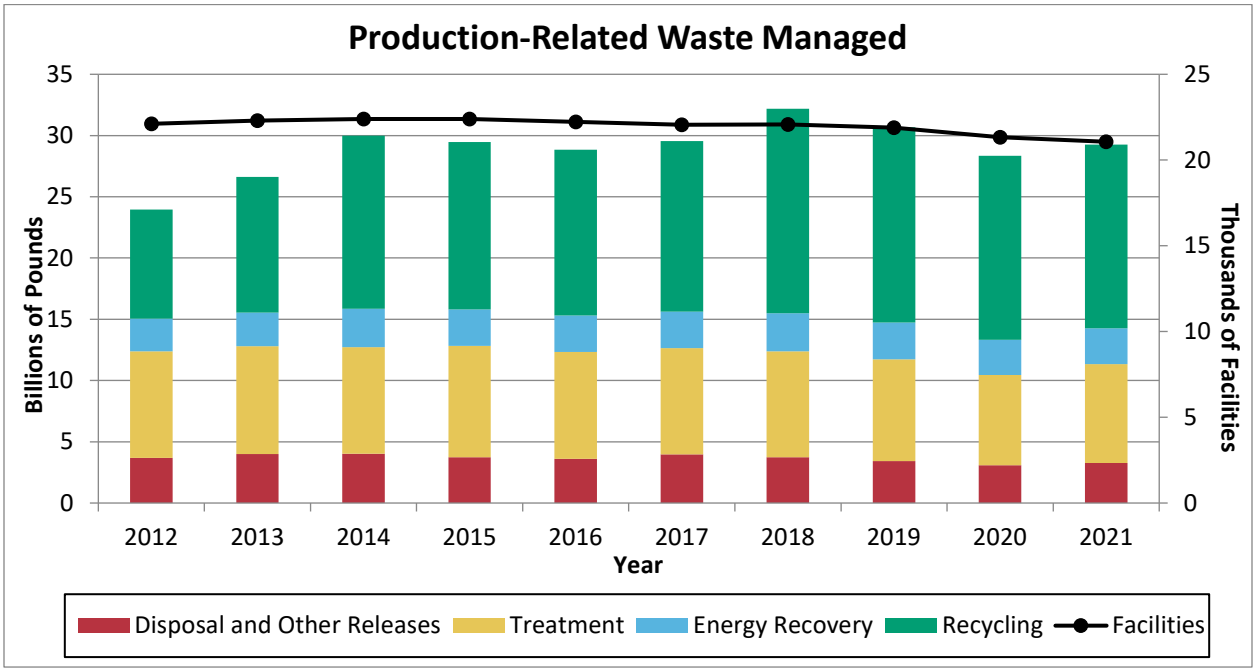
2021 Highlights

- Facilities managed 29.3 billion pounds of TRI chemical waste, 89% of which was not released due to preferred waste management practices such as recycling.
- Production-related waste managed increased by 5.3 billion pounds (22%) since 2012, driven by a 6.1 billion pound (68%) increase in recycling.

As with any dataset, there are many factors to consider when using TRI data. Find a summary of key factors associated with data used in the National Analysis in the Introduction. For more information see *Factors to Consider When Using Toxics Release Inventory Data.*

Production-Related Waste Managed

Waste streams generated during normal industrial operations may be released, treated, used for energy recovery, or recycled. For example, facilities report the recovery of solvents as a recycling method, or the destruction of a chemical waste through incineration as treatment. This figure shows the 10-year trend in on-site and off-site recycling, combusting for energy recovery, treating for destruction, and releasing into the environment, collectively referred to as production-related waste managed.



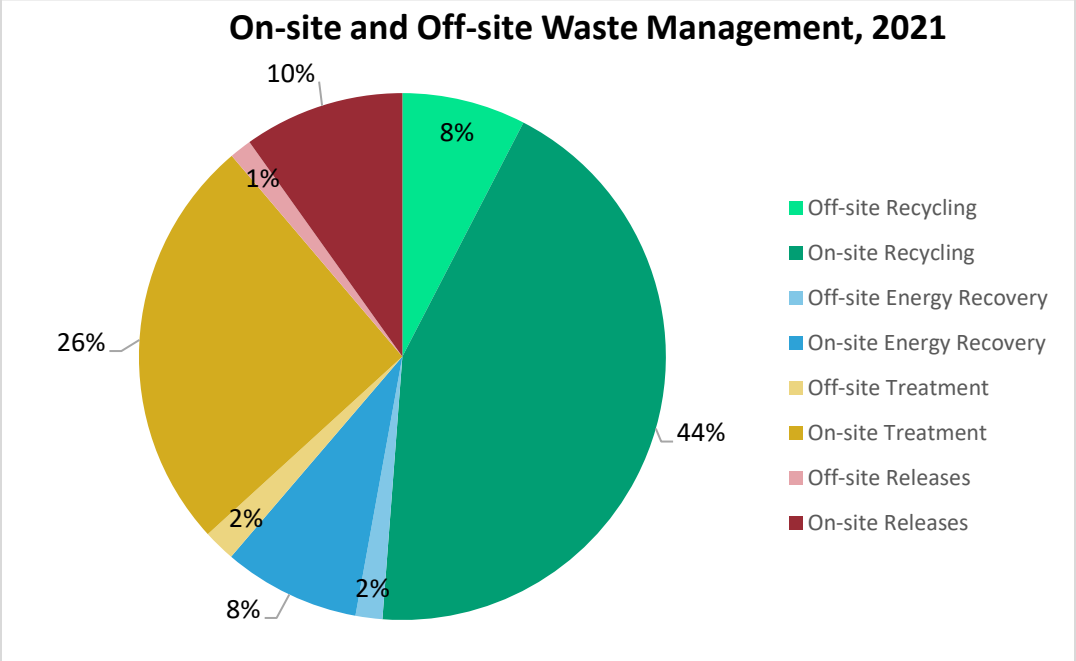
Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2012 to 2021:

- Production-related waste managed increased by 5.3 billion pounds (22%), driven by increased recycling.
  - Disposal and other releases decreased by 402 million pounds (-11%).
  - Treatment decreased by 644 million pounds (-7%).
  - Energy recovery increased by 273 million pounds (10%).
  - Recycling increased by 6.1 billion pounds (68%), a trend largely driven by several facilities that each reported recycling one billion pounds or more annually in recent years.
- The number of facilities that report to TRI has declined by 5% since 2012. Reasons for this decrease include facility closures, outsourcing of operations to other countries, and facilities

reducing their manufacture, processing, or other use of TRI-listed chemicals to below the reporting thresholds.

Facilities report both on- and off-site waste management. The following chart shows the relative quantities of on-site and off-site waste management methods for 2021.



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

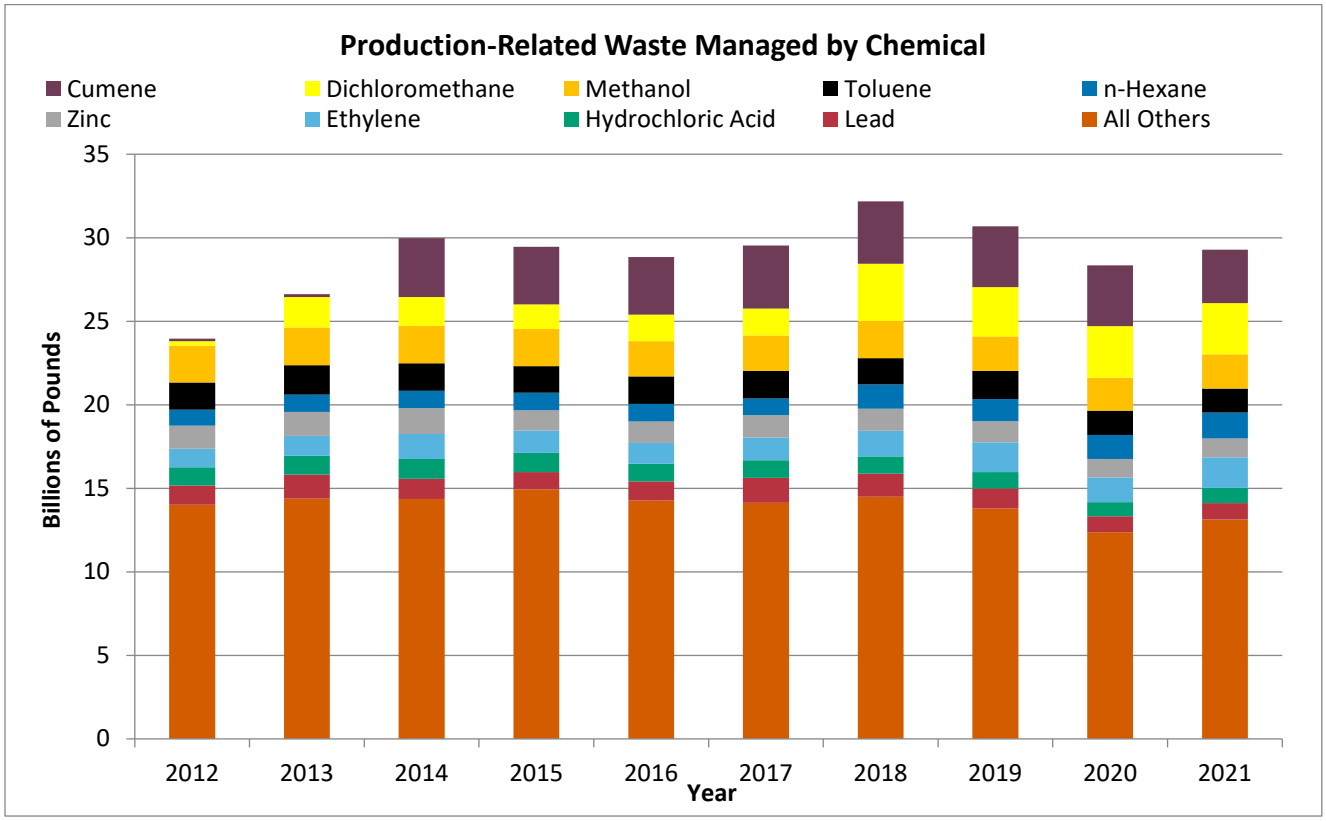
For 2021, 87% of production-related waste was managed on site.

- Most production-related waste managed off site is recycled. Most of this recycling is reported by the primary and fabricated metals sectors. Facilities in these sectors often send scrap metal containing TRI chemicals such as zinc and copper off site for recycling.
- The 2021 distribution of waste managed on site and off site is similar to previous years.

Waste Management by Chemical and Industry

Waste Managed by Chemical

This figure shows the TRI chemicals managed as waste in the greatest quantities from 2012 to 2021.



Note: 1) For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented. 2) In this figure, the metals (lead and zinc) are combined with their metal compounds, although metals and compounds of the same metal are listed separately on the TRI list.

From 2012 to 2021:

- Facilities reported production-related waste managed for more than 500 chemicals and chemical categories. The chart above shows the nine chemicals managed as waste in the largest quantities. Together, these chemicals represent 52% of the total waste managed reported to TRI.
- Of the chemicals shown above, facilities reported increased quantities of waste managed for: cumene, dichloromethane (methylene chloride), ethylene, and *n*-hexane.
    - Cumene recycling increased over 20-fold. This increase was mostly driven by one facility that reported recycling over 3 billion pounds of cumene annually from 2014 to 2021. [Click to view facility details in the TRI P2 Search Tool]

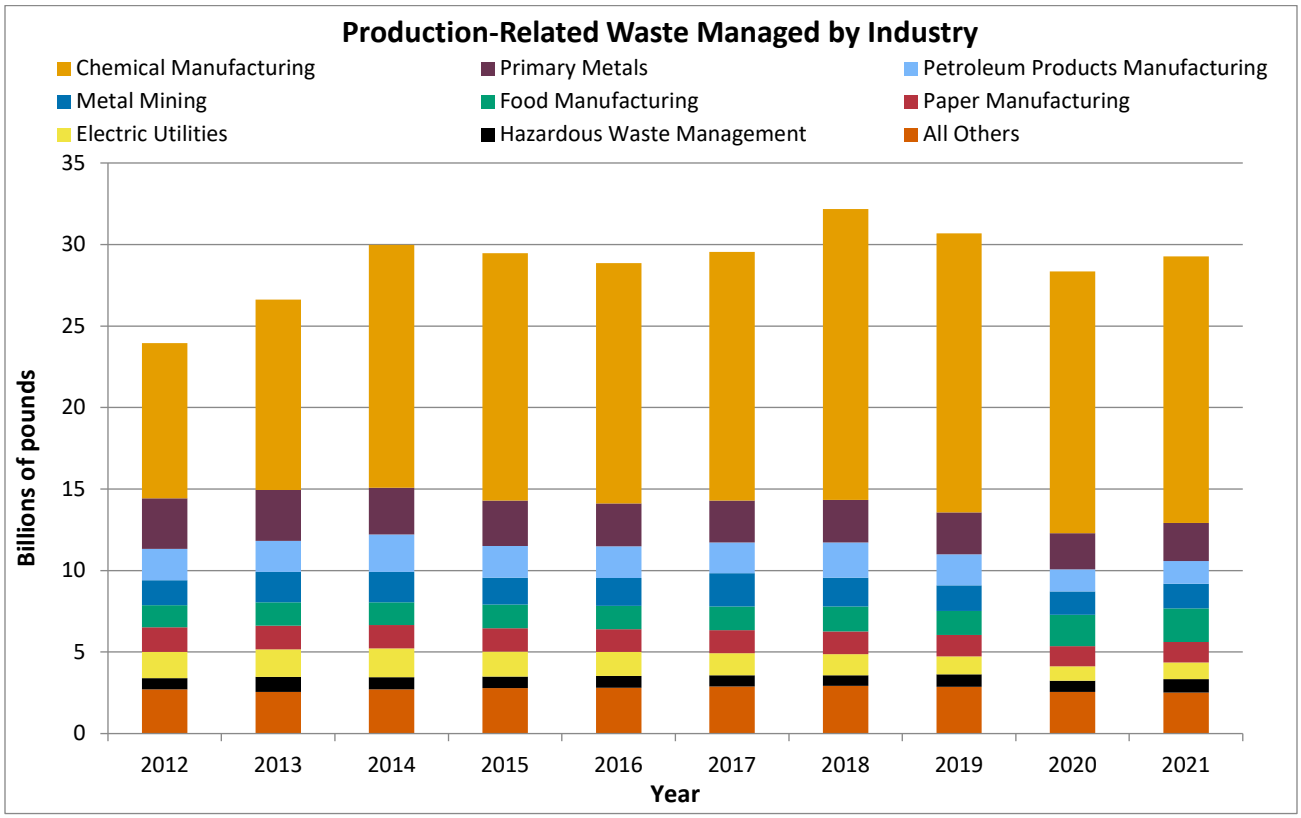
- Dichloromethane waste managed increased over 10-fold, due to 2 facilities that started recycling large quantities of the chemical after 2012.
- Ethylene waste managed increased by 721 million pounds (66%), driven by increased treatment.
- *n*-Hexane waste managed increased by 603 million pounds (64%). This was mostly driven by one soybean processing facility which increased their *n*-hexane recycling by almost 600 million pounds since 2012. [Click to view facility details in the TRI P2 Search Tool]

From 2020 to 2021:

- Quantities of TRI chemical waste managed increased for several chemicals including:
  - Ethylene increased by 350 million pounds (24%).
  - *n*-Hexane increased by 115 million pounds (8%).
  - Methanol increased by 81 million pounds (4%).
  - Hydrochloric acid increased by 63 million pounds (7%).
- Quantities of TRI chemical waste managed decreased for cumene.
- Quantities of TRI chemical waste managed remained about the same for zinc, lead, dichloromethane, and toluene.

Waste Managed by Industry

This figure shows the industry sectors that managed the most TRI chemical waste from 2012 to 2021.



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

From 2012 to 2021:

- The eight sectors in this chart consistently reported managing the most production-related waste since 2012. The amount of waste managed by these sectors has changed year to year, especially for the chemical manufacturing sector. The chemical manufacturing sector accounted for 40% of all production-related waste managed in 2012 and increased to 56% in 2021.
- Three of the sectors shown in the graph increased their quantities of waste managed:
  - Chemical manufacturing increased by 6.8 billion pounds (71%).
  - Food manufacturing increased by 715 million pounds (53%).
  - Hazardous waste management increased by 126 million pounds (18%).
- The quantity of waste generated in some industries fluctuates considerably from year to year due to changes in production or other factors. For example, quantities of waste

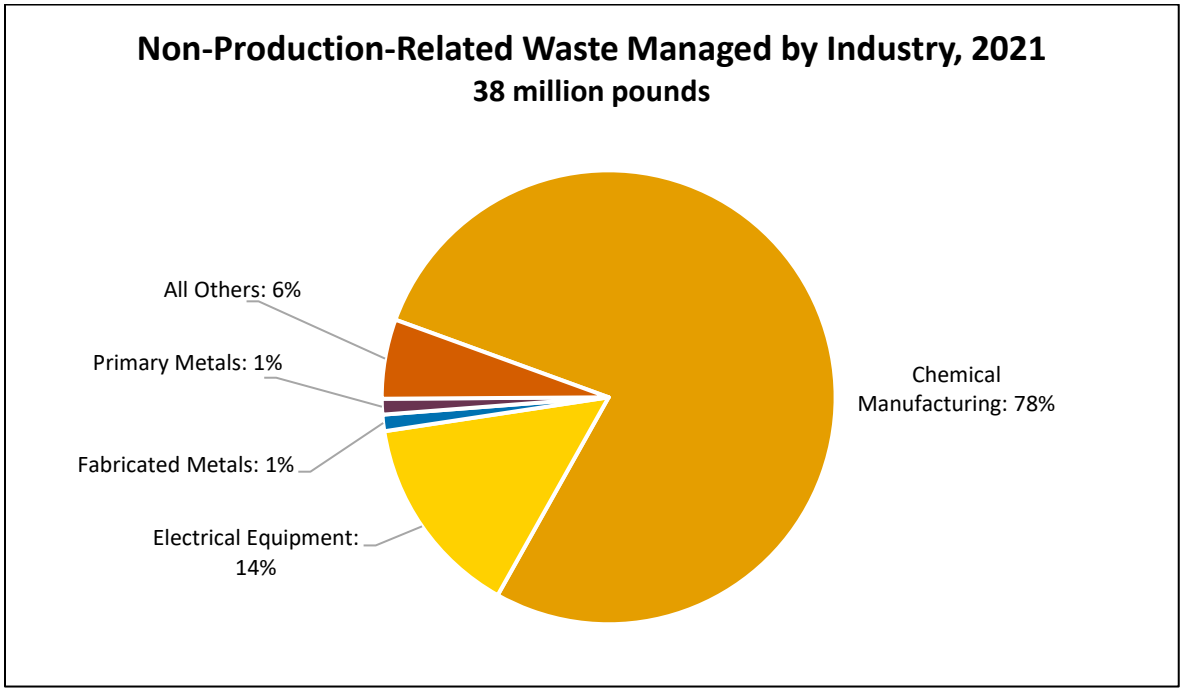
managed reported by metal mining facilities can change significantly based on differences in the composition of waste rock.

From 2020 to 2021:

- Industry sectors that reported the greatest changes in waste management quantities were:
  - Chemical manufacturing increased by 299 million pounds (2%).
  - Hazardous waste management increased by 134 million pounds (20%).
  - Electric utilities increased by 132 million pounds (15%).
  - Food manufacturing increased by 129 million pounds (7%).

Non-Production-Related Waste Managed

Sometimes, chemical waste is created by one-time events like remedial actions and natural disasters rather than normal production processes. Waste generated this way is referred to as non-production-related waste. Non-production-related waste is reported separately from production-related waste because it is largely unpredictable and less amenable to pollution prevention. Non-production-related waste is included in a facility's "total disposal or other releases" but not in its "production-related waste managed." The following graph shows the quantities of non-production-related waste reported to TRI for 2021.

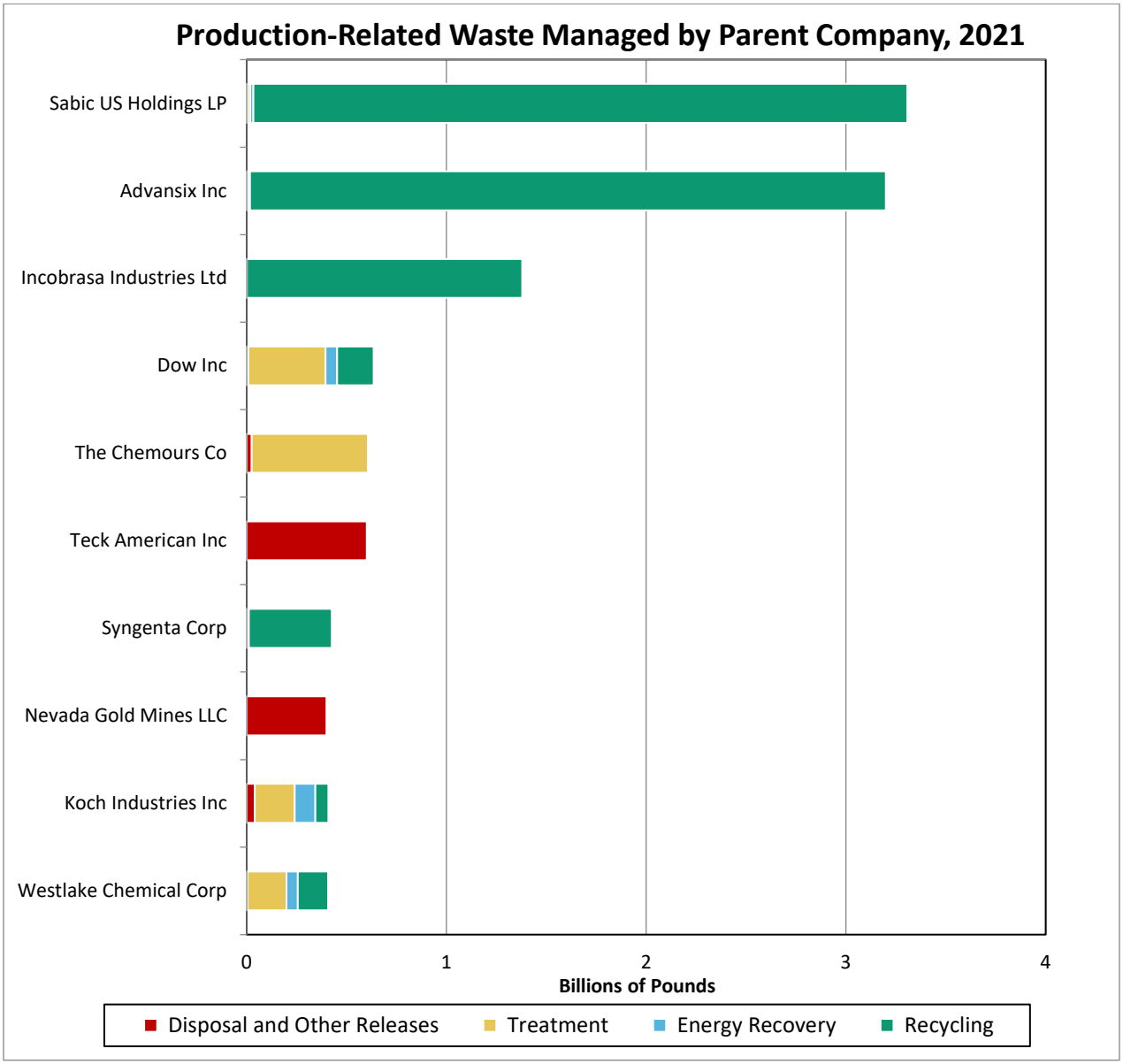


- For 2021, 473 facilities reported managing a total of 38 million pounds of non-production-related waste. This represents 0.13% of the total amount of TRI waste managed in 2021.
- In recent years, non-production-related waste reported by all TRI facilities has totaled less than 10 million pounds per year. One facility reported managing a large amount of zinc compounds as non-production-related waste in 2021 due to a remediation effort, increasing the non-production-related waste total for 2021.

Waste Managed by Parent Company

Facilities that report to the Toxics Release Inventory (TRI) provide information about their parent company. For TRI reporting purposes, the parent company is the highest-level company located in the United States. For TRI reporting, a parent company is defined as the highest-level company, located in the United States, that directly owns at least 50% of the company's voting stock. EPA groups facilities by parent company to assess waste management at the parent company level and identify companies and industries that regularly implement source reduction activities.

This figure shows the parent companies whose facilities reported the most production-related waste managed for 2021. Note that most of these companies manage most of their waste through EPA's preferred waste management methods–recycling, energy recovery, or treatment–rather than releasing it into the environment.



Notes: 1) This figure uses EPA's standardized parent company names. 2) To view facility counts by parent company, hover over the bar graph. 3) Incobrasa Industries Ltd does not report a parent company but it is included in this figure because it reported a comparable quantity of production-related waste managed.

These parent companies' TRI-reporting facilities mostly operate in the following industry sectors:

- **Chemical manufacturing**: Sabic US Holdings LP, Advansix Inc, Dow Inc, The Chemours Company, Syngenta Corp, Westlake Chemical Corp
- **Soybean processing**: Incobrasa Industries Ltd
- **Metal mining**: Teck American Inc, Nevada Gold Mines LLC

- **Multiple sectors**, e.g., pulp and paper, petroleum refining, and chemicals: Koch Industries Inc

You can find information about a specific parent company and compare facilities' waste management methods and trends for any TRI chemical by using the TRI P2 Search Tool.

Releases of Chemicals

Release or disposal of Toxics Release Inventory (TRI) chemicals into the environment occurs in several ways. Facilities may release chemical waste directly into the air or water or dispose of it to land. Some facilities also transfer waste that contains TRI chemicals to off-site locations for disposal. Facilities releasing or disposing of TRI chemical waste must comply with a variety of regulatory requirements and restrictions that are designed to minimize potential harm to human health and the environment.

Facilities must report the quantities of TRI-listed chemicals they release into the environment. Analyzing these release data along with data from other sources helps to:

- Identify potential concerns in communities.
- Better understand potential risks chemical releases may pose.
- Identify opportunities to engage with facilities or provide technical assistance to lessen potential risks.

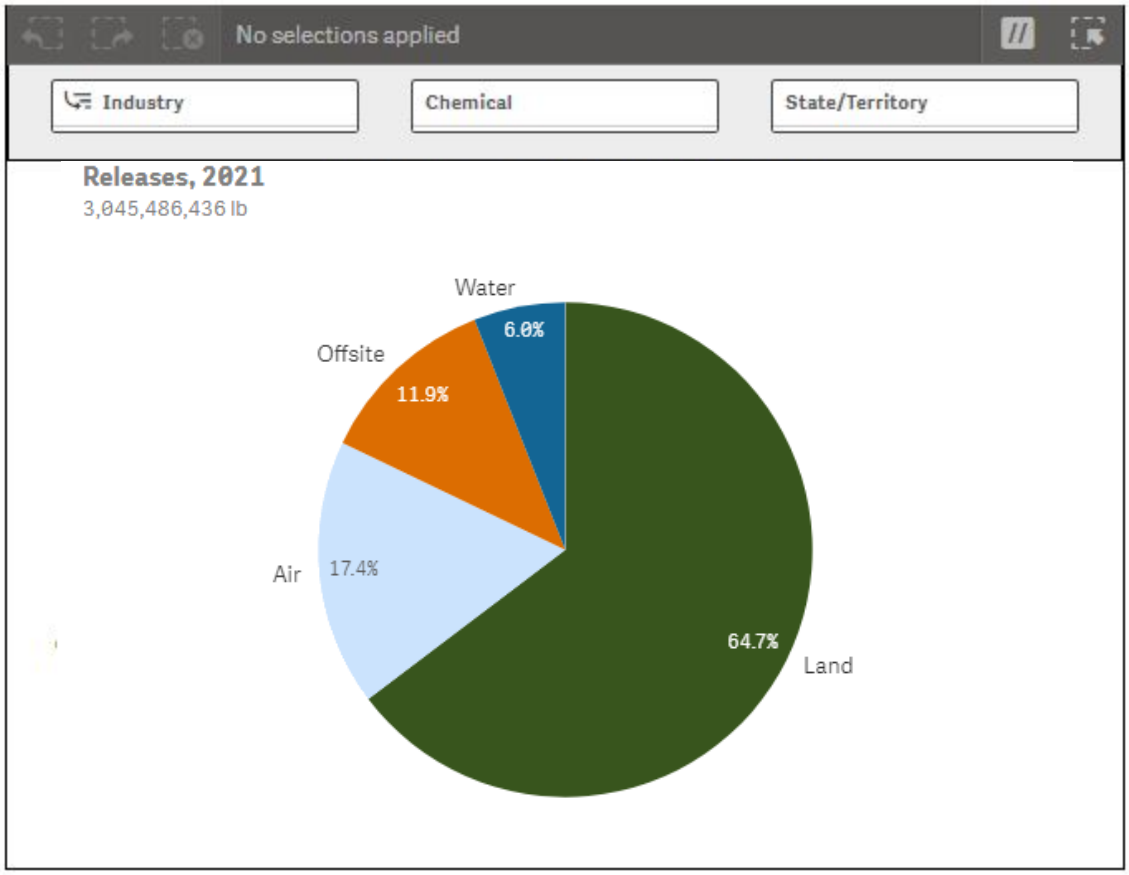
Helpful Concepts

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.

However, it is important to understand that the quantity of chemical releases alone is not necessarily an indicator of health outcomes or environmental impacts from the chemicals. Other important factors that contribute to potential harm and risks from releases of chemicals are discussed in the section Risks from TRI Chemicals.

Use the chart below to explore the 2021 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.



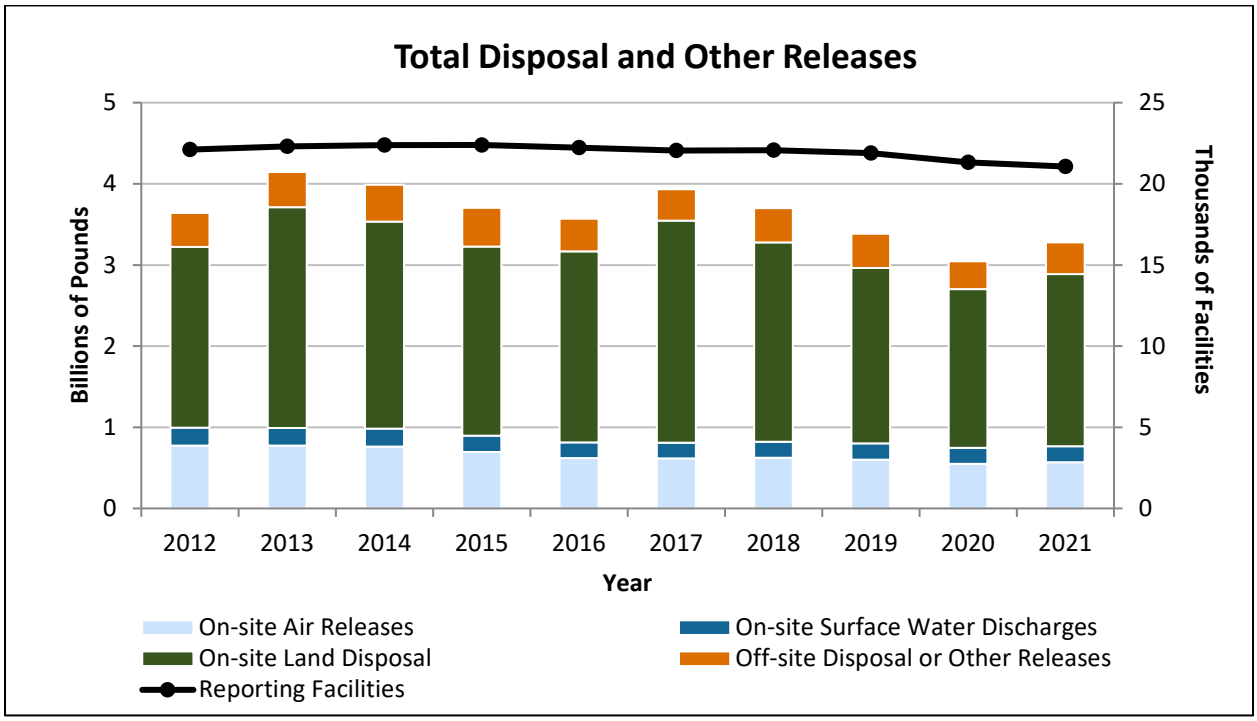
2021 Highlights

- Facilities released 3.3 billion pounds of TRI chemicals, a 10% decrease since 2012.
- Air releases decreased 26% in the last 10 years, driven by reductions from electric utilities.

As with any dataset, there are many factors to consider when using TRI data. Find a summary of key factors associated with data used in the National Analysis in the Introduction. For more information see *Factors to Consider When Using Toxics Release Inventory Data*.

Trends in Releases

The following graph shows the latest 10-year trend in total releases (also referred to as "total disposal or other releases"). Many factors can affect the trend in releases over time, including changes in production rates, waste management practices, the composition of raw materials, and pollution control technologies.



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

From 2012 to 2021:

- Total releases of TRI chemicals decreased by 10%.
    - Reduced releases to air from electric utilities were the most significant contributor to the decline.
- Air releases decreased by 26%, surface water discharges decreased by 10%, on-site land disposal decreased by 5%, and off-site disposal decreased by 6%.
    - The number of facilities that reported to TRI declined by 5%.

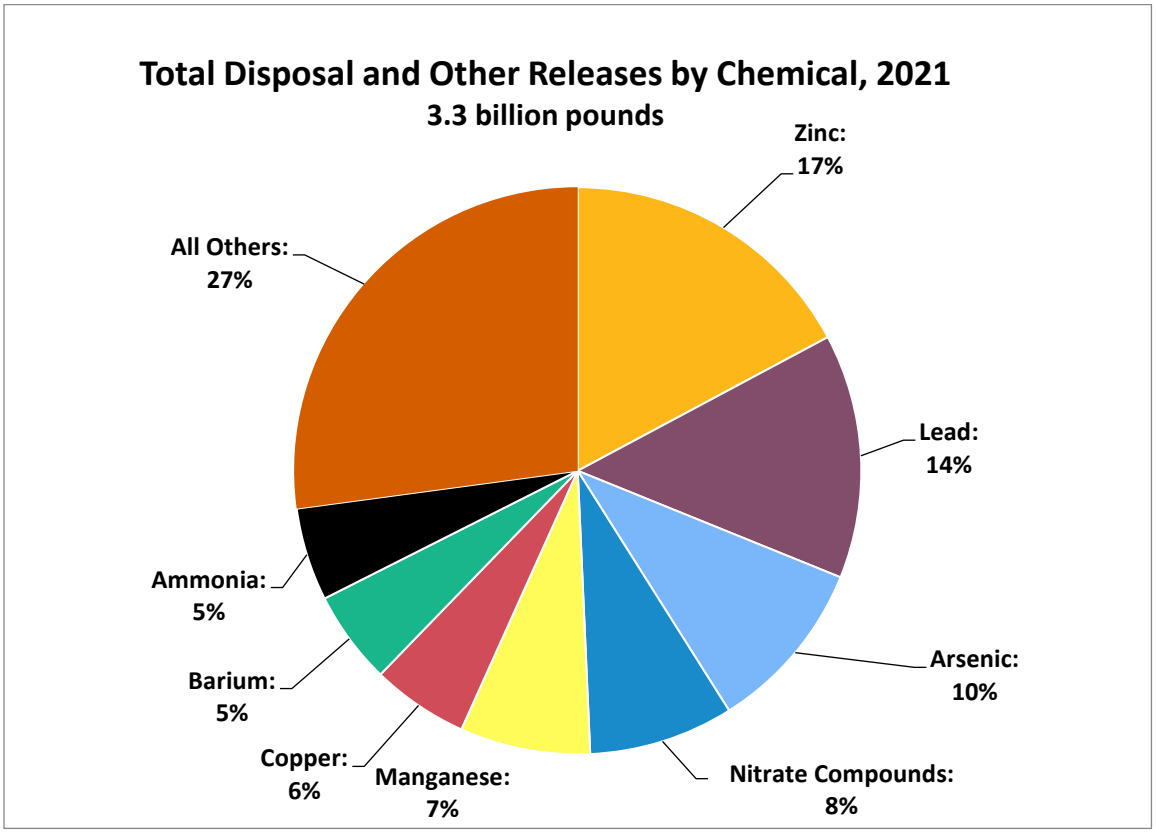
From 2020 to 2021:

- Total releases increased by 8%, driven by an 8% increase in land disposal.
- Air releases increased by 3%, water discharges increased by 1%, and quantities transferred off site for disposal increased by 14%.

Releases by Chemical and Industry

Releases by Chemical

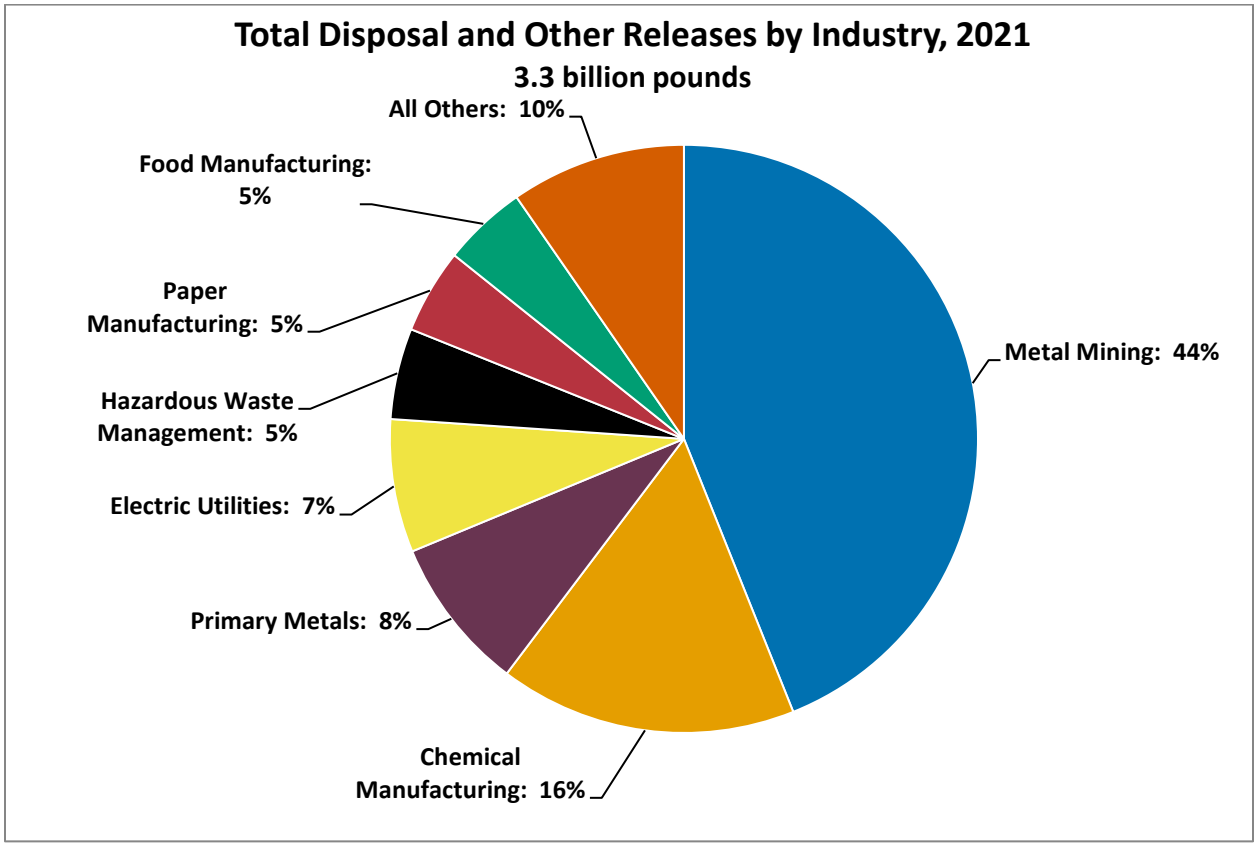
Release quantities of 8 chemicals made up 73% of total releases.



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 (1.44 billion pounds), which were primarily in the form of on-site land disposal. Learn more about this sector in the Metal Mining sector profile.

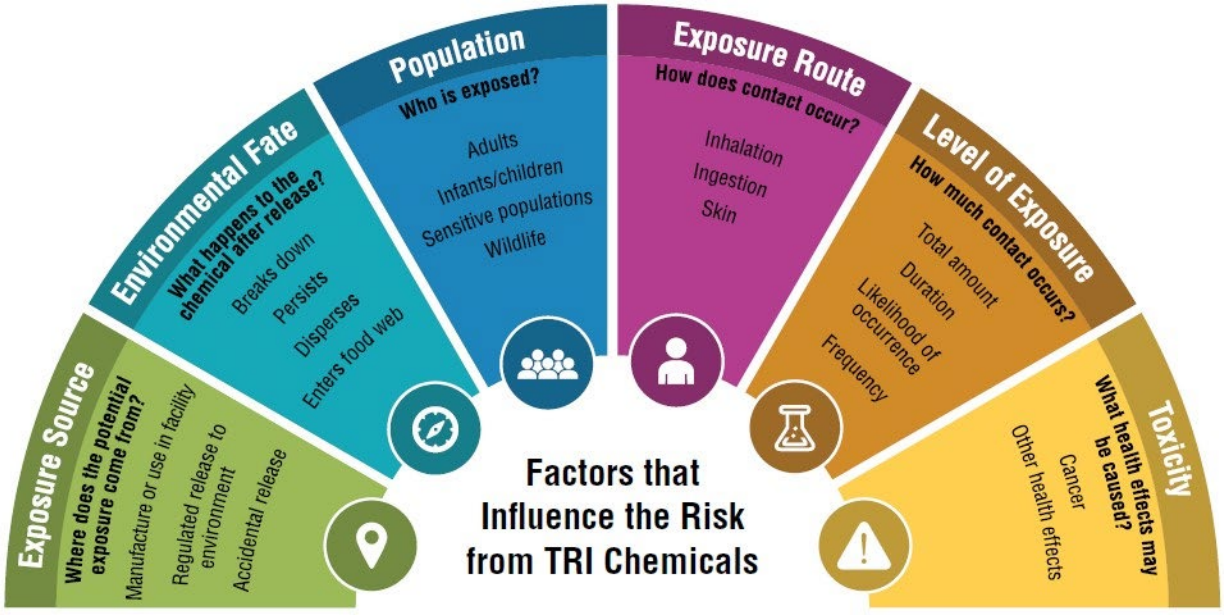


Potential Risks from TRI Chemicals

Health risks that may result from exposure to chemicals are determined by many factors. The quantities of chemicals released into the environment are not an indicator of risks to human health because these quantities alone do not indicate the extent of exposure to these chemicals. Factors listed in the figure below must be considered in order to assess the potential risk of a chemical release causing an adverse effect.

TRI data can be used as a starting point—along with other resources such as EPA's Risk-Screening Environmental Indicators (RSEI) model—to evaluate potential exposure and risks to human health.

Overview of Factors that Influence Risk



EPA developed the Risk-Screening Environmental Indicators (RSEI) model to help identify geographic areas, industry sectors, and chemical releases that may be associated with significant human health risks and examine how these potential risks change over time. RSEI incorporates information from TRI on the amount of chemicals released along with factors such as how chemicals change and where they go as they move through the environment, each chemical's relative toxicity, and the potential for human exposure.

People are most likely to be exposed to TRI chemicals through the air or water, so RSEI focuses on releases to air and water, including releases to air from waste incinerators and releases to water following transfers to publicly owned treatment works (POTWs). Using these waste management quantities reported to TRI, the RSEI model produces two primary results—hazard-

based values (RSEI Hazard) and risk-related scores (RSEI Score)—that enable screening-level comparisons of relative potential harm and potential risks to human health from TRI chemicals.

- **RSEI Hazard** consists of the pounds of a chemical released or transferred multiplied by the chemical's toxicity weight.
- A **RSEI Score** is a calculated estimate of relative potential human health risk. It is a unitless value that accounts for the amount of a chemical released to air or water, what happens to the chemical in the environment, size, and location(s) of potentially exposed populations, and the chemical's toxicity weight.

Helpful Concepts

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

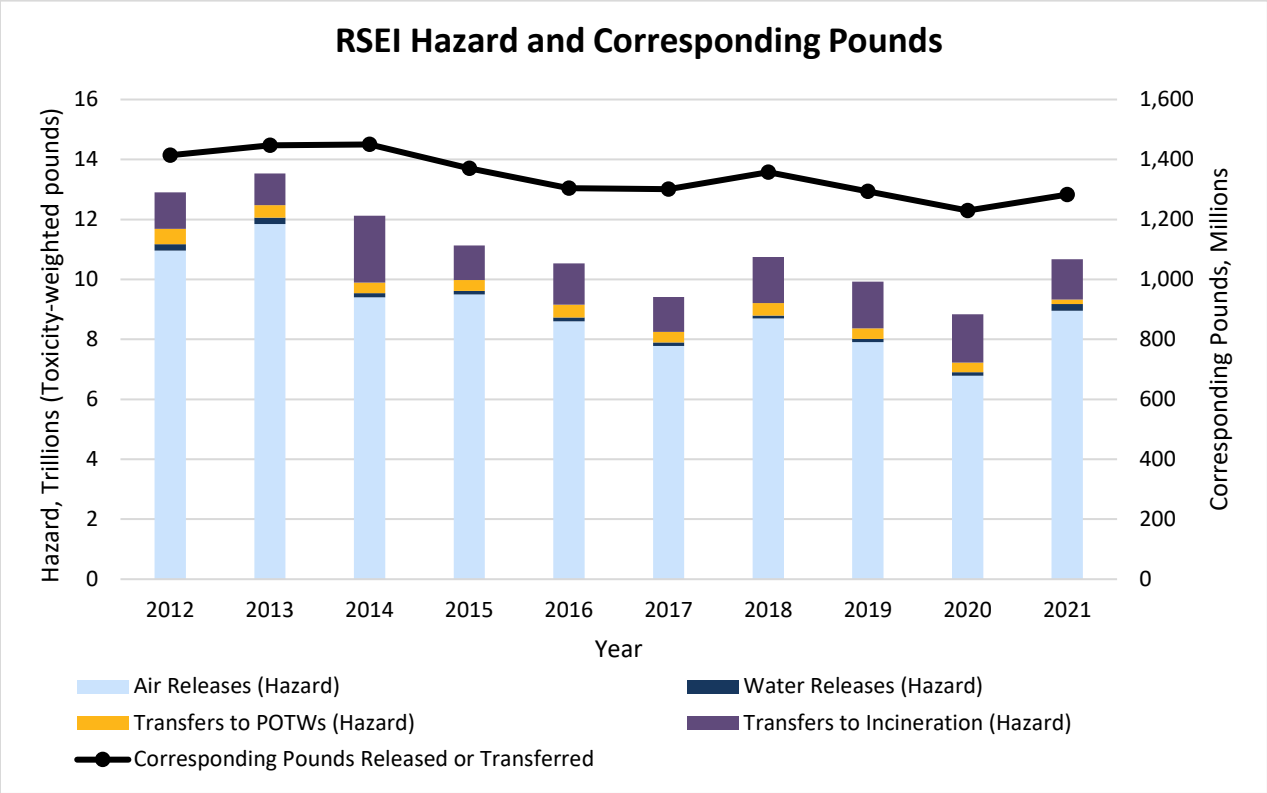
Exposure is how a person comes into contact with a chemical (e.g., inhalation, ingestion) and can be described in terms of its magnitude (how much), frequency (how often), and duration (how long).

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.

Both RSEI Score and RSEI Hazard provide greater insight on potential health impacts than TRI release quantities alone. However, RSEI Hazard or RSEI Score values do not provide estimates of human health risks from industrial emissions of TRI chemicals. Rather, these values are used for relative comparisons, such as the analysis of trends over time or comparison of sectors. Studies and analysis using RSEI data can be used to help establish priorities for further investigation and to look at changes in potential human health impacts over time. More information on RSEI and its applications is available at EPA's RSEI website.

Hazard Trend

RSEI Hazard values provide additional 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 compared to the trend in the unweighted quantity of chemicals used to calculate RSEI Hazard (corresponding pounds).



Note: For comparability, trend graphs include only those chemicals with toxicity weights that were reportable to TRI for all years presented. RSEI Hazard values and corresponding pounds include only on-site air releases, on-site water releases, transfers to publicly owned treatment works (POTWs), and transfers to incineration.

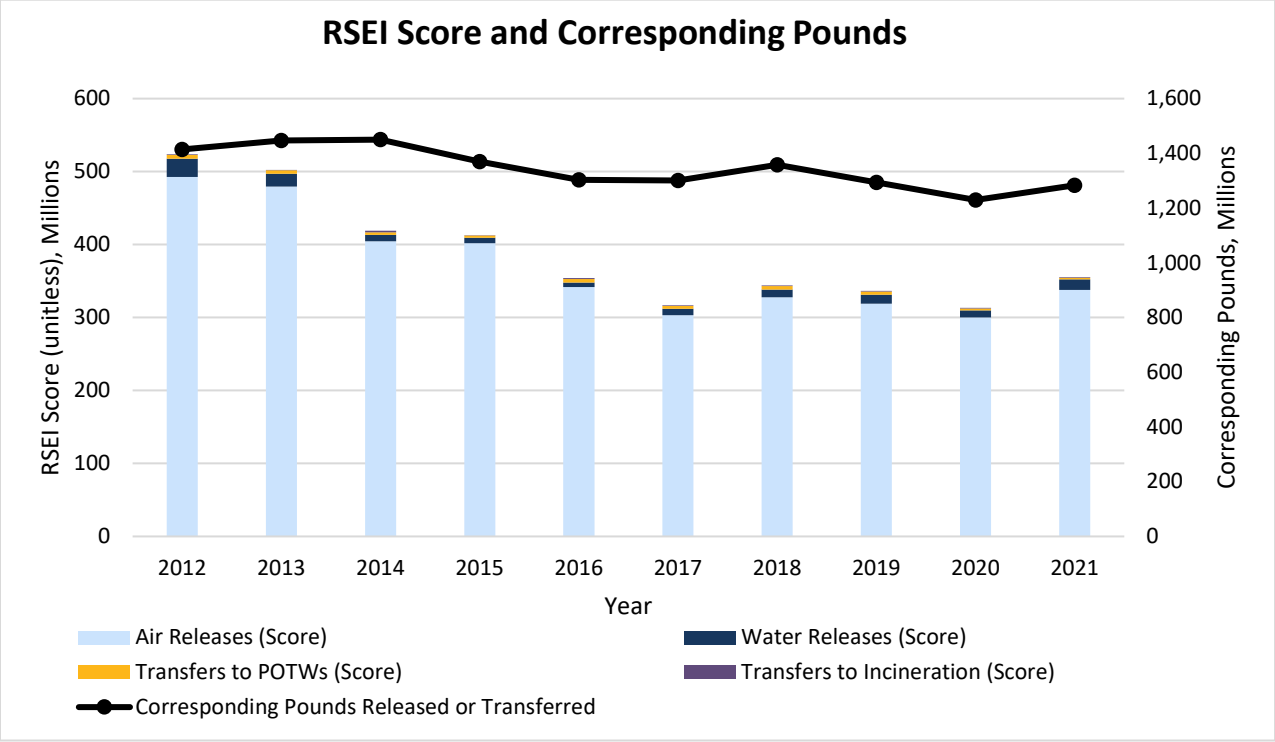
From 2012 to 2021:

- The calculated RSEI Hazard values shown in the figure above decreased by 17%, while their corresponding pounds decreased by 9%. This suggests that TRI facilities are not only releasing or transferring fewer pounds of TRI chemicals for these activities but are also releasing or transferring less of the more toxic chemicals.
- The 14% increase in RSEI Hazard from 2020 to 2021 was driven in part by an increase in air releases of chromium from one facility in Indiana.

Risk-Screening Trend

RSEI Scores are estimates that describe relative potential risk to human health for use in comparative analysis. RSEI Scores consider the location of TRI chemical releases and the number of people living in the surrounding areas. RSEI Scores also account for what happens to the chemical in the environment, where the chemical might travel, and how much of the chemical people might be exposed to.

The following graph shows the 10-year trend in calculated RSEI Score compared to the trend in the corresponding pounds of TRI chemicals released or transferred that are used to calculate the RSEI Score.



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 2012 to 2021:

- The overall calculated RSEI Score decreased by 32%, while corresponding pounds decreased by 9%. This suggests that TRI reporting facilities are: releasing or transferring fewer pounds of TRI chemicals; or releasing fewer pounds of the more toxic TRI chemicals; or that releases are occurring in areas that are less populated.

- While RSEI Score does not describe actual risks to human health from TRI chemicals, the overall decrease in RSEI Score indicates that, at the national level, the relative potential risk from toxic chemicals reported to TRI has declined from 2012 to 2021.
- Of the types of releases modeled by RSEI, air releases contribute the most to potential human health risks based on calculated RSEI Scores.
- The decrease in RSEI Score from 2012 to 2021 was driven by large decreases in air releases of ethylene oxide.

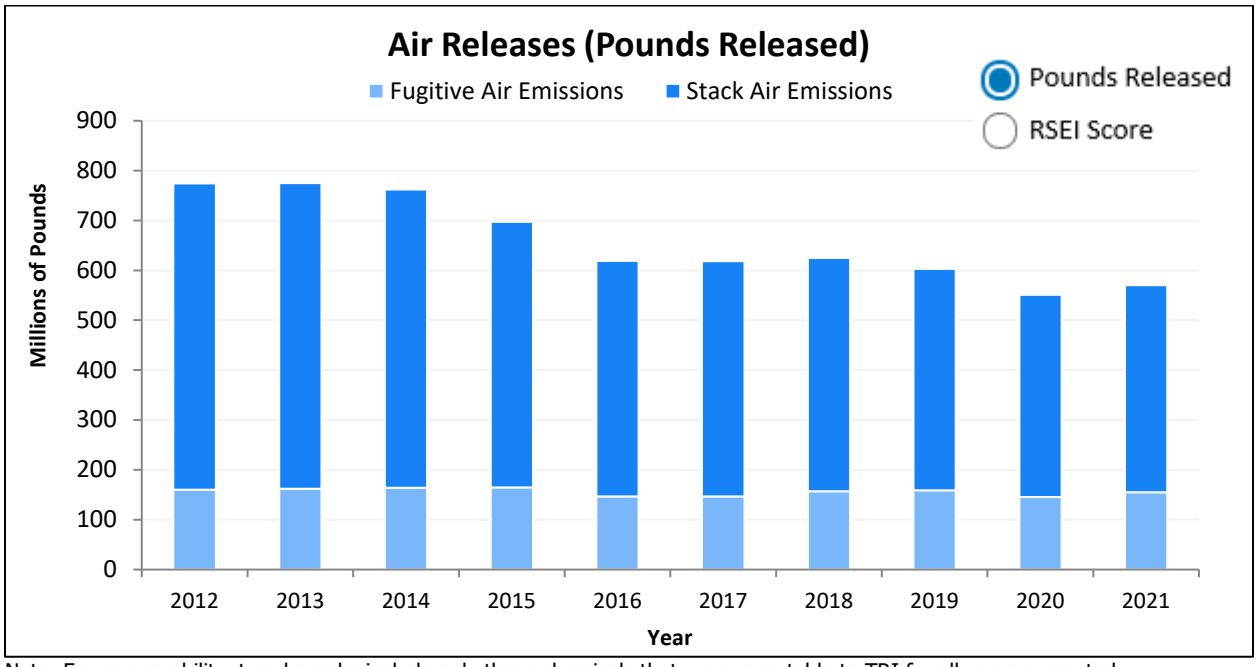
RSEI Dashboard

- Use EPA's 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

Releases of TRI chemicals into the air have declined notably over the last 10 years, driving the decrease in total releases. These releases include both fugitive air emissions and stack air emissions.

This graph shows the 10-year trend in the quantity of chemicals released into the air. EPA regulates air emissions under the Clean Air Act, which requires facilities to comply with permitting requirements if they meet certain criteria such as size and pollutant release minimums.



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

From 2012 to 2021:

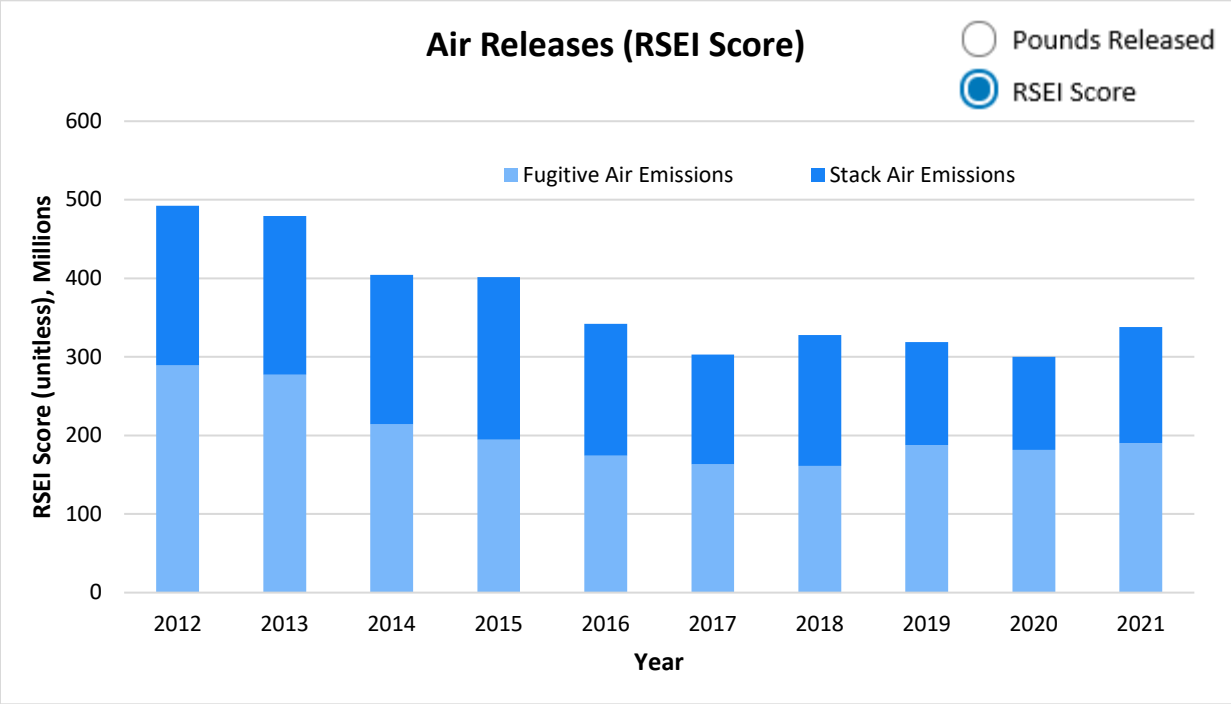
- Releases into the air decreased by 26% (-204 million pounds).
    - Since 2012, air releases of hydrochloric acid, sulfuric acid, hydrogen fluoride, methanol, and toluene decreased the most.
    - This decrease was driven by electric utilities due to: decreased releases of hydrochloric acid and sulfuric acid to air; 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. 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 chemicals of special concern, including lead and mercury, see the Chemical Profiles section.

In 2021:

- The TRI chemicals released into the air in the largest quantities were ammonia and methanol.
- Air releases of TRI chemicals increased by 3% since 2020.
    - The largest increase in air releases was reported by electric utilities. More information about this sector is available in the Electric Utilities sector profile.

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

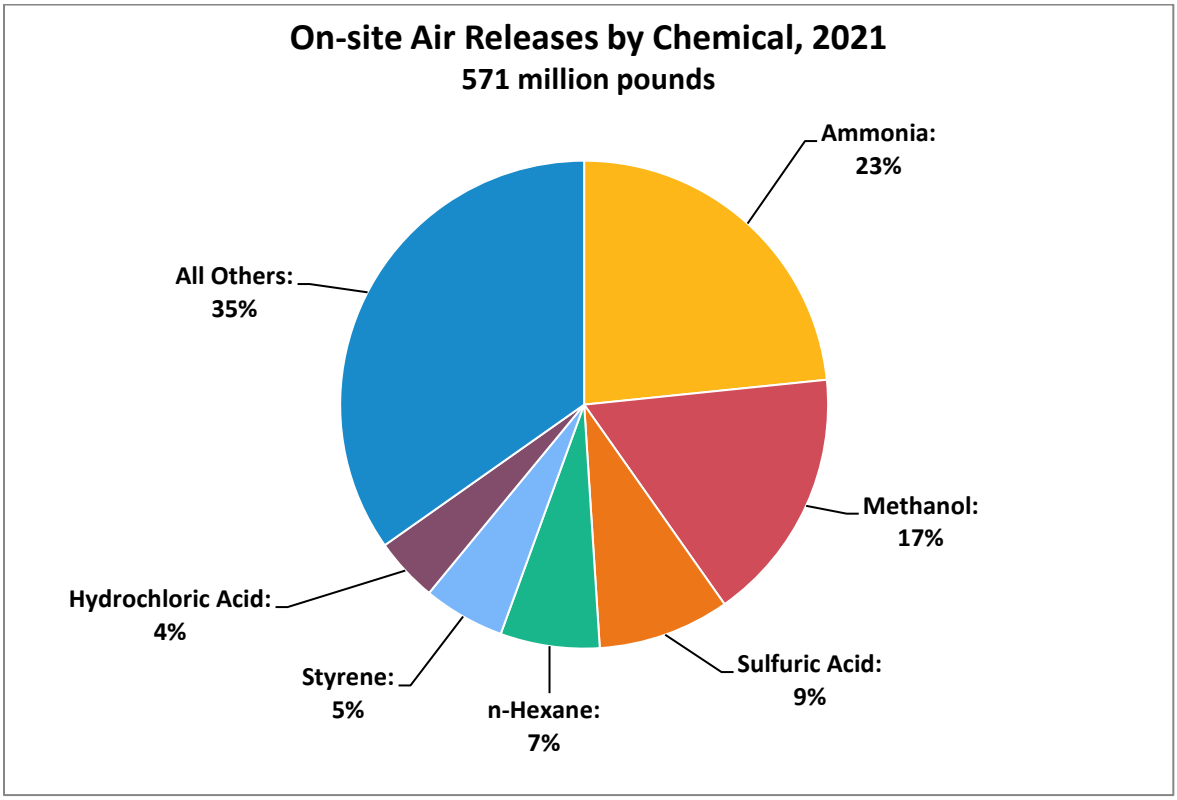


Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

- The chemicals that contributed the most to the RSEI Score values for air releases are ethylene oxide and chromium.
    - While chromium and ethylene oxide combined accounted for less than one percent of total air releases in 2021, they accounted for 35% and 27% of total RSEI Score, respectively.
- As shown in the Pounds Released chart, facilities reported considerably more stack air emissions than fugitive air emissions, 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 emissions, resulting in lower average concentrations. As a result, surrounding populations are less likely to be 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" of EPA's Risk-Screening Environmental Indicators (RSEI) Methodology.
- For general information on how RSEI Scores are estimated, see Potential Risks from TRI Chemicals.

Air Releases by Chemical

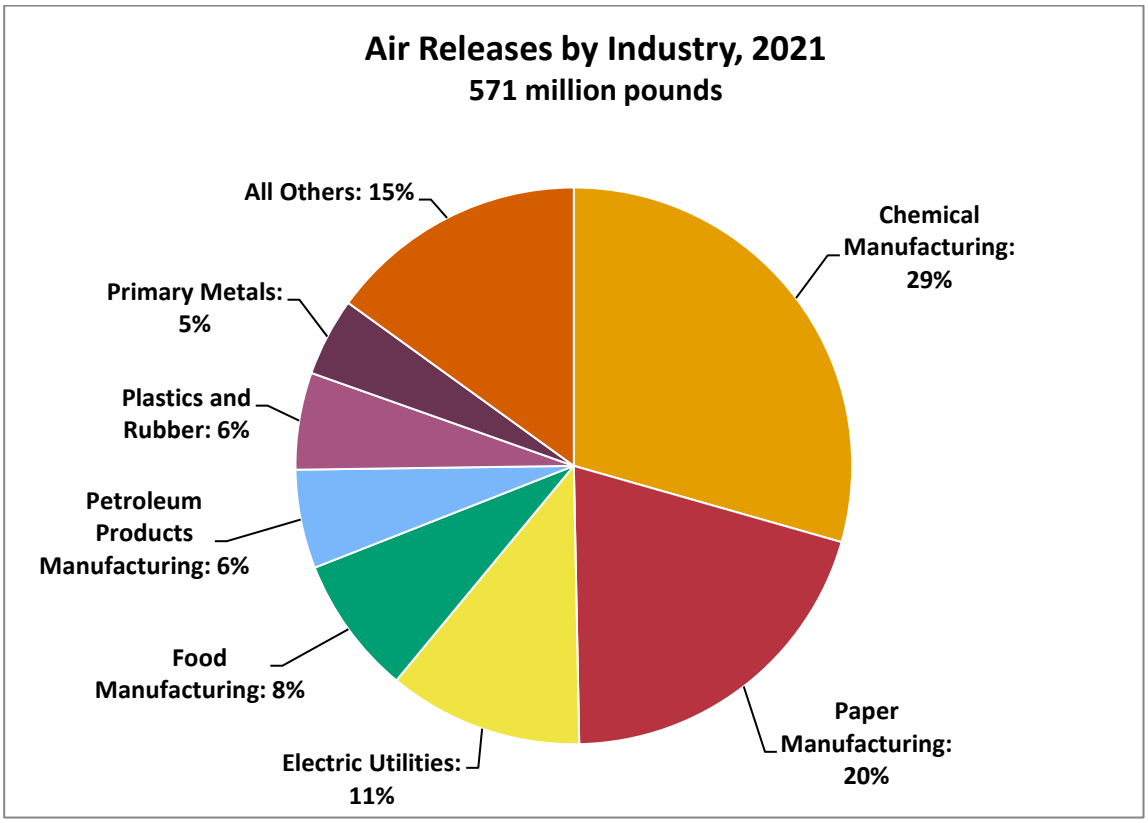
This pie chart shows which TRI chemicals were released into the air in the greatest quantities during 2021.



- Ammonia: Facilities that manufacture nitrogen-based fertilizers accounted for 43% of the ammonia released to air during 2021.
- Methanol: Paper manufacturing facilities released the most methanol to air.
- Sulfuric acid: In 2021, facilities in the electric utilities sector released more sulfuric acid and hydrochloric acid to air than any other industry sector.

Air Releases by Industry

This pie chart shows the TRI-covered industry sectors that reported the largest quantities of air releases during 2021.

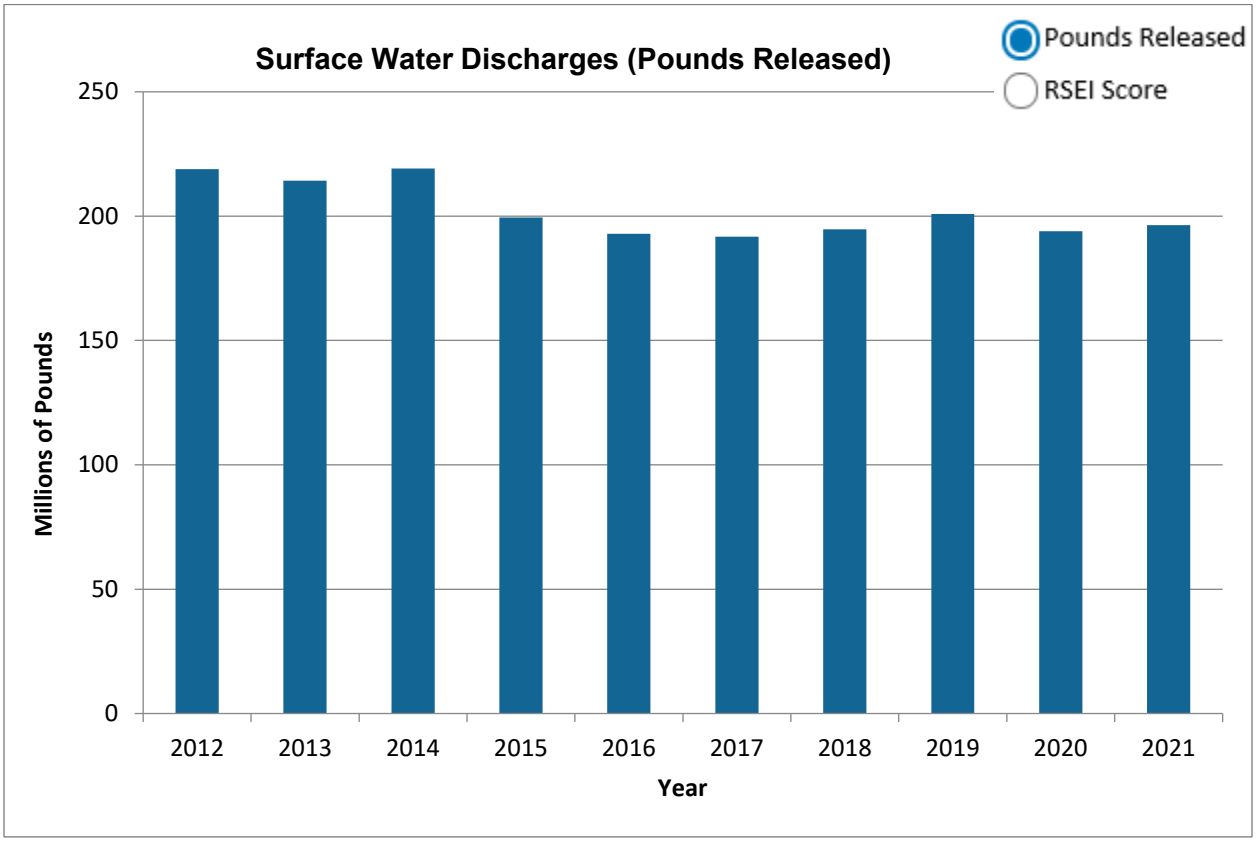


- Facilities in the chemical manufacturing, paper manufacturing, and electric utility sectors accounted for the largest air releases of TRI chemicals during 2021.
    - Chemical manufacturing: Air releases were mostly of ammonia (46%) and ethylene (10%).
    - Paper manufacturing: Air releases were primarily of methanol (66%).
    - Electric utilities: Air releases were mostly of sulfuric acid (61%).

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, which often requires facilities to obtain permits under the National Pollutant Discharge Elimination System (NPDES).

The following graph shows the 10-year trend in the amount of 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.

From 2012 to 2021:

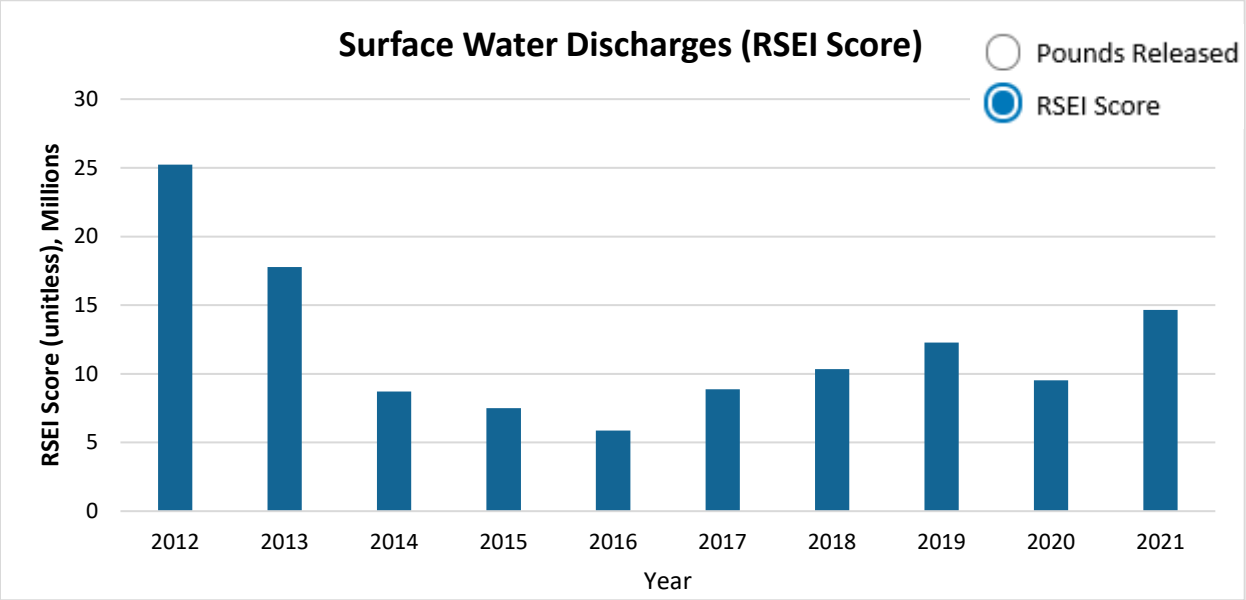
- Discharges of TRI chemicals into surface water decreased by 22 million pounds (-10%). Most of this decline was due to reductions in releases of nitrate compounds.
    - Nitrate compounds are often formed as byproducts during wastewater treatment processes such as neutralization of nitric acid, or when nitrification takes place to meet standards under EPA's effluent guidelines.

In 2021:

- Nitrate compounds alone accounted for 90% of total releases of TRI chemicals to water.

- Nitrate compounds are released by many sectors, with the most releases of nitrate compounds reported by facilities in the food manufacturing sector.

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 and calculated RSEI Score values for on-site water releases (Water Releases).

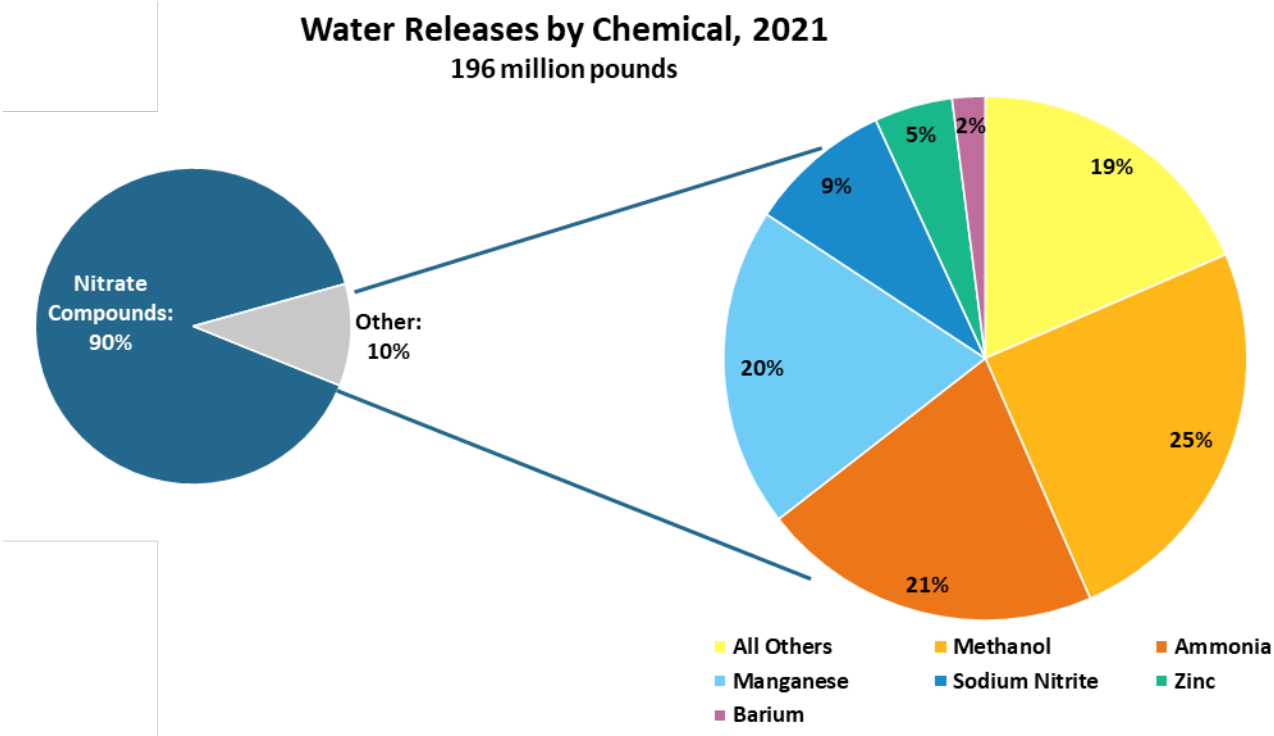
- While total water releases have been fairly steady from 2012 through 2021, associated RSEI Scores have fluctuated substantially. The total pounds of water releases are driven by nitrate compounds, which are relatively low in toxicity; the annual quantities of nitrate compounds released have been fairly constant. RSEI Scores are driven by chemicals that are more toxic. Relatively small changes in the releases of these chemicals can have large impacts on RSEI Scores even though they have little impact on the trend in pounds.
- The biggest chemical contributors to the RSEI Scores for water releases from 2012 to 2021 were arsenic compounds and nitroglycerin.
- The decreased RSEI Score since 2012 was driven in part by a large decrease in hexachlorobenzene. Decreased releases of arsenic compounds were also an important contributor.
- The increase from 2020 to 2021 was driven in part by increases in discharges of mercury compounds 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" of EPA's Risk-Screening Environmental Indicators (RSEI) Methodology.

- For general information on how RSEI Scores are estimated, see Potential Risks from TRI Chemicals.

Water Releases by Chemical

This pie chart shows which TRI-listed chemicals facilities released into water bodies in the largest quantities during 2021.



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) The nitrate compounds category in TRI includes only water dissociable nitrate compounds. 3) Percentages do not sum to 100% due to rounding.

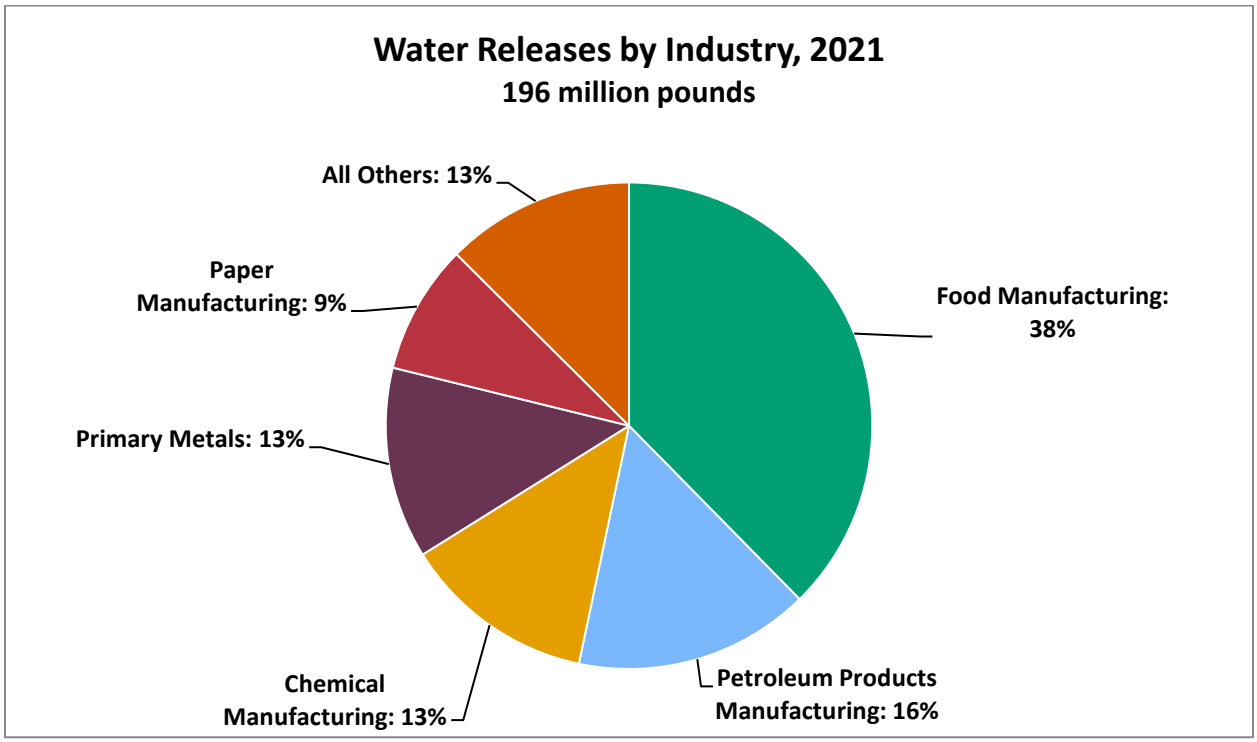
- Nitrate compounds accounted for 90% of the total quantity of TRI chemicals released to water in 2021. Nitrate compounds are commonly formed as part of facilities' on-site wastewater treatment processes. The food manufacturing sector contributed 42% of total nitrate compound releases to water, due to the treatment required for biological materials in wastewater, such as from meat processing facilities.
- After nitrate compounds, methanol, ammonia, and manganese compounds were released in the largest quantities, and in terms of combined mass, accounted for 7% of the chemicals released into water.

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.

Water Releases by Industry

This pie chart shows the TRI-covered industry sectors that reported the largest quantities of TRI water releases during 2021.



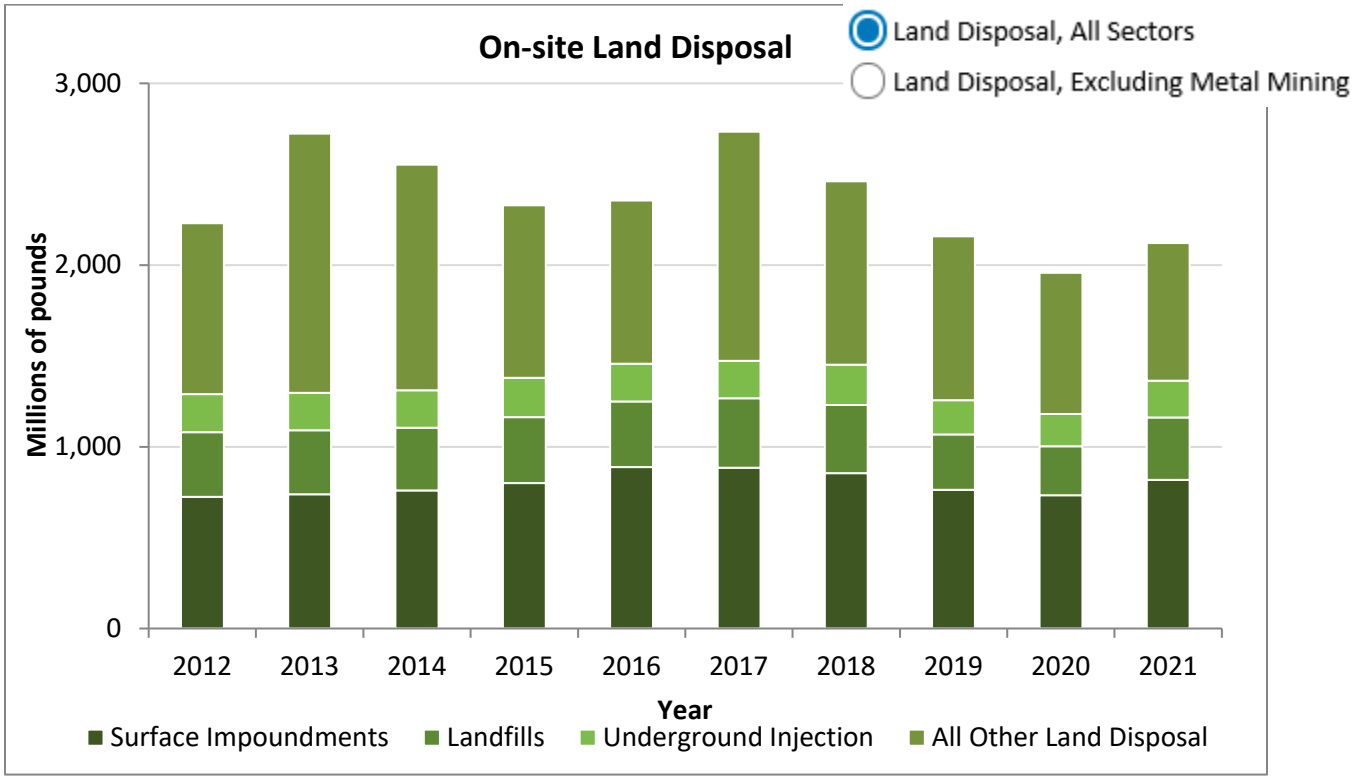
Note: Percentages do not sum to 100% due to rounding.

- Facilities in the food manufacturing sector accounted for 38% of water releases of TRI chemicals for 2021 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. Compared to many other TRI chemicals discharged into surface waters, nitrate compounds are less toxic to humans. They are formed in large quantities by this sector during wastewater treatment processes due to the high biological content of wastewater.

Land Disposal

Facilities report the quantities of TRI chemical waste disposed in landfills, underground injection wells, surface impoundments, and 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 hazardous waste 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 on-site land disposal of TRI chemicals. 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 2012 to 2021:

- On-site land disposal has fluctuated over the last ten years.
- Metal mines have driven the decrease in on-site land disposal since 2017.

- "All Other Land Disposal" in the figure includes application of waste to land such as in agricultural fertilizer, spills and leaks to land, and any other land disposal, such as in waste rock piles at metal mines.

Land releases from metal mines:

The metal mining sector generally drives trends in land disposal. In 2021, this sector accounted for 68% of land disposal quantities. 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 2021 were primarily zinc compounds (28%), lead compounds (27%), 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.

Helpful Concepts

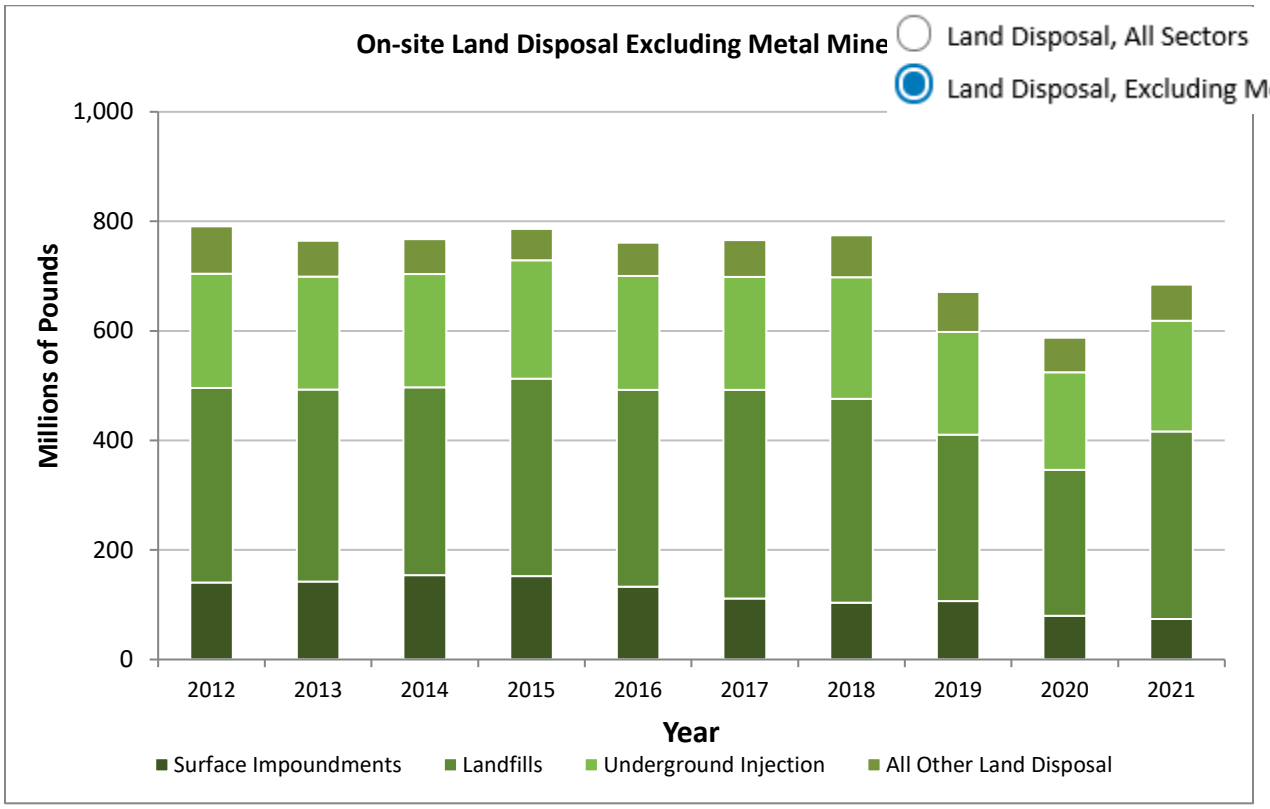
What is underground injection?

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.

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.



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

From 2012 to 2021:

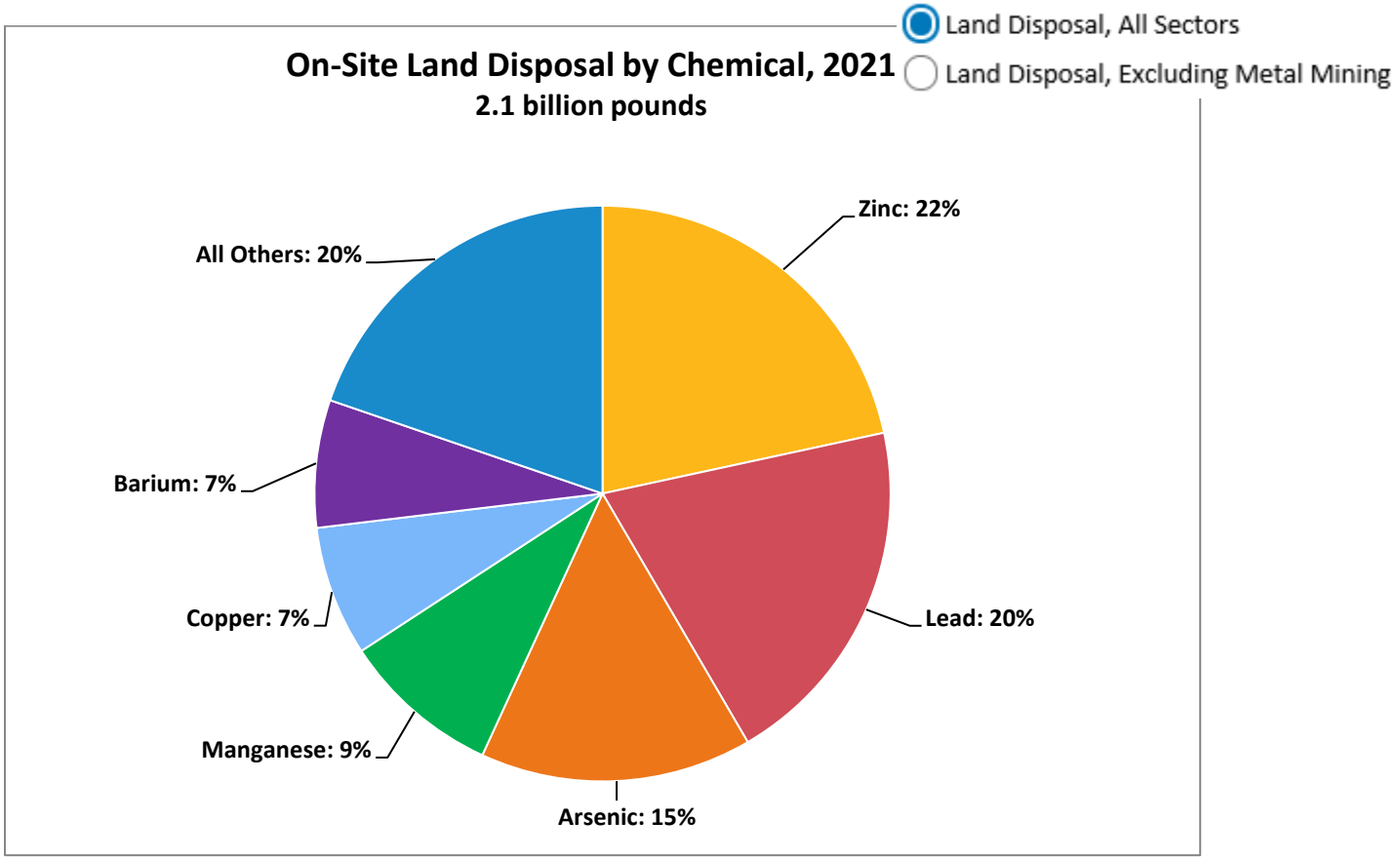
- Total on-site land disposal for all industries other than metal mining was relatively steady from 2012 to 2018.
- Since 2018, the decrease in land disposal for industries other than metal mining was driven by reduced releases to land reported by electric utilities and primary metal manufacturing facilities.

In 2021:

- Land releases in 2021 were about the same as in 2019, indicating that the drop in land releases in 2020 may have been a temporary reduction related to the Covid-19 public health emergency.
- 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 (11%), zinc and zinc compounds (9%), and copper and copper compounds (7%).
- Excluding metal mines, most on-site land disposal quantities were reported by the chemical manufacturing, electric utilities, hazardous waste management, and primary metals sectors.

Land Disposal by Chemical

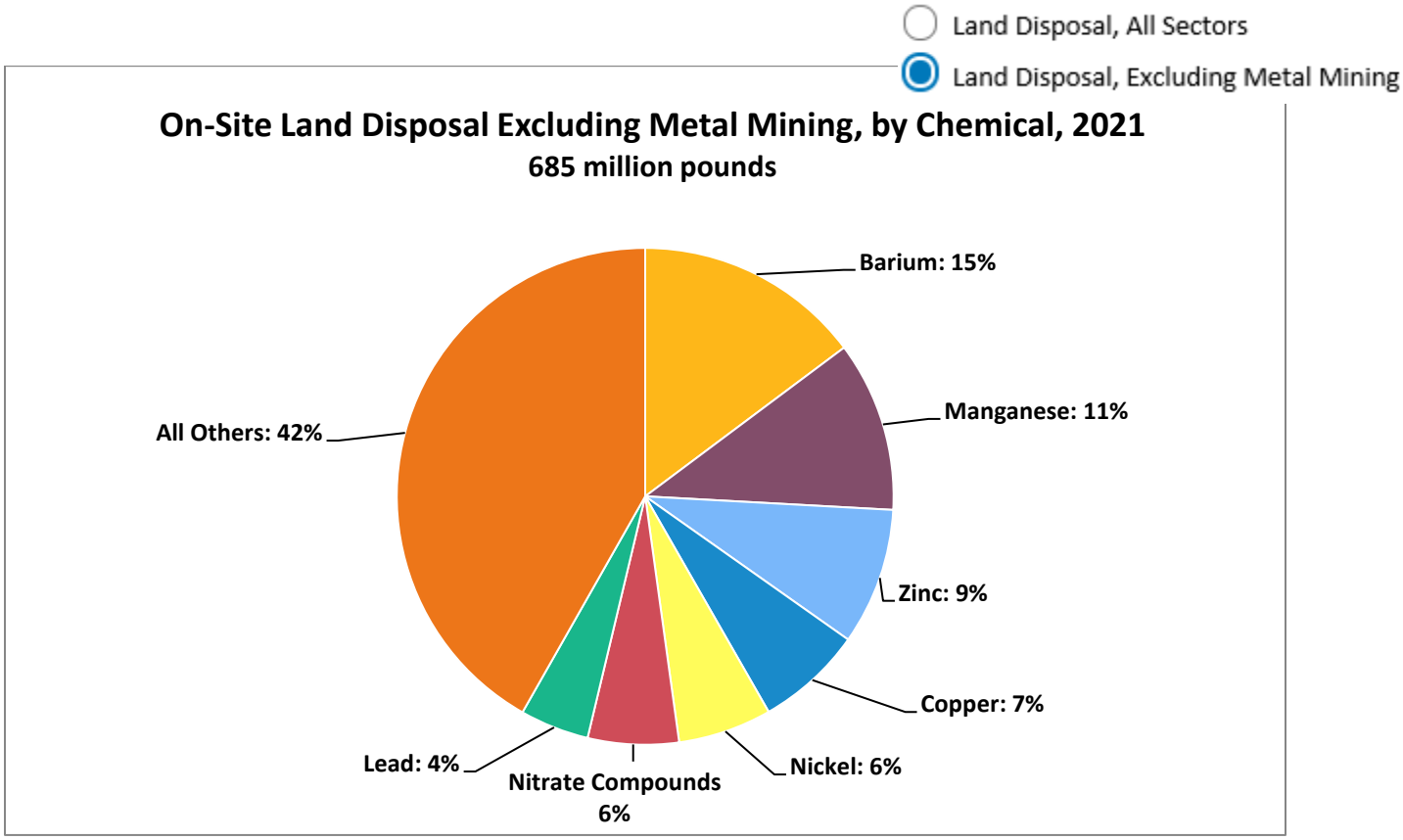
This pie chart shows the chemicals disposed of to land on site in the greatest quantities during 2021. The metal mining sector accounts for most of this disposal. To view the chemicals disposed of to land by sectors other than metal mining, toggle to the "Land Disposal, Excluding Metal Mining" chart.



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 92% of the zinc, lead, and arsenic disposed of to land in 2021. These three chemicals made up 57% of the total quantities of TRI chemicals disposed of 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 on site to land in the greatest quantities during 2021, excluding quantities from facilities in the metal mining sector.

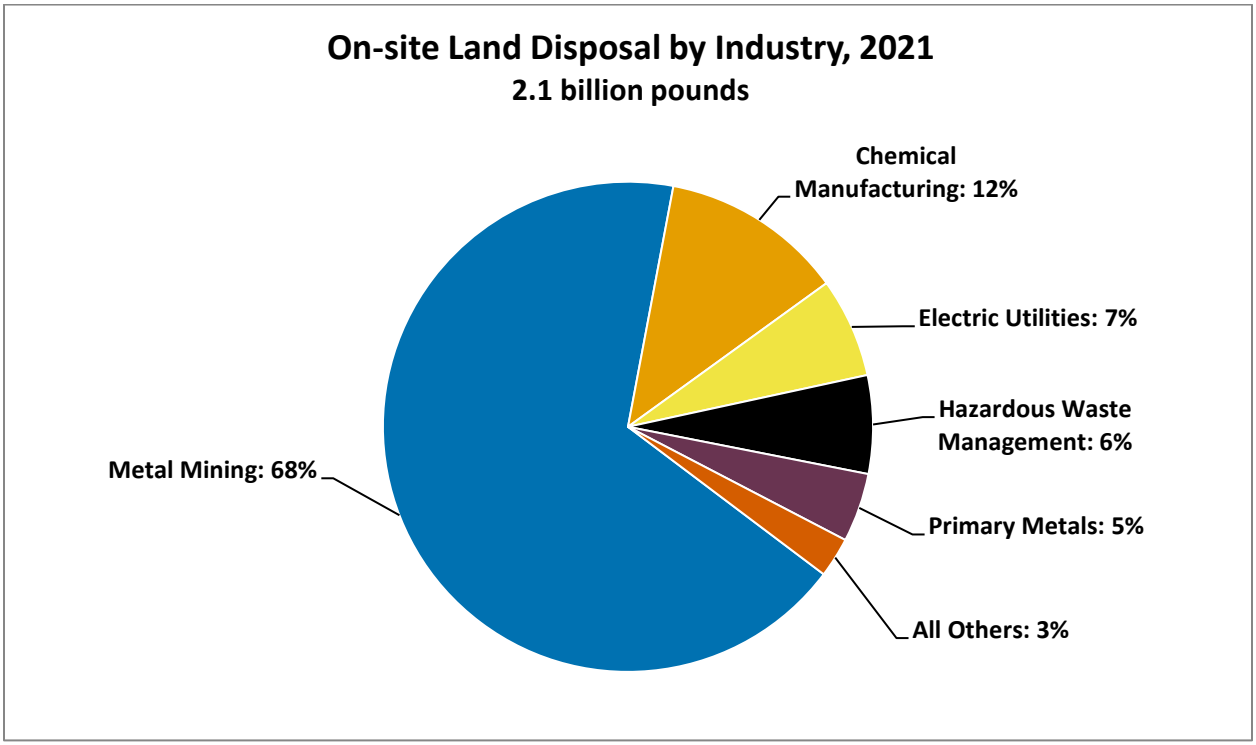


Note: In this chart, metals are combined with their metal compounds, although metals and compounds of the same metal are listed separately on the TRI list (e.g., lead is listed separately from lead compounds).

- When the metal mining sector is excluded, a wider variety of chemicals contribute to most of the land releases. For example, seven different chemicals made up 58% of land releases when metal mining facilities are excluded, whereas three chemicals made up a comparable 57% of land releases when these facilities are 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, electric utilities, and primary metals sectors.
- Zinc: Most land releases were from the primary metals sector.

Land Disposal by Industry

This pie chart shows the industry sectors that reported the greatest quantities of on-site land disposal of TRI chemicals during 2021.



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

- Metal mines accounted for most of the TRI chemicals disposed of to land in 2021.
- The relative contribution by each industry sector to on-site land disposal has not changed considerably in recent years.

Chemical Profiles

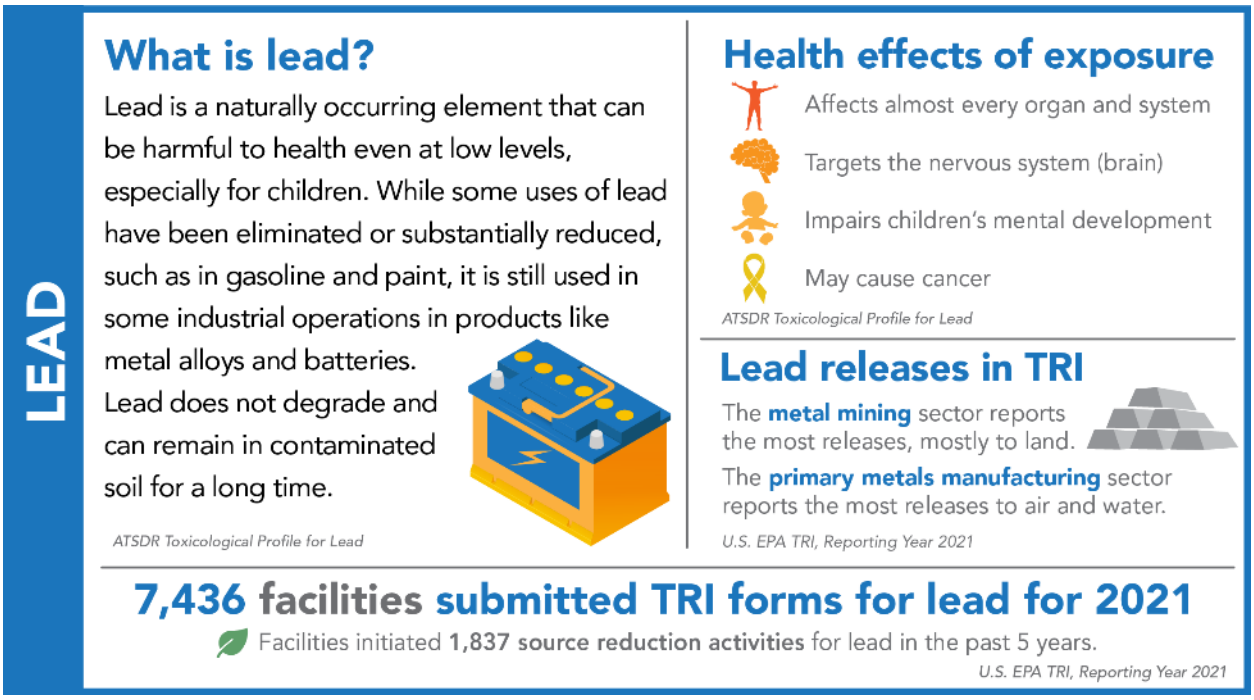
In this section, we take a closer look at some of the Toxics Release Inventory (TRI) chemicals of interest to the public, the Environmental Protection Agency (EPA), lawmakers, and industry. These profiles include persistent bioaccumulative toxic (PBT) chemicals that are classified by TRI as chemicals of special concern. Other profiles focus on carcinogens (chemicals that cause cancer) and per- and polyfluoroalkyl substances (PFAS, persistent chemicals that were recently added to TRI).

PBTs are toxic, break down very slowly in the environment, and tend to build up in organisms throughout the food web. These organisms are food sources for other organisms, including humans, which are sensitive to the toxic effects of PBT chemicals. Reporting thresholds for the PBTs on the TRI chemical list are either 10 pounds or 100 pounds, lower than for most TRI chemicals. For dioxin and dioxin-like compounds, the reporting threshold is even lower, at 0.1 gram. The PBTs covered here are lead and lead compounds, mercury and mercury compounds, and dioxin and dioxin-like compounds.

You can generate a fact sheet for any chemical using TRI Explorer.

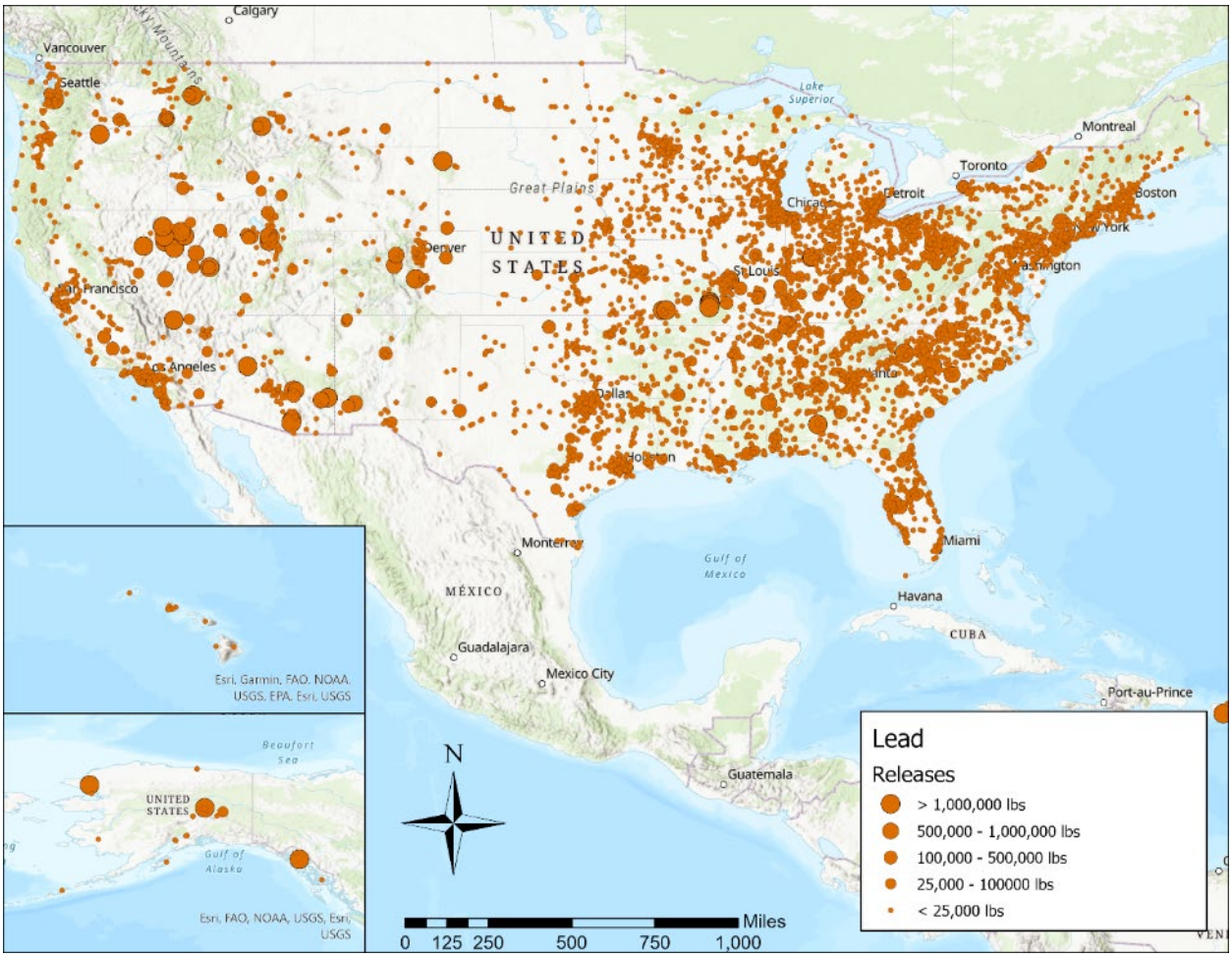
Lead

This chemical profile focuses on releases of lead and lead compounds.



Facilities report their management of both lead and lead compounds in waste to TRI. For TRI, "lead" only includes pure lead, while "lead compounds" includes any chemical that contains lead. Although facilities may report for lead compounds separately from lead, the two are combined and referred to simply as "lead" in this analysis.

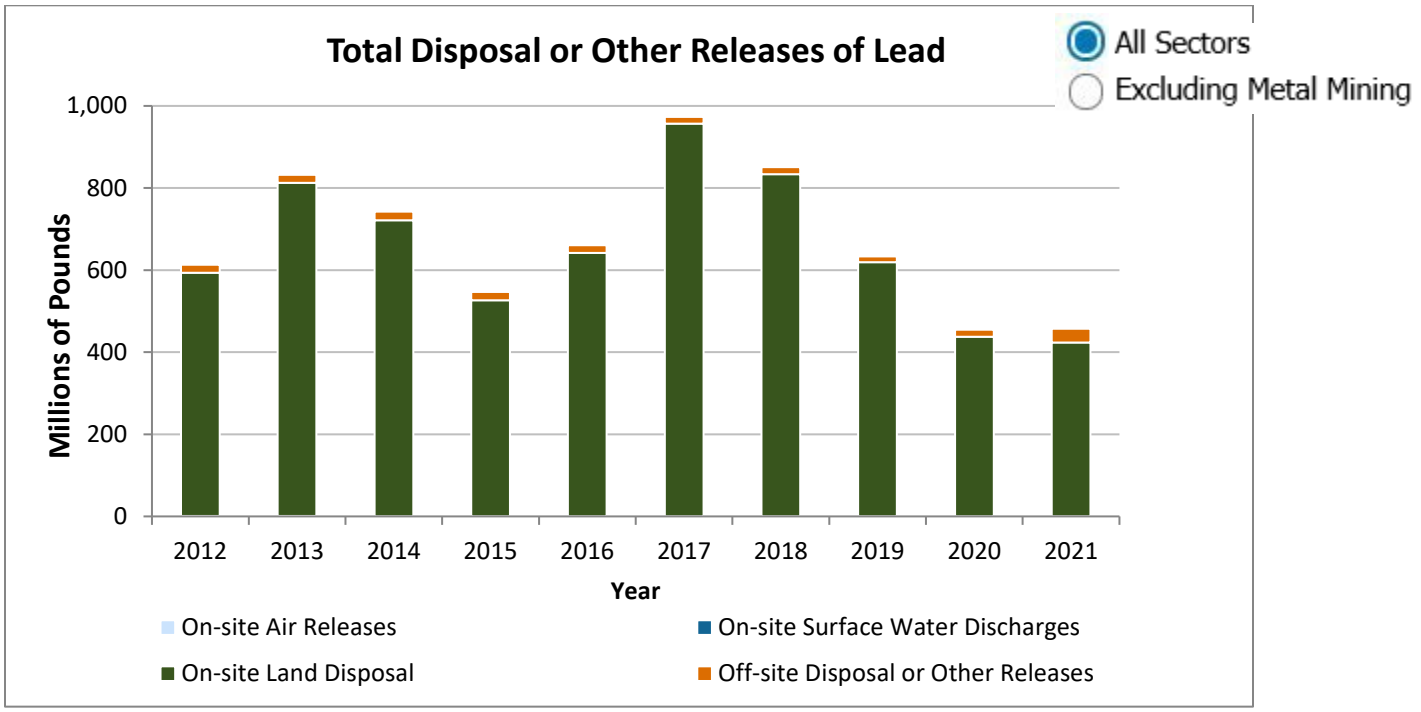
This map shows the locations of the facilities that reported lead to TRI for 2021, sized by their relative release quantities. Zoom in to view demographic data for communities around these facilities. Click on a facility for more details on its reporting.



Click on any one of the locations on the map to see detailed information.

View Larger Map

More TRI forms are received for lead each year than any other chemical. This graph shows the 10-year trend in lead disposed of or otherwise released by facilities in all TRI reporting industry sectors.



From 2012 to 2021:

- Total releases of lead fluctuated between 2012 and 2021.
- Land disposal by metal mines drives annual lead releases. For 2021, metal mines reported 86% of all releases of lead, which was almost all disposed of to land.

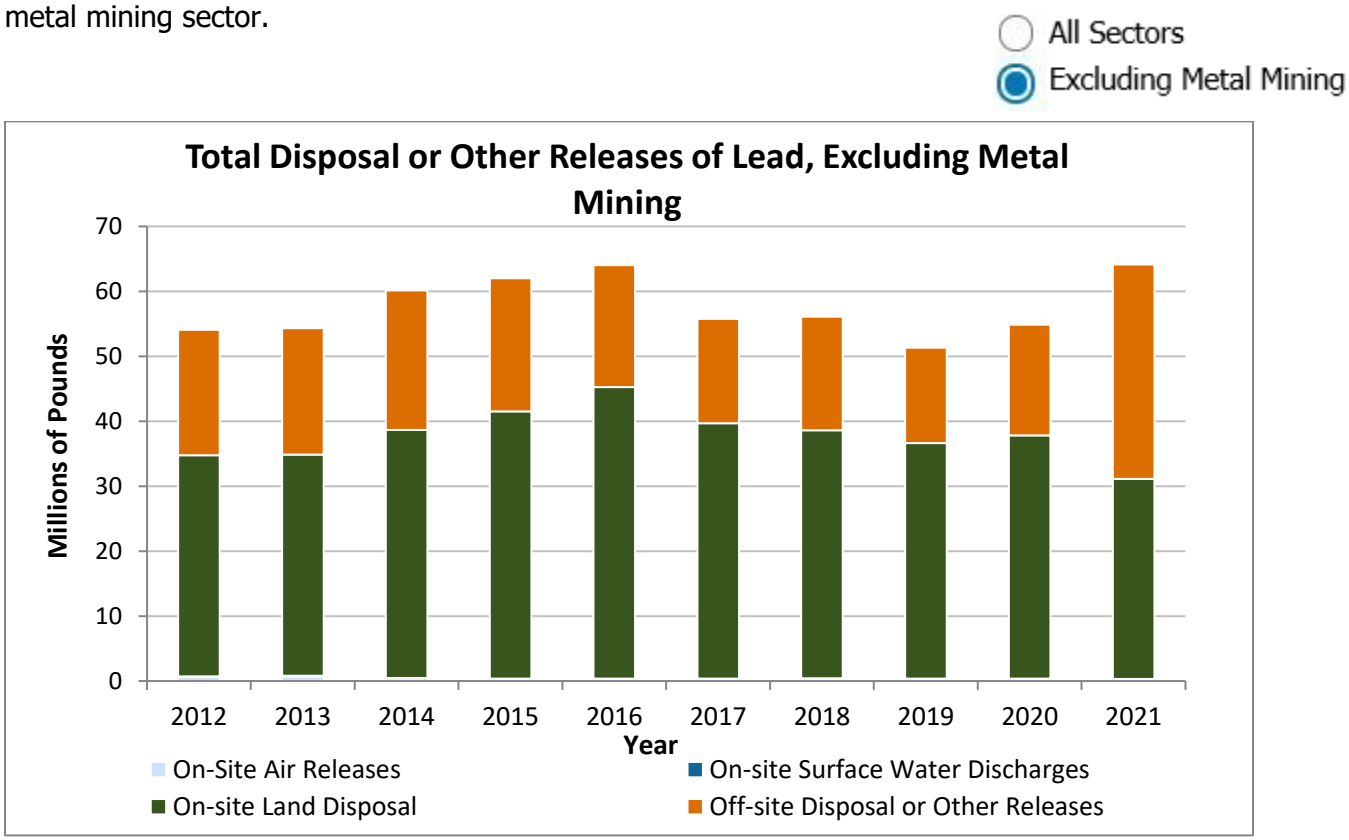
From 2020 to 2021:

- Total releases of lead stayed about the same.

Learn more about lead

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

This graph shows the 10-year trend in lead released, but excludes quantities reported by the metal mining sector.



From 2012 to 2021:

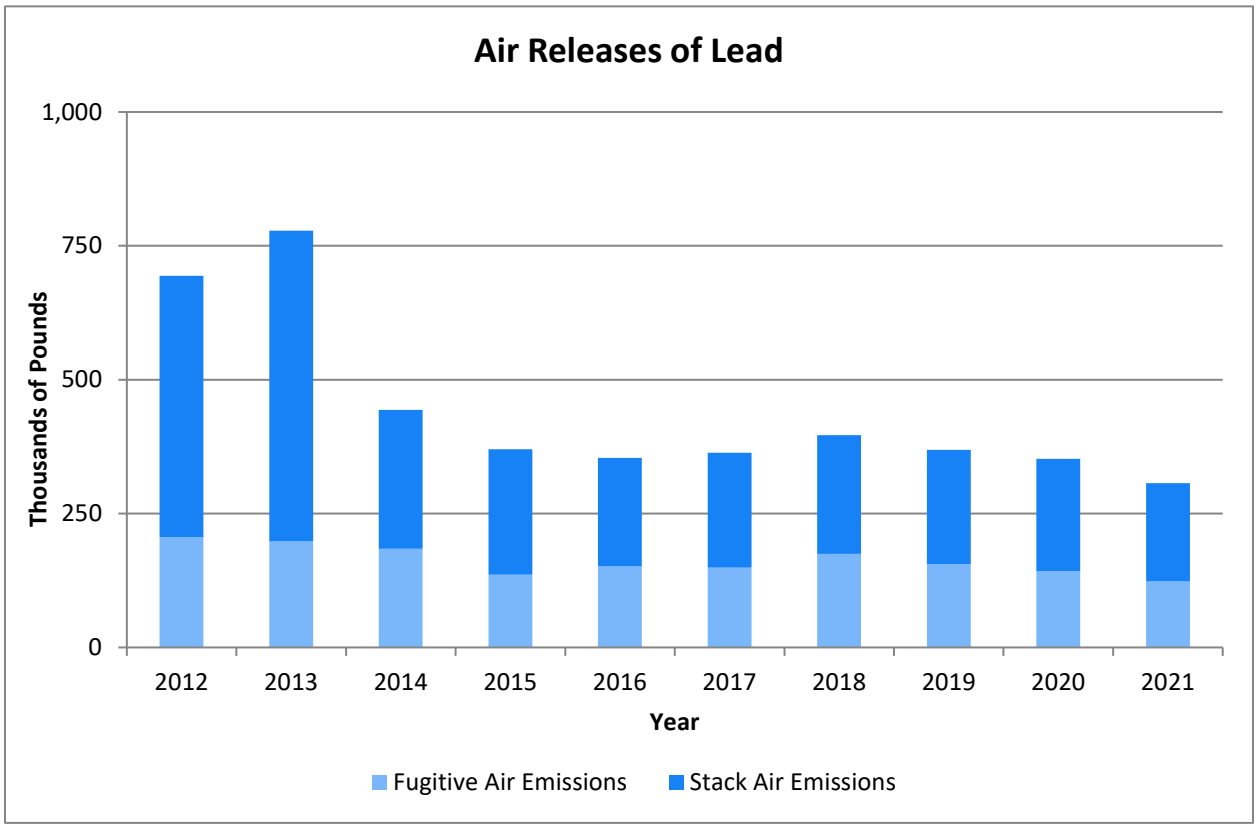
- For sectors other than metal mining, total releases of lead fluctuated between 2012 and 2021.
- Among sectors other than metal mining, most releases of lead came from the primary metals and hazardous waste management sectors.

From 2020 to 2021:

- Off-site disposal of lead increased by 94% driven by several facilities that reported large increases in off-site lead disposal for 2021. For two of these facilities, the increase was due to lead remediation activities. Two other facilities commented that reduced options to ship off site in 2020 due to COVID delayed shipments until 2021.

Lead Air Releases

This graph shows the 10-year trend in lead released to air.



From 2012 to 2021:

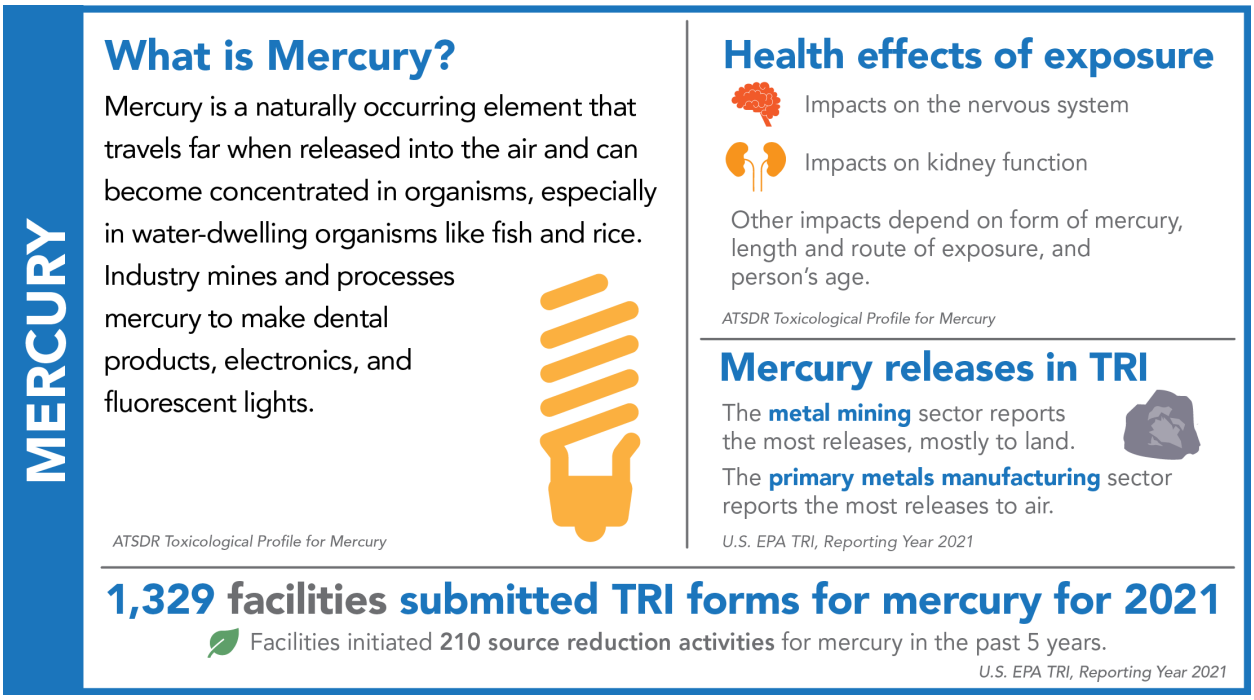
- Air releases of lead decreased by 56%. Most of the decrease comes from reduced stack emissions.
- The primary metals sector, which includes copper smelting and iron and steel manufacturing, released the largest quantities of lead to air. This sector has also been the biggest driver of reduced air releases since 2012, although lead air releases have decreased in most sectors.

From 2020 to 2021:

- Air releases of lead decreased by 13%. The primary metals and plastics and rubber products manufacturing sectors accounted for the largest reductions.
- In 2021, the primary metals sector accounted for 33% of lead released into the air.

Mercury

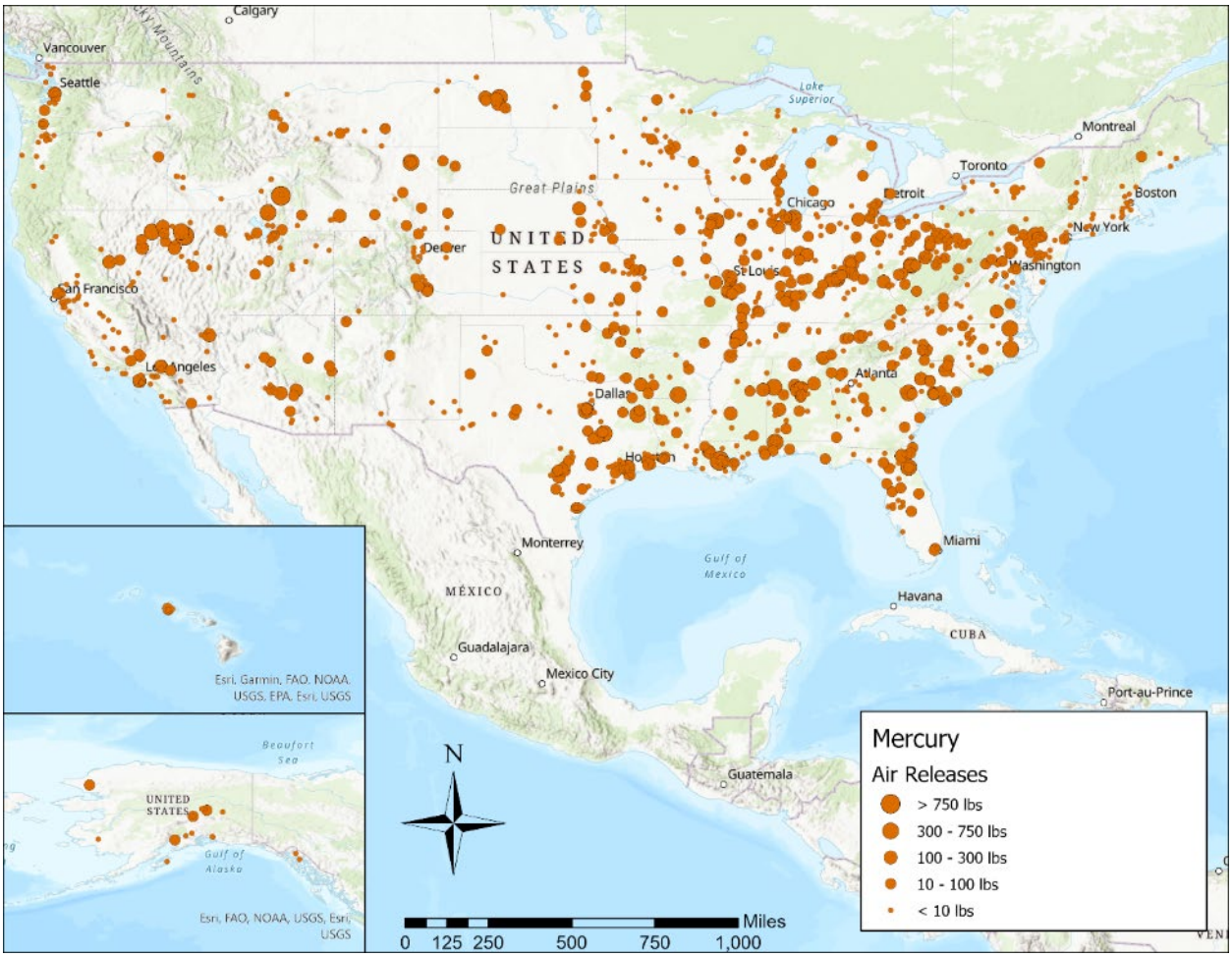
This chemical profile focuses on releases of mercury and mercury compounds.



Facilities report waste management of both mercury and mercury compounds to TRI. For TRI, "mercury" only includes pure mercury, while "mercury compounds" includes any chemical that contains mercury. Although facilities may report for mercury compounds separately from mercury, the two are combined and referred to simply as "mercury" in this analysis.

This profile focuses on air releases of mercury as they are the type of release most likely to impact human health.

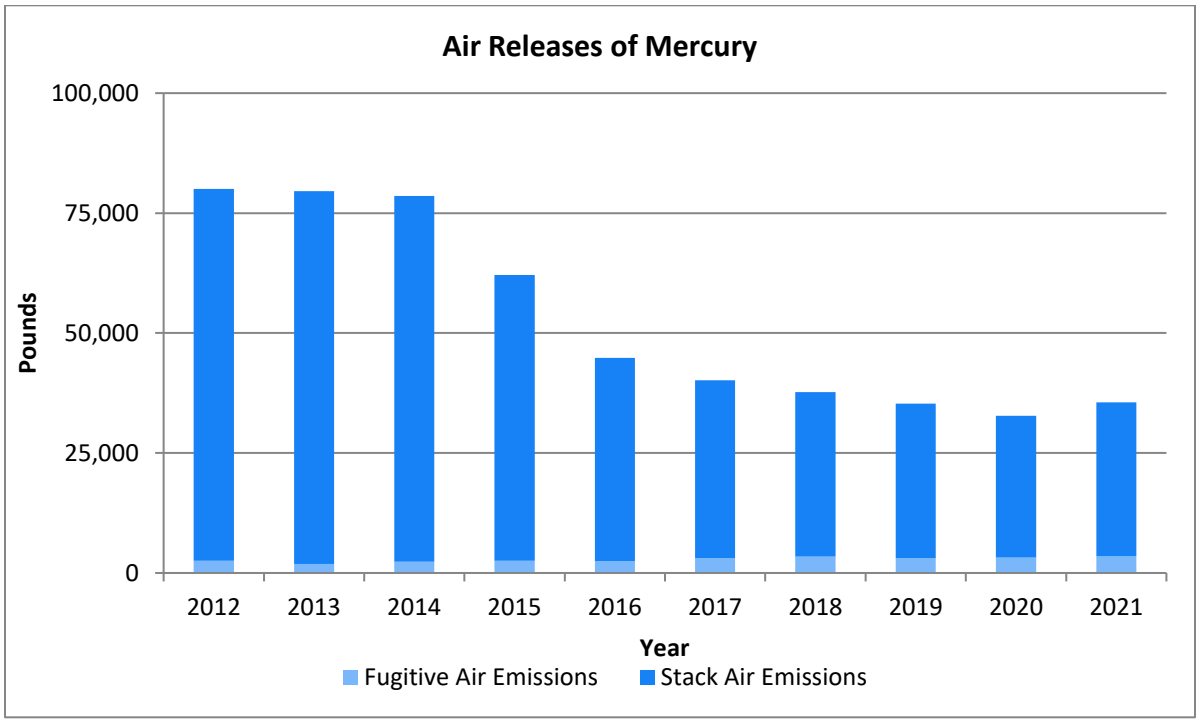
This map shows the locations of the facilities that reported mercury to TRI for 2021, sized by their relative release quantities to air. Zoom in to view demographic data for communities around these facilities. Click on a facility for more details on its reporting.



Click on any one of the locations on the map to see detailed information.

View Larger Map

This graph shows the 10-year trend in mercury released to air.



From 2012 to 2021:

- Releases of mercury to air decreased by 56%.
- Electric utilities drove the decline in mercury air emissions, with an 85% reduction (-41,000 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. Electric utilities that shift from combusting any coal or oil to entirely using other fuel sources (such as natural gas) are not required to report to TRI.

Learn more about mercury

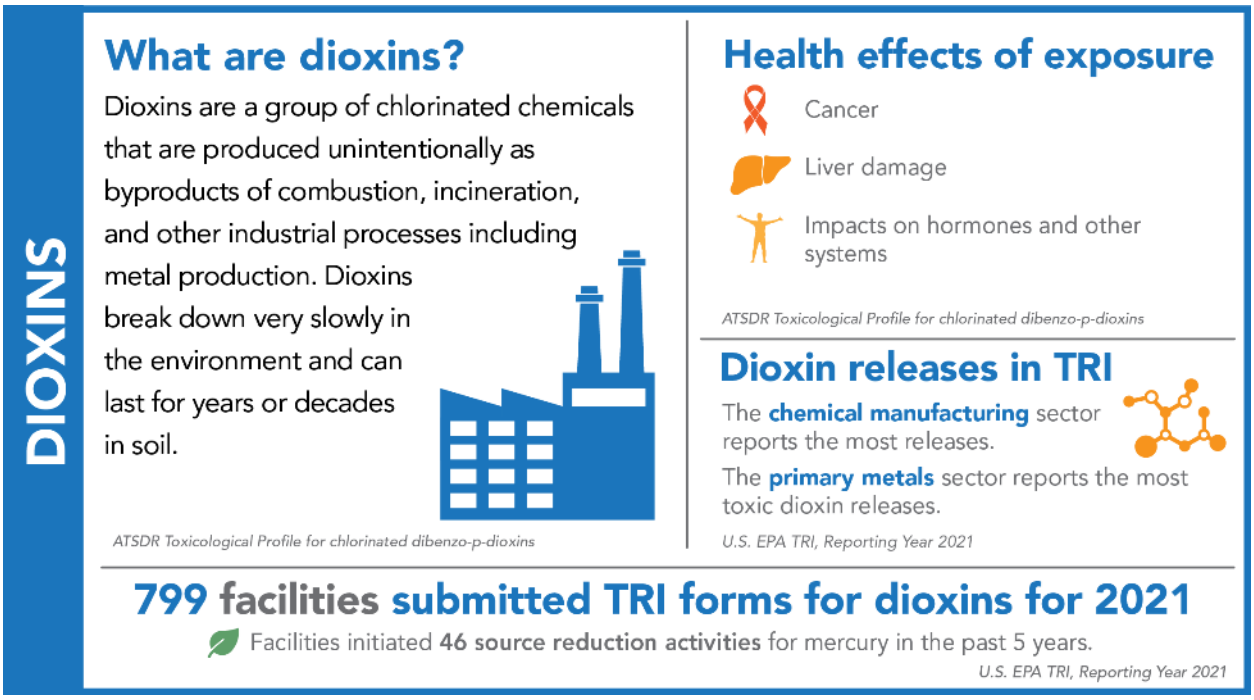
Visit EPA's mercury homepage for more information about mercury and EPA's actions to reduce mercury exposures.

From 2020 to 2021:

- Releases of mercury to air increased by 9% but were only slightly higher than quantities released in 2019.
- For 2021, the primary metals sector, which includes iron and steel manufacturers, accounted for 39% of the air emissions of mercury and the electric utilities sector accounted for 21% of mercury air emissions.

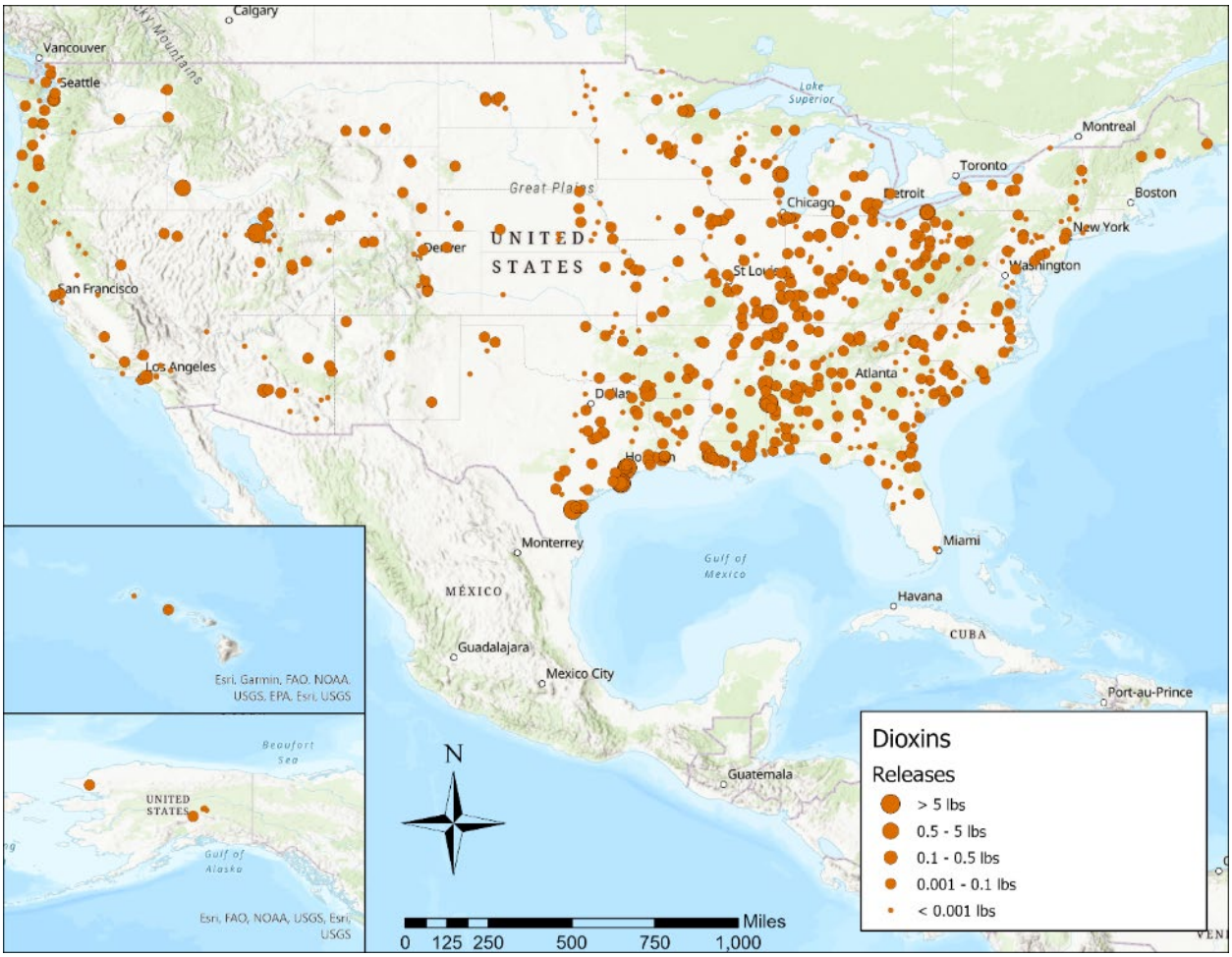
Dioxins

This chemical profile focuses on releases of dioxin and dioxin-like compounds.



Dioxins are typically produced in very small quantities compared to other chemicals, but are toxic at much lower concentrations than most other chemicals. Additionally, they persist in the environment and bioaccumulate in the food web. Therefore, dioxins have a lower reporting threshold and are reported in grams instead of pounds to capture smaller amounts of these chemicals.

This map shows the locations of the facilities that reported dioxins to TRI for 2021, sized by their relative release quantities. Zoom in to view demographic data for communities around these facilities. Click on a facility for more details on its reporting.



Click on any one of the locations on the map to see detailed information.

View Larger Map

Dioxin and dioxin-like compounds ("dioxins") are persistent bioaccumulative toxic (PBT) chemicals characterized by EPA as probable human carcinogens.

TRI requires facilities to report data on the 17 individual members (congeners) of the TRI dioxin and dioxin-like compounds category. While each of the dioxin congeners causes the same toxic effects, some cause these effects at lower levels of exposure than others because congeners have different toxicities. As a result, one mixture of dioxins can have a very different toxic potency than the same amount of a different mixture. Facilities in different sectors release different mixtures of dioxins depending on their operations, so the potential for harm from their releases may also be different.

EPA accounts for the different toxicities of the dioxin congeners by using Toxic Equivalency (TEQ) values. TEQs help to understand the toxicity of dioxin releases. They are most useful when comparing releases of dioxins from different sources or different time periods, where the mix of congeners may vary.

Helpful Concepts

Toxic Equivalent Factor (TEF)

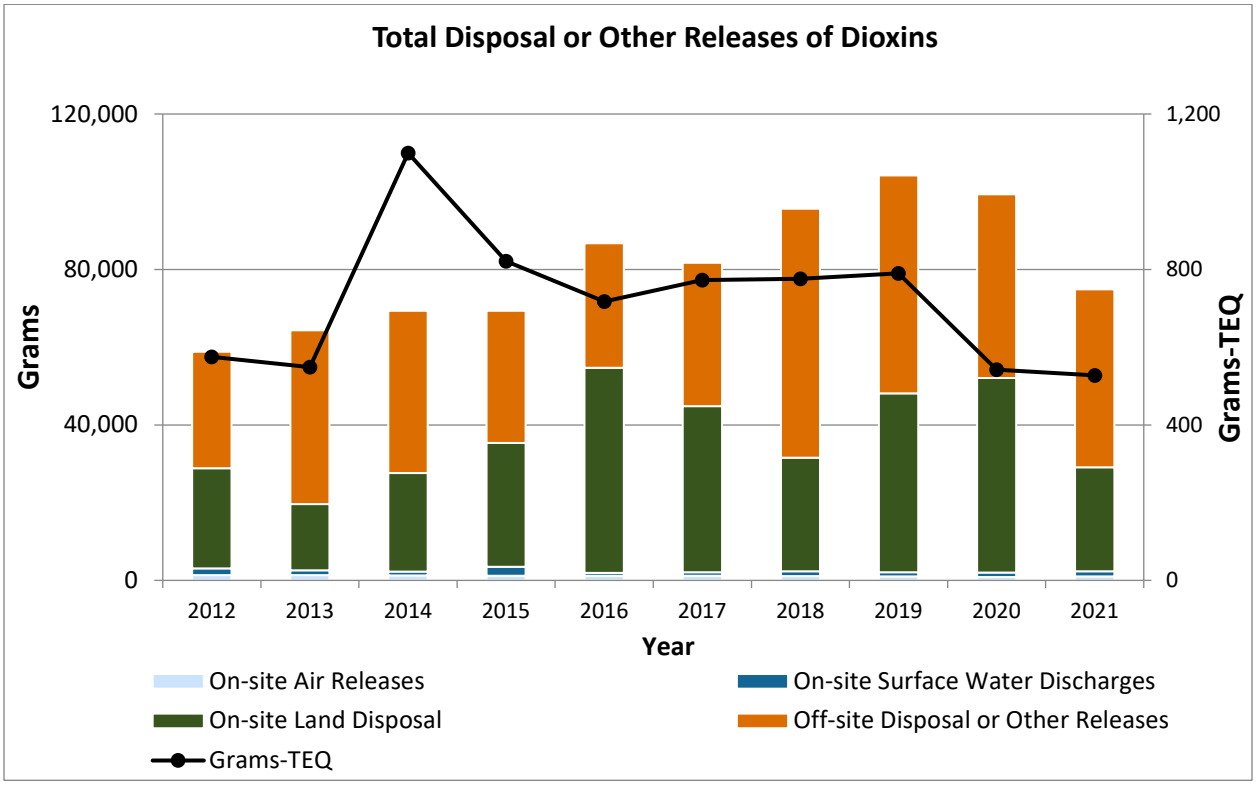
Each dioxin congener is assigned a TEF that compares that compound's toxicity to the most toxic dioxin in the category.

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.

This graph shows the 10-year trend in the quantity of dioxins that facilities released from 2012 to 2021. Note that the dioxins chemical category is reported in grams while all other TRI chemicals are reported in pounds.



From 2012 to 2021:

- Dioxin releases increased by 27%. Most of this 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 8%, 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.

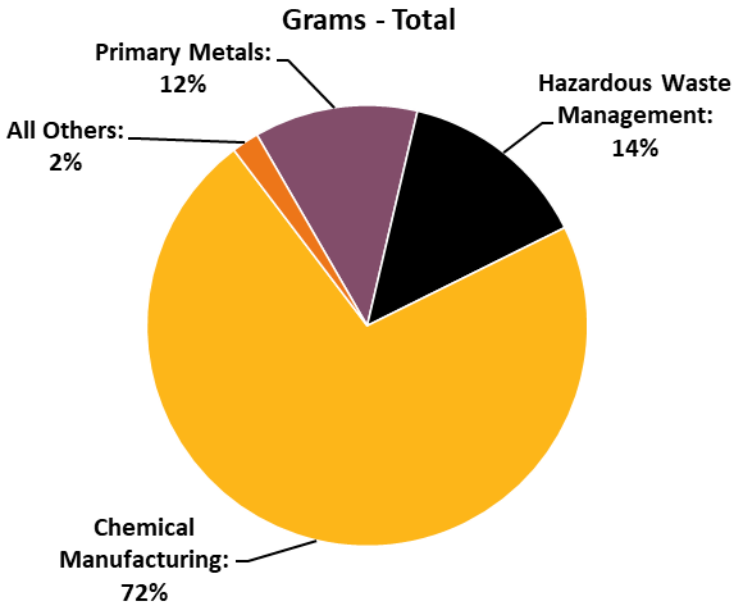
From 2020 to 2021:

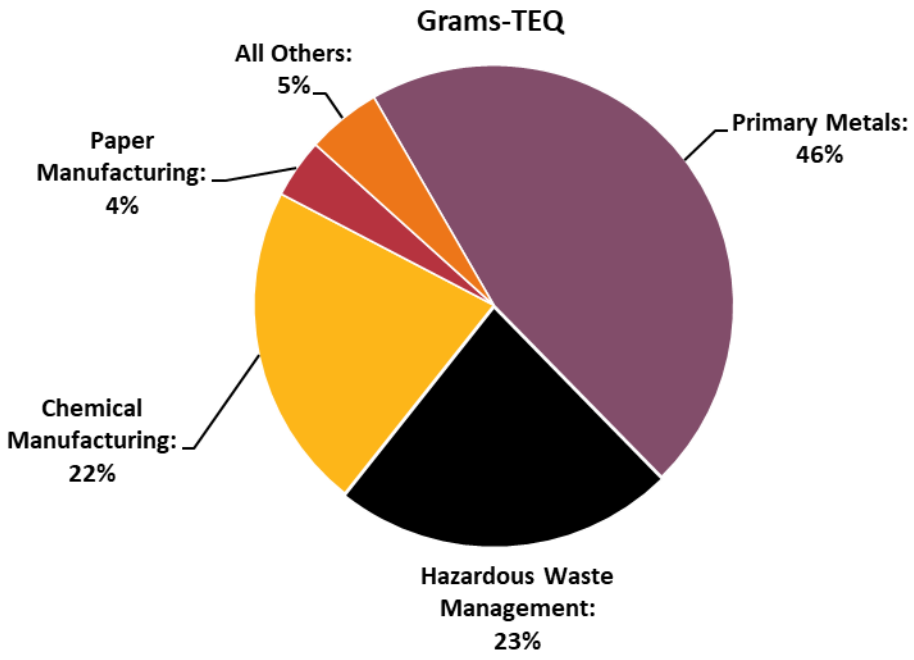
- Releases of dioxins decreased by 25%, driven by decreased releases reported by one hazardous waste management facility in Alabama.
    - Toxicity equivalents (grams-TEQ) decreased by 3%, indicating changes in the dioxin congener composition reported from 2020 to 2021. Although facilities released lower total quantities of dioxins, a higher proportion of dioxin releases were more toxic congeners.
- In 2021, 61% of dioxin releases were disposed off site, primarily in landfills.

Dioxins Releases by Industry

The following two pie charts compare the industry sectors that reported the greatest releases of dioxins (in units of grams) to those that reported the greatest releases of dioxins based on toxicity equivalency (in units of grams-TEQ).

Releases of Dioxin and Dioxin-like Compounds by Industry, 2021



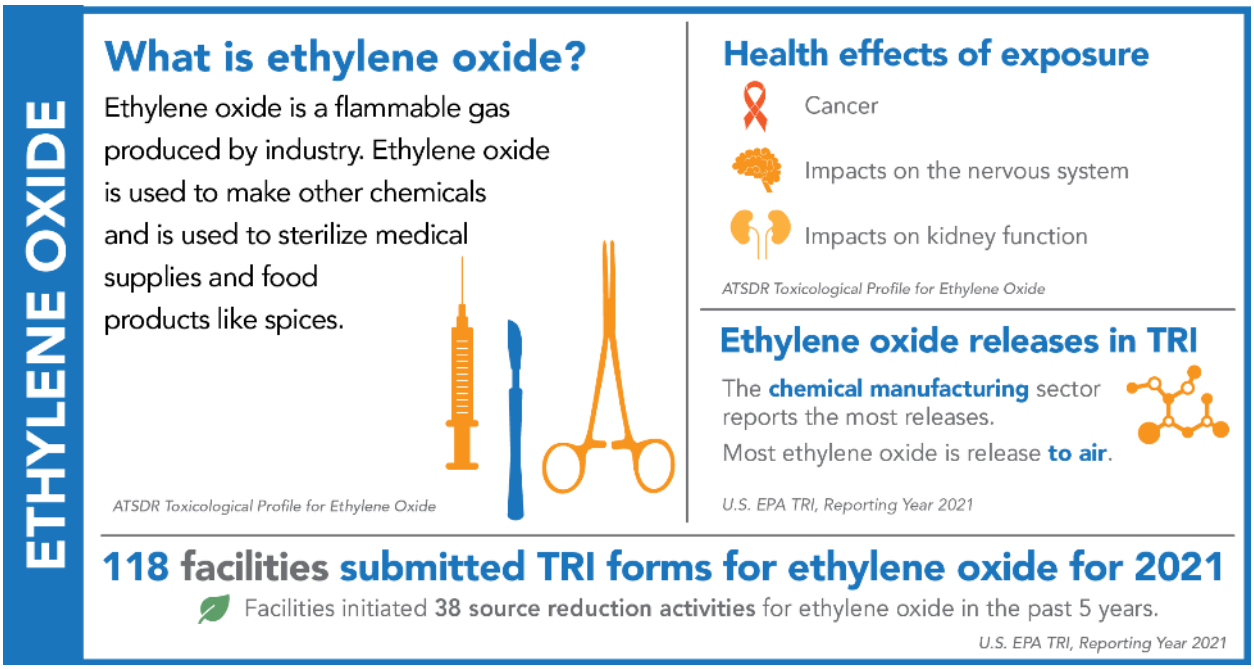


- Various industry sectors may release very different mixes of dioxin congeners.
- The chemical manufacturing industry accounted for 72% and the primary metals sector for 12% of total grams of dioxins released.

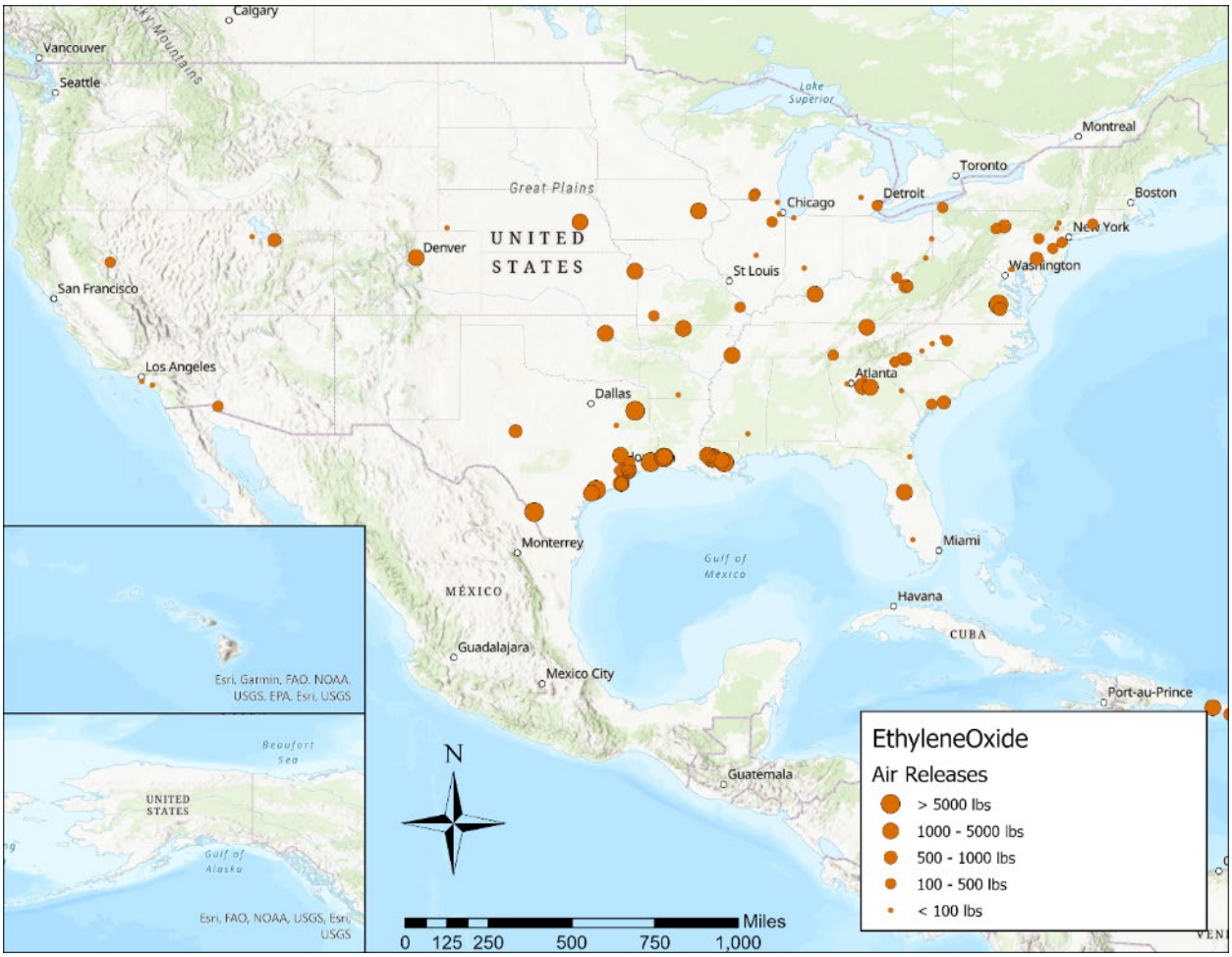
- In terms of toxicity equivalents, however, the primary metals sector accounted for 46% and the chemical manufacturing sector for 22% of the total grams-TEQ.

Ethylene Oxide

This section focuses on ethylene oxide, a human carcinogen.



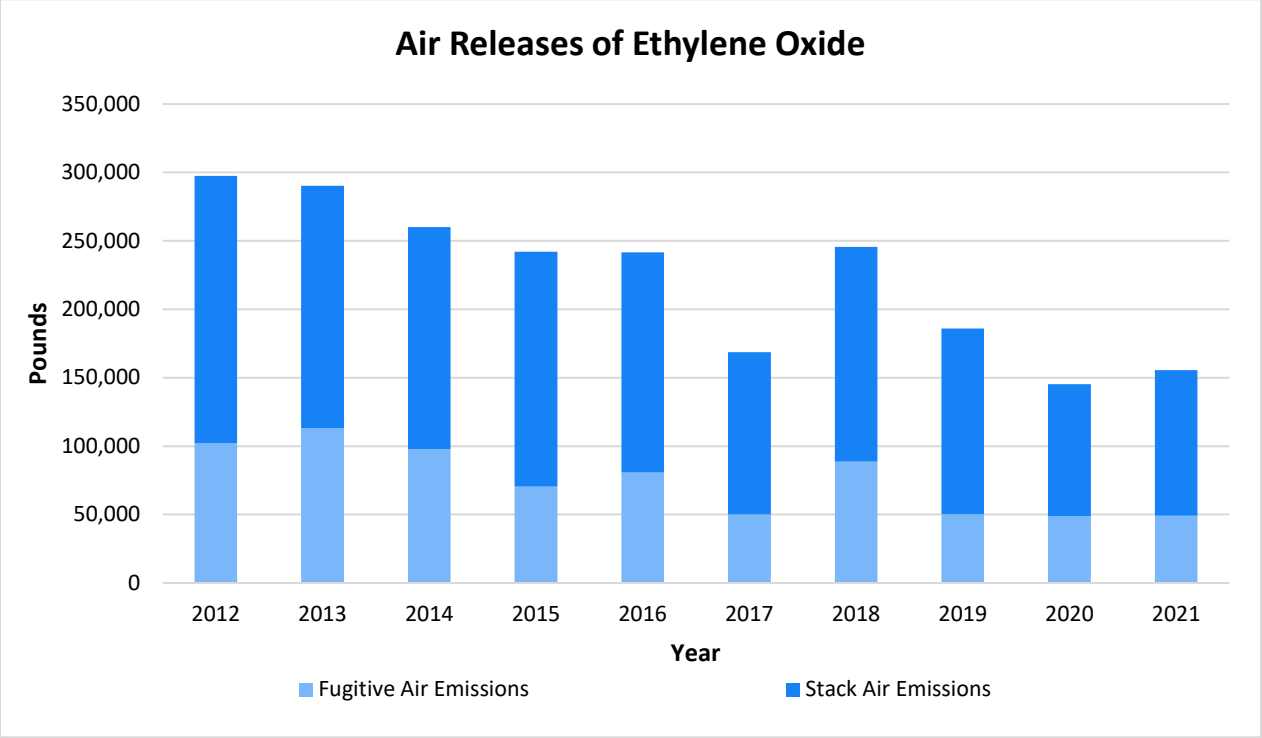
This map shows the locations of the facilities that reported ethylene oxide to TRI for 2021, sized by their relative release quantities to air. Zoom in to view demographic data for communities around these facilities. Click on a facility for more details on its reporting.



Click on any one of the locations on the map to see detailed information.

View Larger Map

The figure below presents the 10-year trend in air releases of ethylene oxide.



- From 2012 to 2021, releases of ethylene oxide to air decreased by 142,000 pounds (-48%).
- From 2020 to 2021, air releases of ethylene oxide increased by 7%, driven by increased releases from facilities in the chemical manufacturing sector.
- 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 in 2019 and 2020.

Learn More About Ethylene Oxide

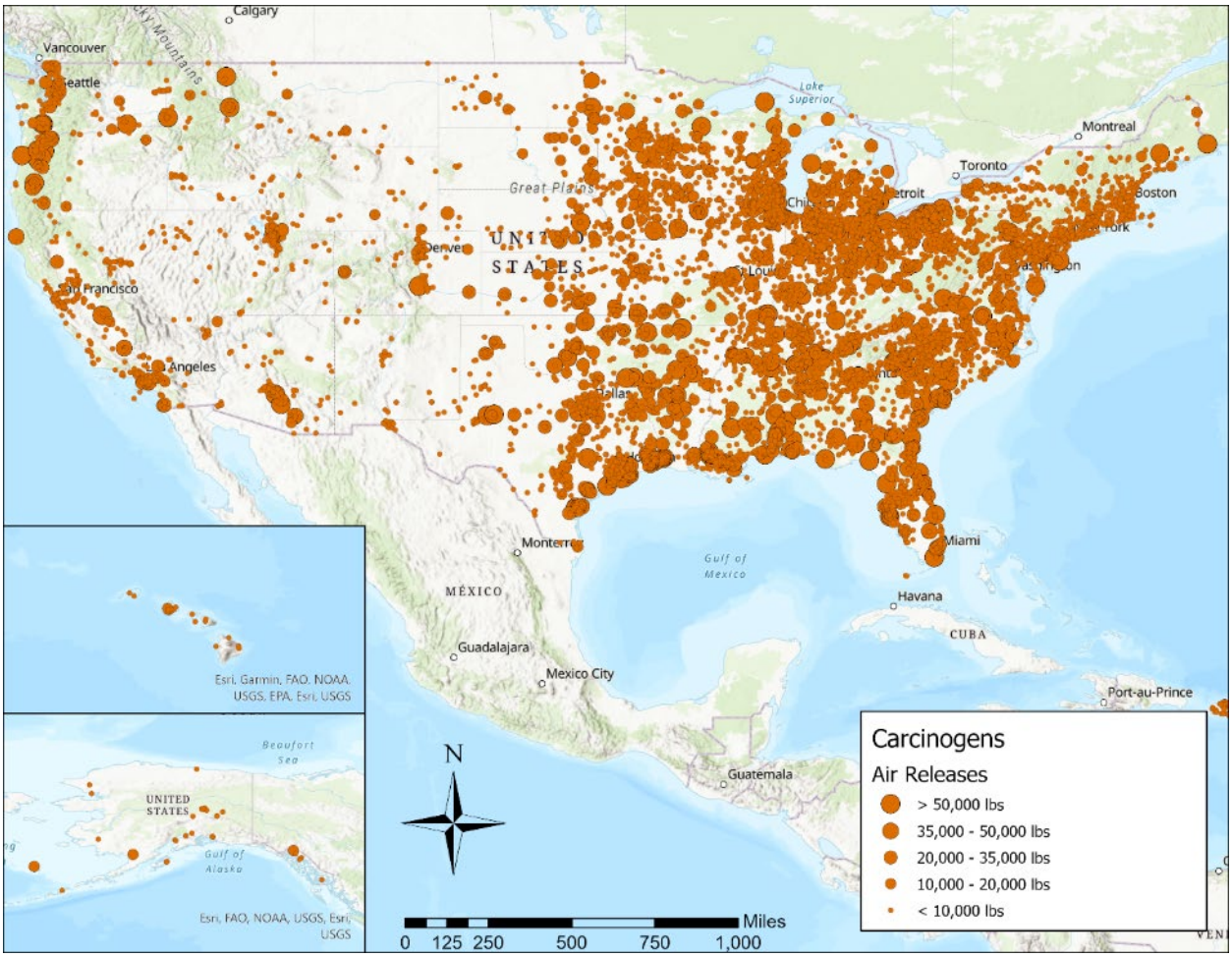
Ethylene oxide is a human carcinogen, meaning that it is known to cause cancer in humans. Recently, EPA extended TRI reporting requirements to certain contract sterilization facilities that use ethylene oxide. This action is effective for the 2022 reporting year with the first reporting forms due from facilities by July 1, 2023.

Learn More about Ethylene Oxide.

Occupational Safety and Health Administration (OSHA) Carcinogens

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.

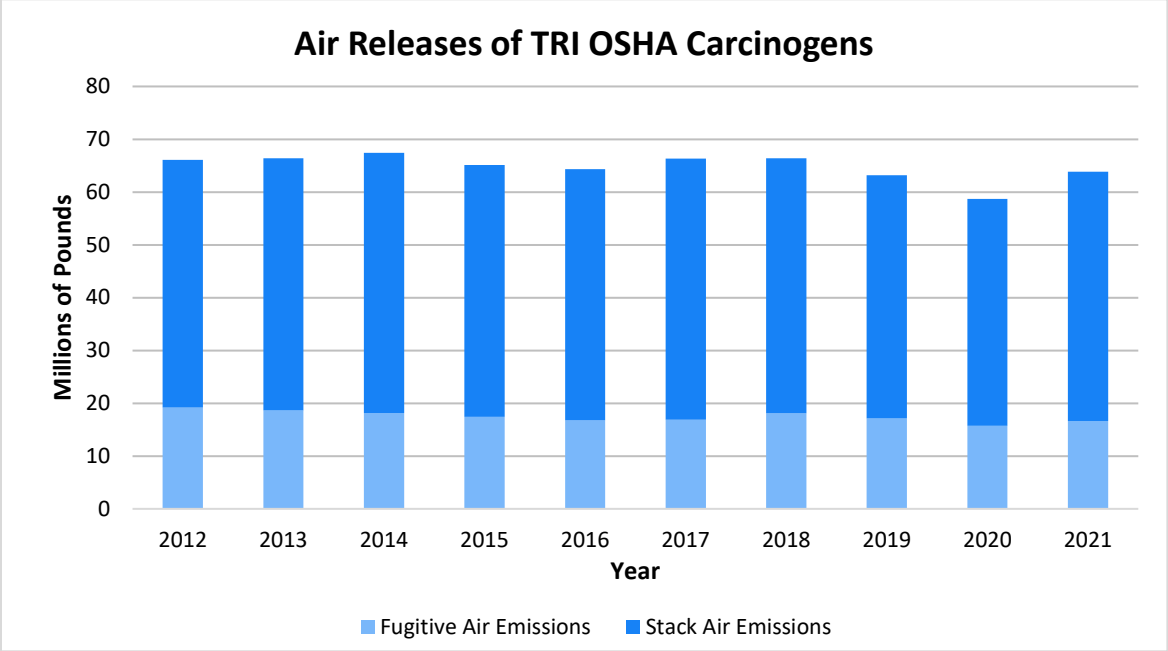
This map shows the locations of the facilities that reported carcinogens to TRI for 2021, sized by their relative release quantities to air. Zoom in to view demographic data for communities around these facilities. Click on a facility for more details on its reporting.



Click on any one of the locations on the map to see detailed information.

View Larger Map

This graph shows the 10-year trend in air releases of TRI OSHA carcinogens.



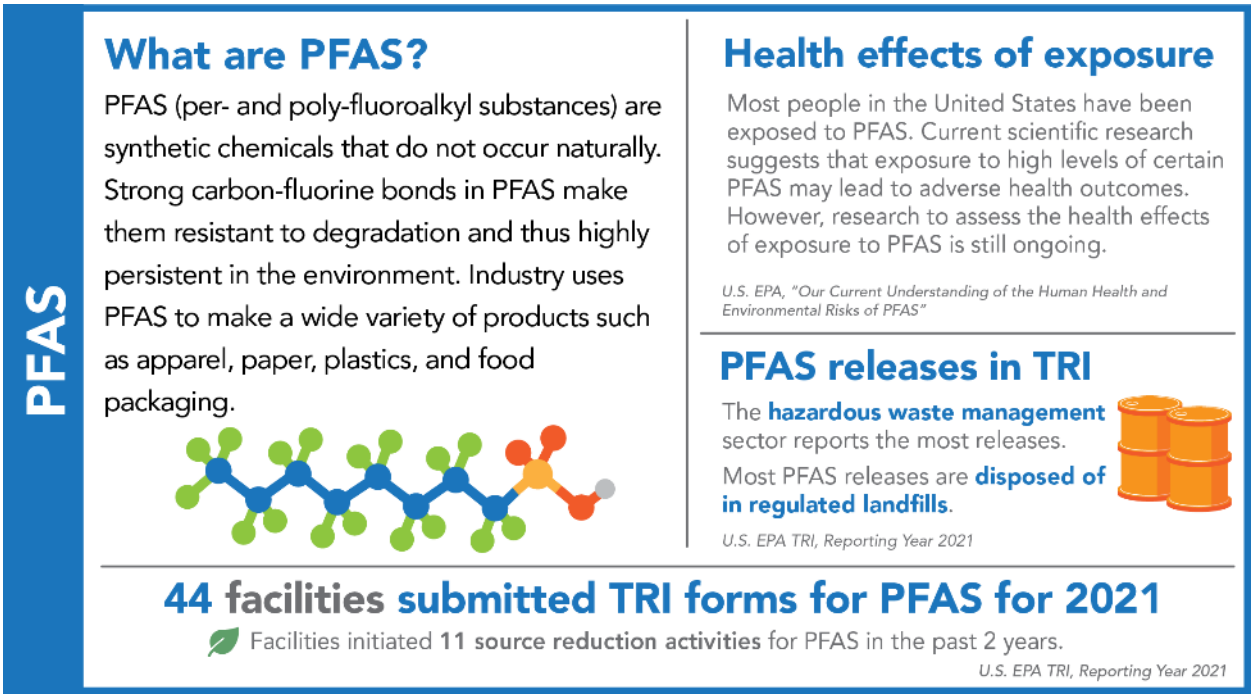
Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2012 to 2021:

- Air releases of these carcinogens showed little overall change since 2012.
- Air releases of many OSHA carcinogens decreased, with reductions in most sectors. However, these decreases were partially offset by increased releases of styrene by the plastics and rubber products manufacturing sector and the transportation equipment manufacturing sector.
- In 2021, TRI OSHA carcinogens with the highest air releases were styrene, acetaldehyde, and formaldehyde.

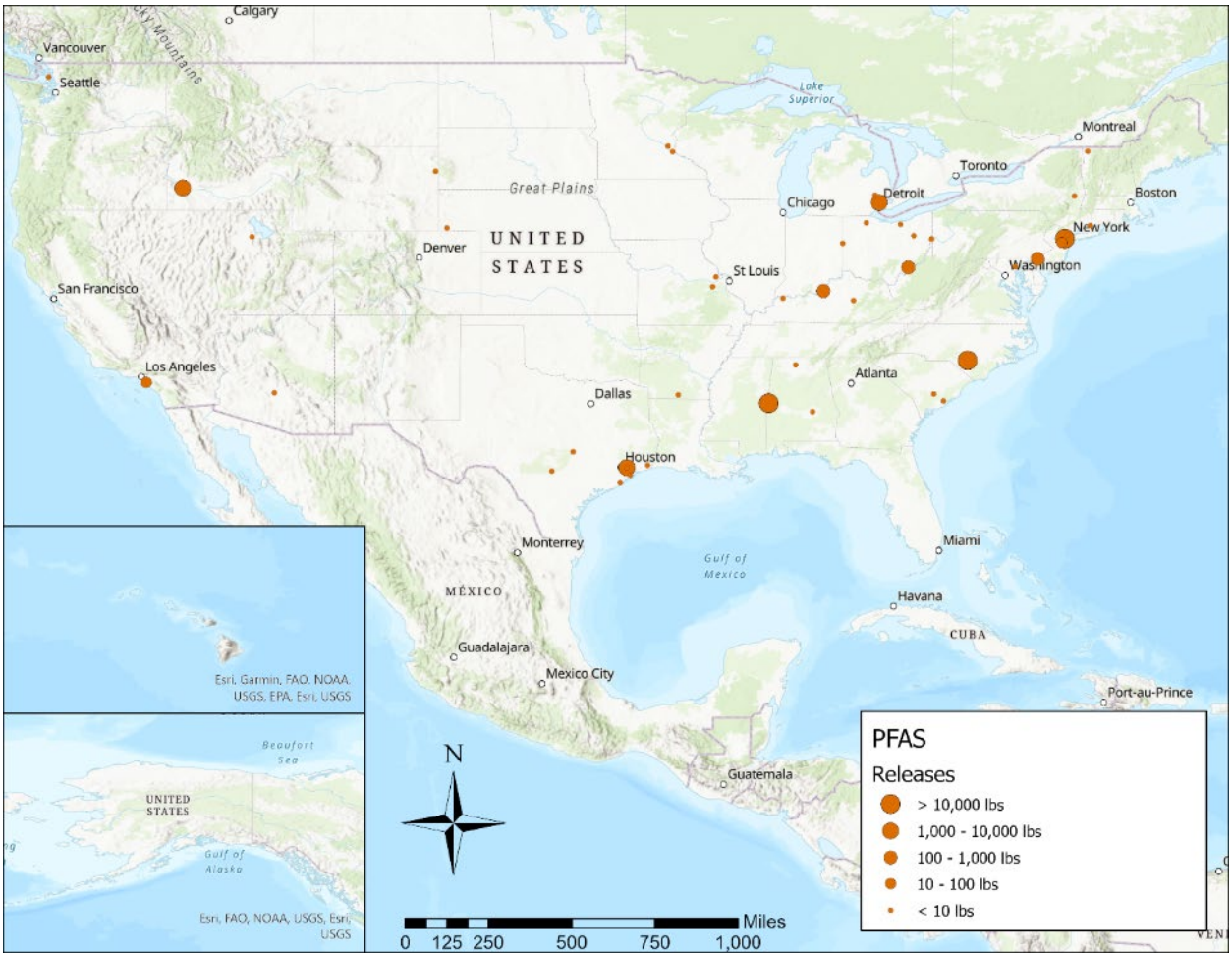
Per- and Polyfluoroalkyl Substances (PFAS)

Recently, 176 per- and polyfluoroalkyl substances (PFAS) were added to the list of chemicals covered by TRI. The TRI program reviews newly available information each year and adds PFAS to the TRI reporting list if they meet certain criteria.

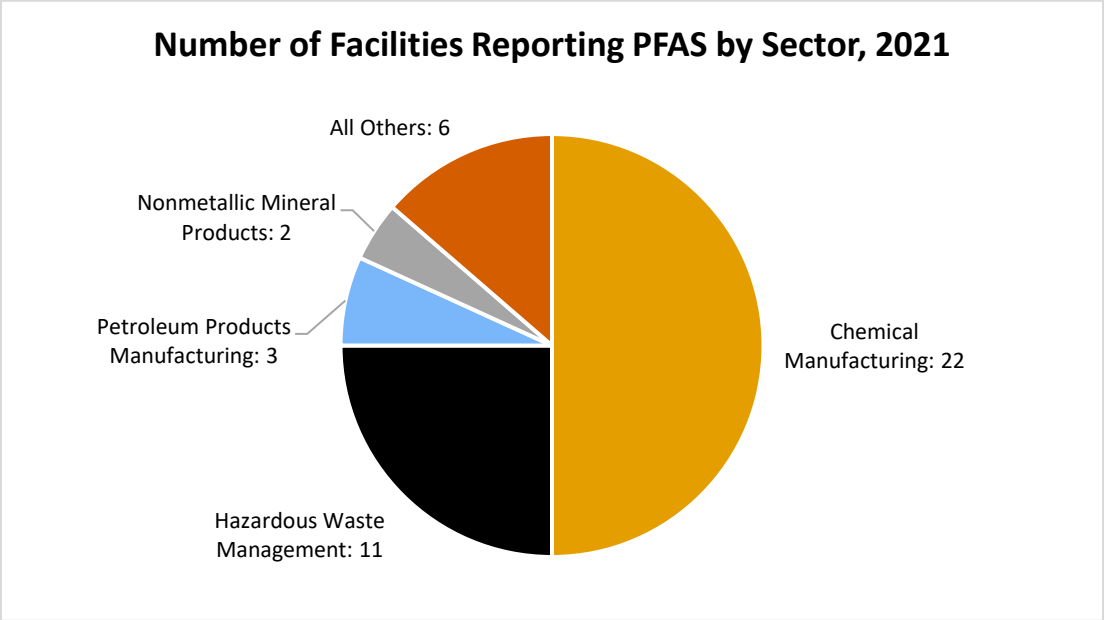


Facilities reported their releases and other waste management practices for these PFAS for the first time for 2020. Four additional PFAS were added to the TRI chemical list for 2021. The TRI reporting threshold for these PFAS is 100 pounds, which is lower than the thresholds for most TRI chemicals. Note that definitions of which chemicals are considered PFAS vary, and the 176 PFAS on the TRI chemical list 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 2021, sized by their relative release quantities. Zoom in to view demographic data for communities around these facilities. Click on a facility for more details on its reporting.


Calgary
Vancouver
Seattle
Lake Superior
Montreal
Toronto
Great Plains
Chicago
Detroit
Boston
New York
Denver
UNITED STATES
St Louis
Washington
San Francisco
Los Angeles
Atlanta
Dallas
Houston
Monterrey
Miami
Gulf of Mexico
MÉXICO
Havana
CUBA
Guadalajara
Mexico City
Port-au-Prince
Guatemala
Esri, Garmin, FAO, NOAA, USGS, EPA, Esri, USGS
Beaufort Sea
UNITED STATES
Gulf of Alaska
Esri, FAO, NOAA, USGS, Esri, USGS
N
0 125 250 500 750 1,000
Miles
PFAS
Releases
> 10,000 lbs
1,000 - 10,000 lbs
100 - 1,000 lbs
10 - 100 lbs
< 10 lbs

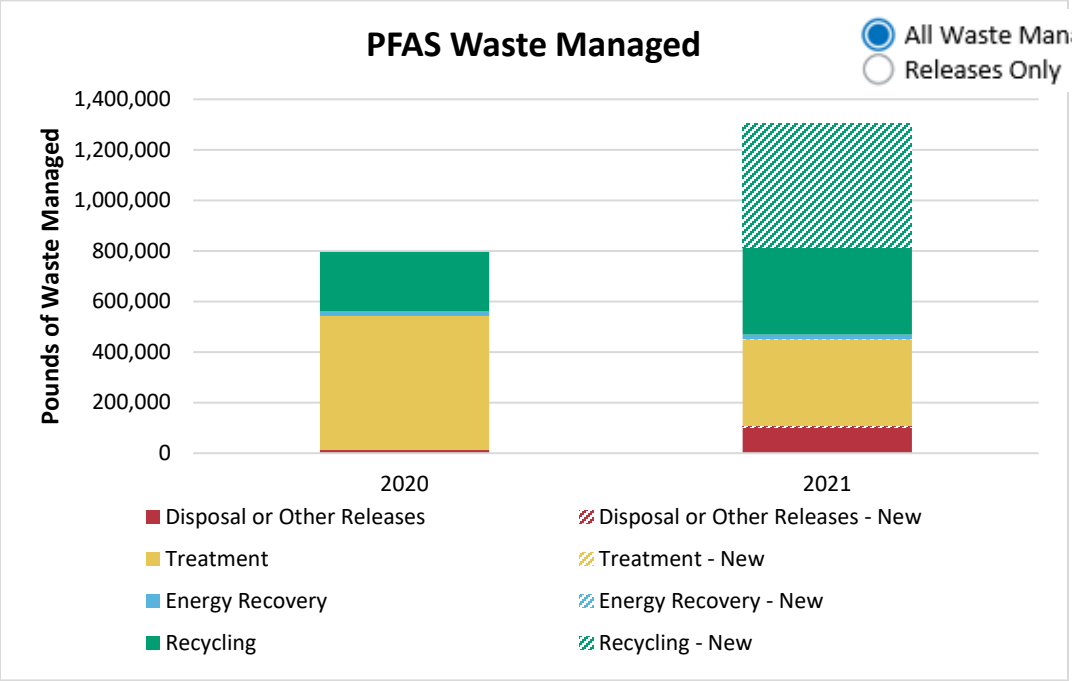
This chart shows the number of facilities in each sector reporting any of the 176 PFAS for 2021.



- Most facilities reporting PFAS were in the chemical manufacturing sector or the hazardous waste management sector.
- Facilities reported 44 different PFAS for 2021. The most reported PFAS were perfluorooctanoic acid (PFOA), hexafluoropropylene oxide dimer acid (HFPO-DA), and perfluorooctanesulfonic acid (PFOS).

PFAS Waste Management

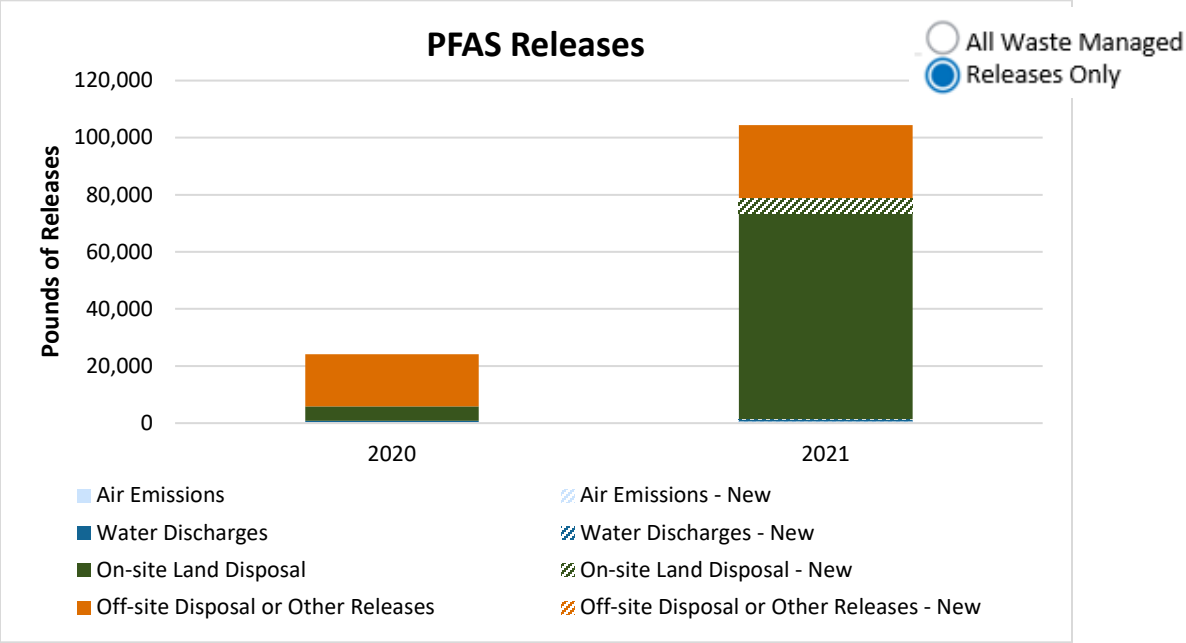
This chart shows how facilities managed PFAS waste. For more details on quantities released, toggle to the "Releases only" figure.



Note: The dashed areas in this chart show waste of PFAS that were newly added to the TRI chemical list for 2021 and were not reportable for 2020.

- The quantity of PFAS managed as waste increased by 59% (483,000 pounds).
  - The increase was driven by one facility in the chemical manufacturing sector that reported recycling a large quantity of perfluorooctyl iodide. This PFAS was added to the TRI chemical list for 2021 and was not reportable for 2020.
  - Considering only PFAS that were reportable in both 2020 and 2021, there was little change in the quantity of PFAS waste reported.
- The hazardous waste management, chemical manufacturing, and plastics and rubber sectors managed the most PFAS waste.

This chart shows PFAS releases by environmental medium.



Note: The dashed areas in this chart show releases of PFAS that were newly added to the TRI chemical list for 2021 and were not reportable for 2020.

- Releases of PFAS increased about five-fold from 2020 to 2021.
  - Releases of PFAS newly added to the TRI chemical list for 2021 accounted for only a small portion of the increase.
  - The increase in PFAS releases was mainly driven by the hazardous waste management sector, especially one facility that reported 68,500 pounds of PFAS released to a landfill during 2021.
  - The hazardous waste management sector reported 82% of all PFAS releases for 2021.

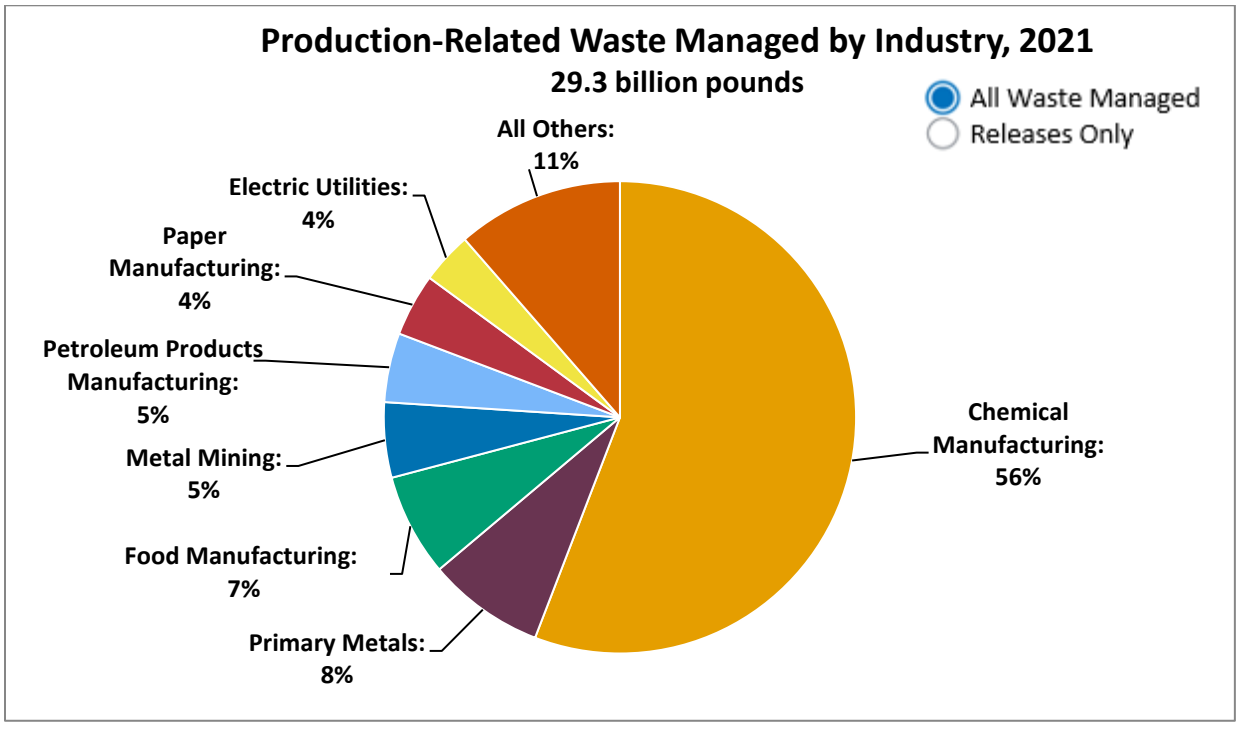
Comparing Industry Sectors

This section examines how industry sectors manage Toxics Release Inventory (TRI) chemical waste. Looking at data from individual sectors can highlight progress made in improving environmental performance and reveal opportunities for better waste management practices.

Industries subject to TRI reporting requirements vary substantially in size, scope, and business type. As a result, the amounts and types of chemicals used, generated, and managed by facilities across industrial sectors often differ. For facilities in the same sector, however, the processes, products, and regulatory requirements are often similar, resulting in similar use and handling of TRI chemicals.

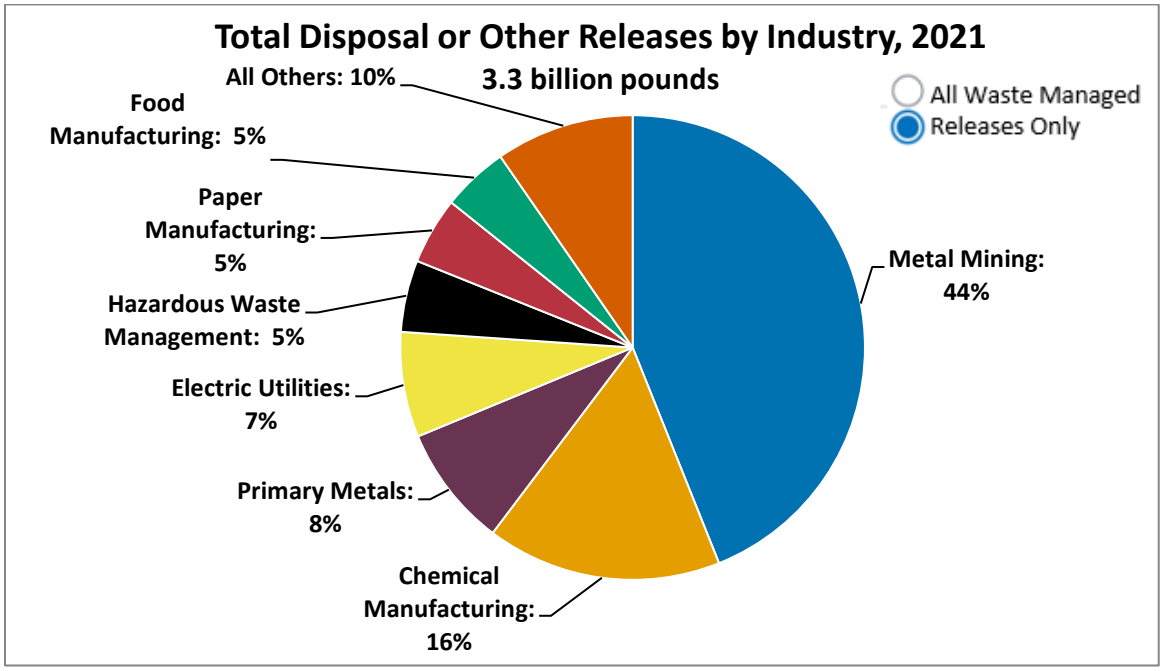
This section presents trends in key sectors' production-related waste managed, including TRI chemical releases into the environment. For analytical purposes, the TRI Program has combined the North American Industry Classification System (NAICS) codes at the 3- and 4-digit levels, creating 29 industry sector categories. To learn more about which business activities are subject to TRI reporting requirements, see this list of covered NAICS codes.

The following pie chart shows the total quantities of TRI chemical waste managed through recycling, energy recovery, treatment, and disposal or other release by sector. For more details on quantities released, toggle to the "Releases Only" figure.



Seven industry sectors reported 89% of the TRI production-related waste managed in 2021. Most of this waste originated from the chemical manufacturing sector (56%). See the Chemical Manufacturing Sector Profile for more information on this sector.

The following pie chart shows the industry sectors that reported the most releases for 2021.



This pie chart shows that four of the 29 TRI sectors accounted for 76% of the quantities of TRI chemicals disposed of or otherwise released: metal mining (44%), chemical manufacturing (16%), primary metals (8%), and electric utilities (7%).

For more details on how the amounts and proportions of TRI chemicals managed as waste have changed over time, see the production-related waste managed by industry trend graph.

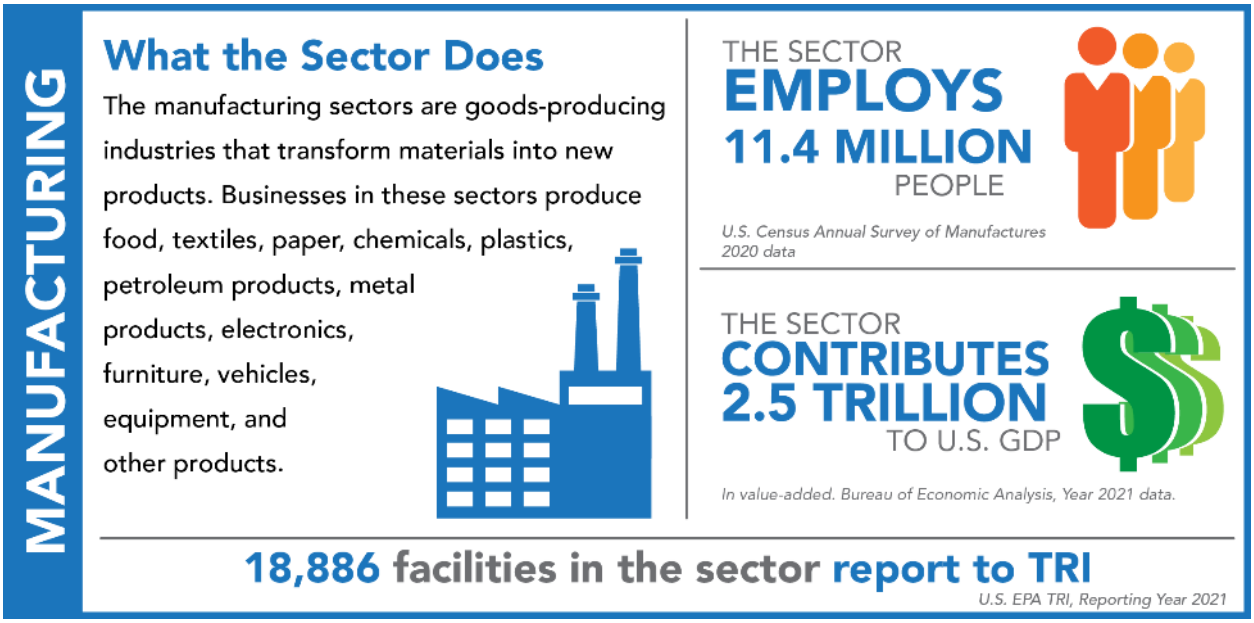
For more information on the breakdown of these releases by environmental medium, see air releases by industry, water releases by industry and land disposal by industry.

TRI Data Considerations

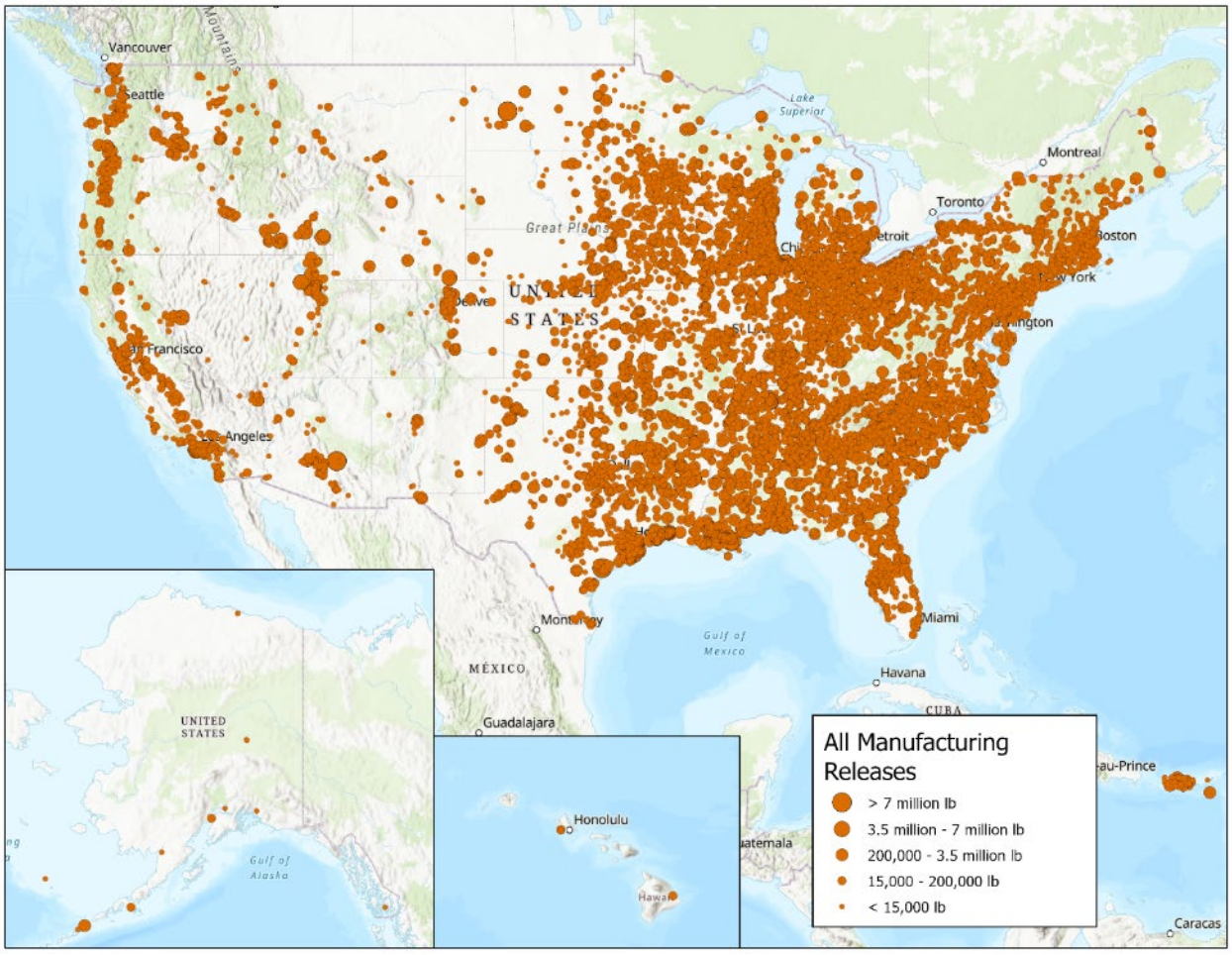
As with any dataset, there are multiple factors to consider when using the TRI data. Find a summary of key factors associated with data used in the National Analysis in the Introduction. For more information see *Factors to Consider When Using Toxics Release Inventory Data.*

Manufacturing Sectors

This section examines how TRI chemical wastes are managed in manufacturing sectors (defined as facilities reporting their primary NAICS codes as 31-33).



This map shows the locations of the manufacturing facilities that reported to TRI for 2021, sized by their releases. Click on a facility for details on its TRI reporting.



Manufacturing Facilities Reporting to TRI, 2021

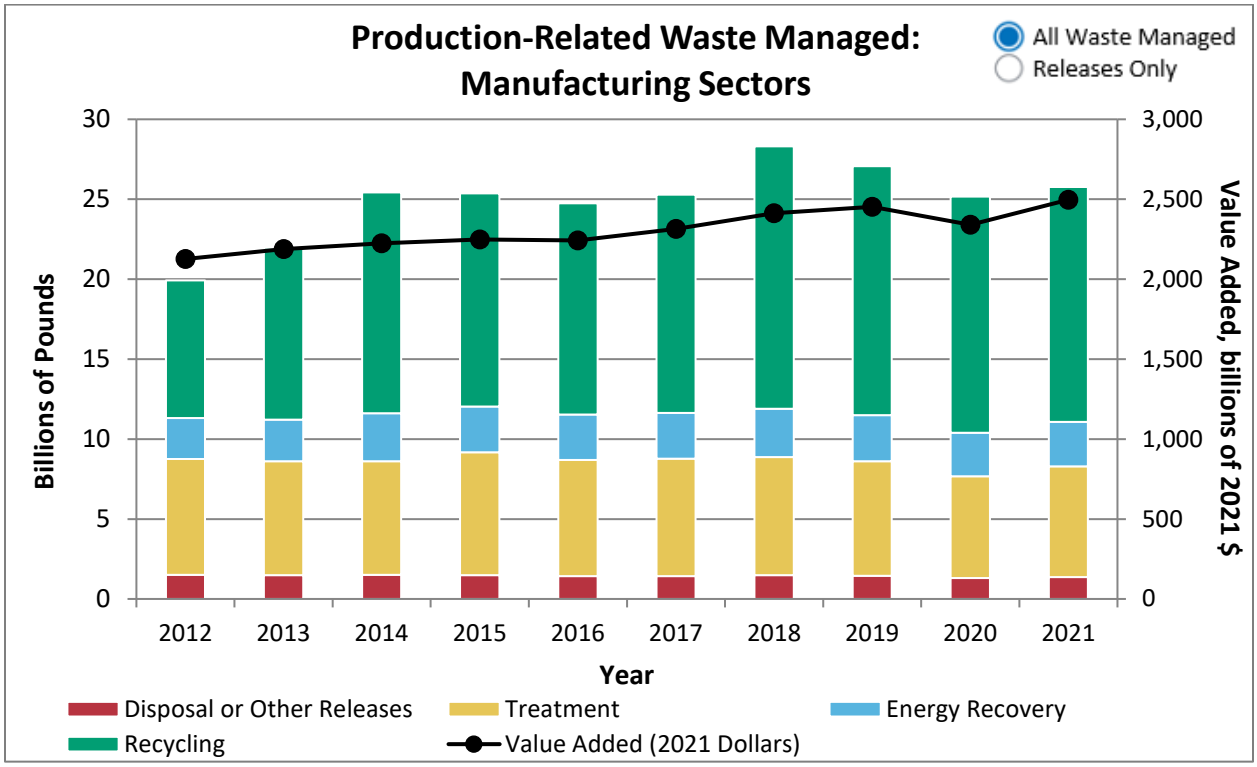
View Larger Map

For 2021, 90% of the facilities that reported to TRI were in a manufacturing sector. Manufacturing sectors accounted for most (88%) of the 29.3 billion pounds of production-related waste managed for 2021. Two manufacturing sectors, chemical manufacturing and plastics product manufacturing, are highlighted in more detail later in this section.

TRI-covered industry sectors not categorized under manufacturing include metal mining, coal mining, electric utilities, hazardous waste management, and others.

Manufacturing Waste Management Trend

The following graph shows the 10-year trend in TRI chemical waste managed through recycling, energy recovery, treatment, and disposal or other releases by the manufacturing sectors. For more details on quantities released, toggle to the "Releases only" graph.



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

From 2012 to 2021:

- Quantities of production-related waste managed by the manufacturing sectors generally increased from 2012 to 2018. Since then, these quantities have fluctuated.
- Releases and treatment of chemical waste decreased, while recycling and combustion for energy recovery increased.
- It is important to consider how the economy influences waste generation at facilities. This figure includes the trend in the manufacturing sectors' value added (represented by the black line, as reported by the Bureau of Economic Analysis, Value Added by Industry).

- Since 2012, value added by the manufacturing sectors increased by 17% while waste managed increased by 29%, driven by increased recycling. The large increase in recycled chemical waste started in 2014 and was driven by several facilities that each reported recycling one billion pounds or more annually in recent years.
- The increase in waste managed is greater than the increase in value added, which may suggest that manufacturing facilities managed more waste per unit of product in 2021 than in 2012.

What is Value Added?

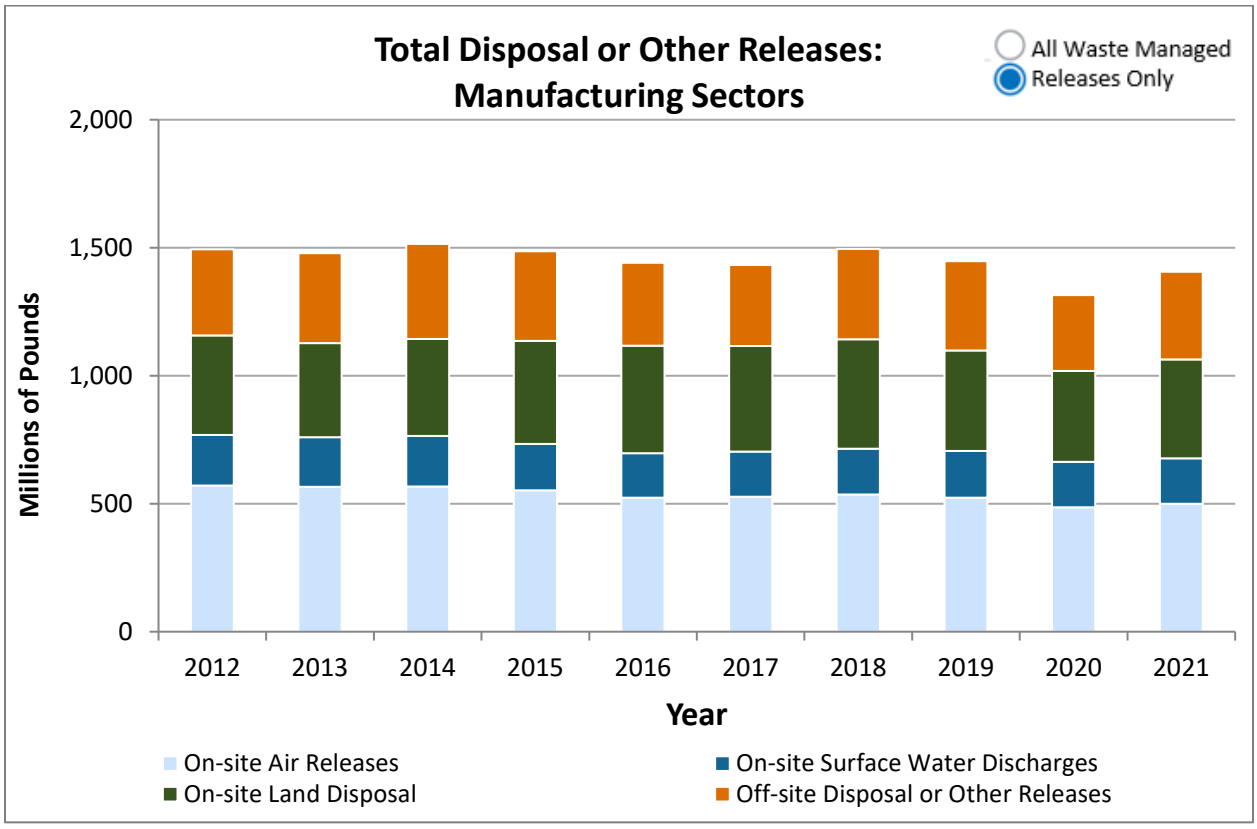
An industry's value added is the market value it adds in production; it is the difference between the price at which it sells its products and the cost of its inputs. Value added for all U.S. industries combined is equal to the nation's gross domestic product.

From 2020 to 2021:

- Production-related waste managed increased by 594 million pounds (2%), while value added increased by 7%.
  - Manufacturing activity increased more than waste managed, which may suggest that manufacturers managed less waste per unit of product in 2021 than in 2020.
- In 2021, only 5% of the manufacturing sectors' waste generated was released into the environment, while the rest was managed through treatment, energy recovery, and recycling.

Manufacturing Releases Trend

The following graph shows the 10-year trend in quantities of TRI chemicals released by facilities in manufacturing sectors.



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

From 2012 to 2021:

- TRI chemical releases from manufacturing sectors decreased by 6%, primarily due to reductions in releases to air (71 million pounds) and water (20 million pounds).
- Off-site disposal or other releases increased slightly (2%). On-site land disposal remained about the same (<1% decrease).

From 2020 to 2021:

- Releases increased by 92 million pounds (7%), driven by the chemical manufacturing and primary metal manufacturing sectors.

Source Reduction in the Manufacturing Sectors:

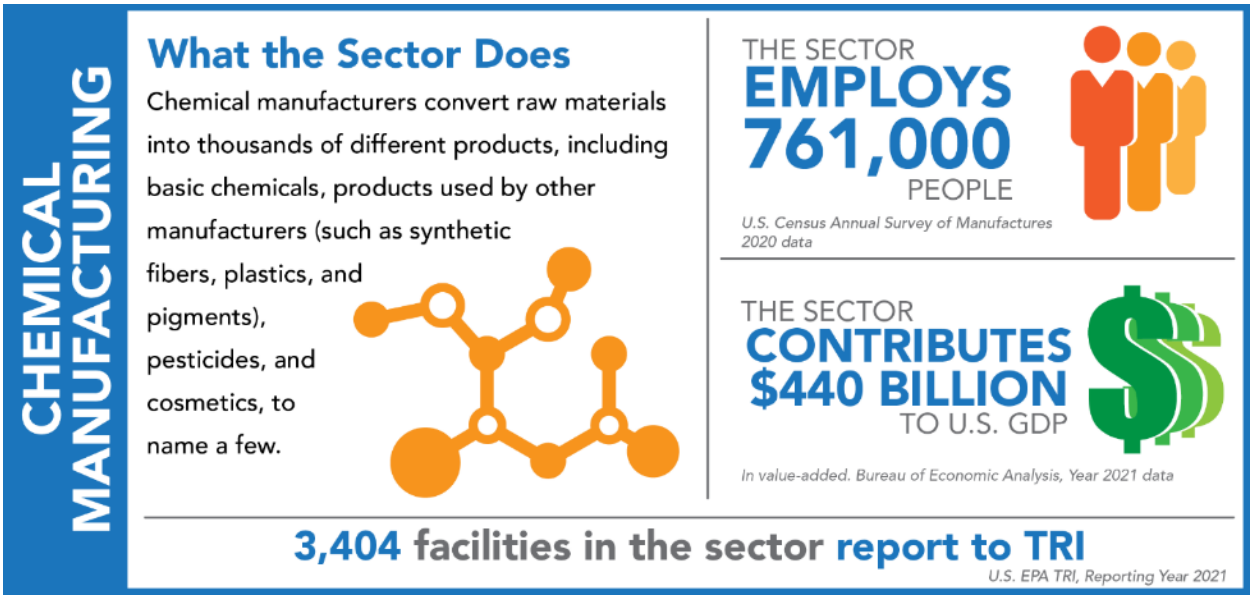
In 2021, 8% of manufacturing facilities initiated over 3,200 source reduction activities to reduce TRI chemical use and waste creation. The most reported type of source reduction activity was Process and Equipment Modifications. For example:

- A paperboard box manufacturer replaced process components and performed maintenance activities to improve cleaning system efficiency, which reduced the amount of N-methyl-2-pyrrolidone managed as waste. [Click to view facility details in the TRI P2 Search Tool]
- A motor vehicle parts manufacturer introduced technological upgrades, including the use of radio frequency identification (RFID) tracking, to eliminate waste when spray painting parts. [Click to view facility details in the TRI P2 Search Tool]

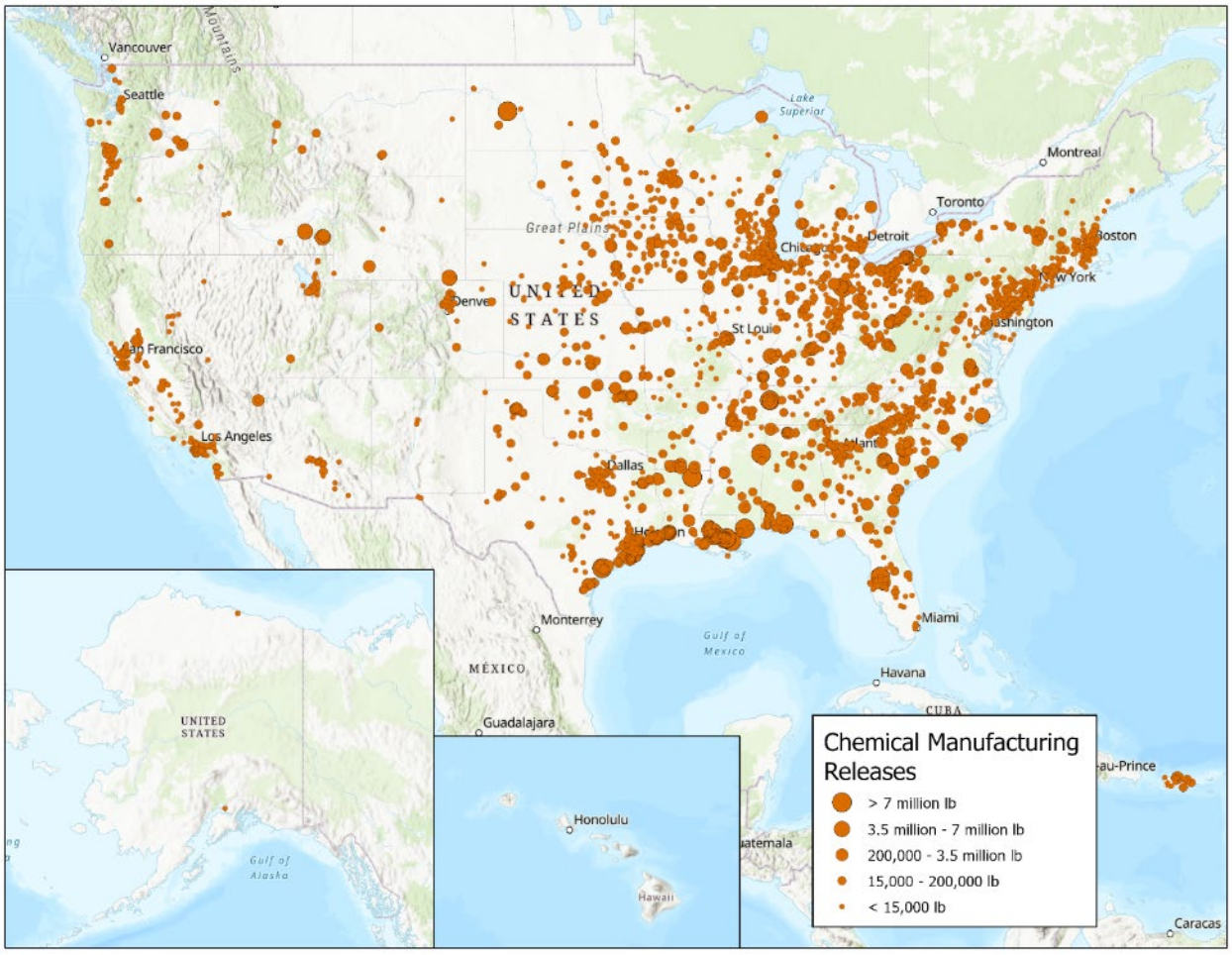
You can learn more about pollution prevention opportunities in this sector by using the TRI P2 Search Tool. Facilities interested in exploring pollution prevention opportunities at their site can contact their Regional P2 Coordinator to arrange a free on-site P2 assessment.

Chemical Manufacturing

This section examines how TRI chemical wastes are managed in the chemical manufacturing sector (defined as facilities reporting their primary NAICS code as 325).



This map shows the locations of the chemical manufacturing facilities that reported to TRI for 2021, sized by their releases. Click on a facility for details on its TRI reporting.

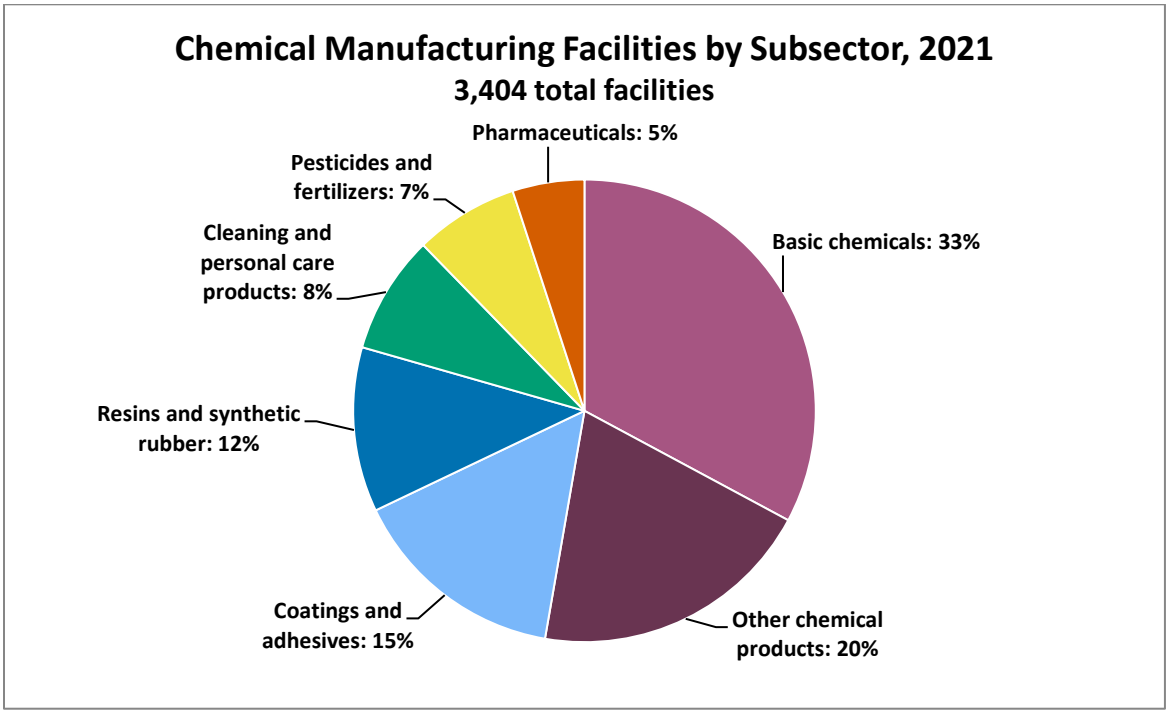


Chemical Manufacturing Facilities Reporting to TRI, 2021

View Larger Map

For 2021, more facilities reported to TRI from the chemical manufacturing sector than from any other industry sector (3,404 facilities; 16% of all facilities that reported to TRI for 2021). This sector reported 56% of all TRI-reported waste managed, more than any other sector.

This large and diverse sector includes facilities producing basic chemicals and those that manufacture products through further processing of chemicals. The chart below shows the number of facilities by chemical manufacturing subsectors that reported to TRI for 2021.

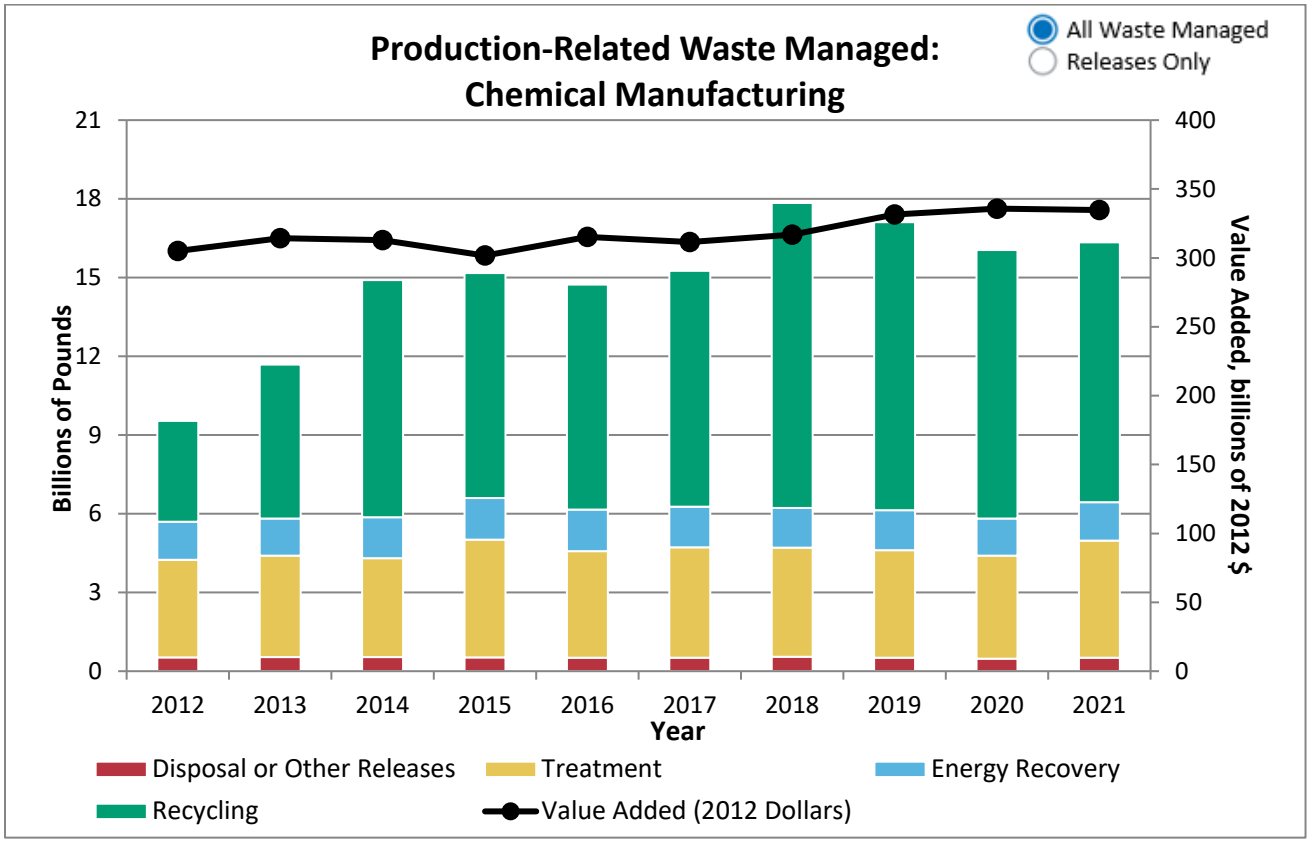


Operations in the chemical manufacturing sector include:

- Basic chemicals facilities produce chemicals in large quantities through processes such as thermal cracking and distillation, often for use in the production of other products. Basic chemicals include petrochemicals, industrial gases, synthetic dyes and pigments, and many other organic and inorganic chemicals.
- Coatings and adhesives facilities mix pigments, solvents, and binders into architectural and industrial paints; manufacture paint products such as paint removers and thinners; and manufacture adhesives, glues, and caulking compounds.
- Resins and synthetic rubber facilities manufacture resins, plastic materials, synthetic rubber, and fibers and filaments.

Chemical Manufacturing Waste Management Trend

The following graph shows the quantities of TRI chemical waste managed through recycling, energy recovery, treatment, and disposal or other releases by the chemical manufacturing sector. For more details on quantities released, toggle to the "Releases only" graph.



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

From 2012 to 2021:

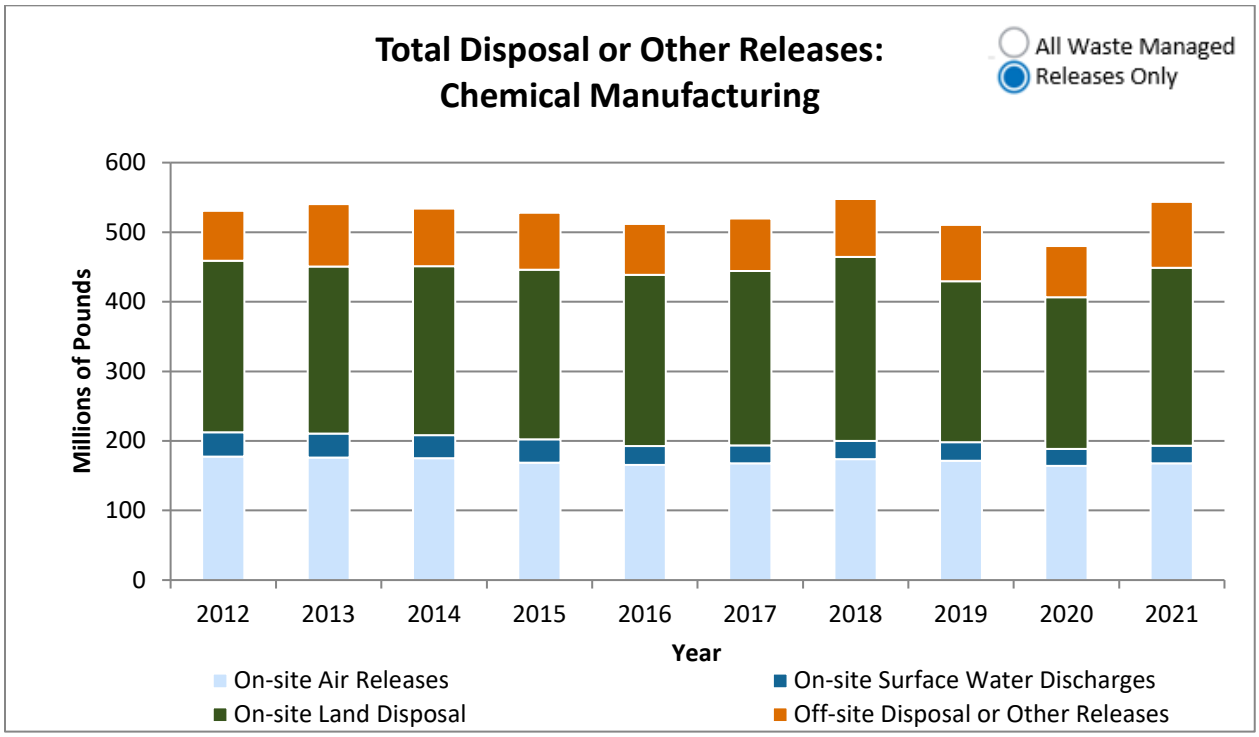
- Quantities of production-related waste managed by the chemical manufacturing sector increased by 71%, while the sector's value added (represented by the black line), as reported by the Bureau of Economic Analysis, Value Added by Industry) increased by 10%.
    - Trends in waste recycled by chemical manufacturers were driven by a few facilities. For example, the large increase in chemical waste recycled in 2014 compared to previous years was primarily due to an increase in the quantity of cumene recycled by one petrochemical manufacturing facility.
- Quantities of TRI chemicals recycled and treated increased, while the quantities of TRI chemicals released decreased slightly. The quantity of chemicals combusted for energy recovery stayed about the same.

From 2020 to 2021:

- Production-related waste managed at chemical manufacturing facilities increased by 299 million pounds (2%).
- In 2021, 3% of this sector's waste was released into the environment, while the rest was managed through treatment, energy recovery, and recycling.

Chemical Manufacturing Releases Trend

The following graph shows the 10-year trend in quantities of TRI chemicals released by facilities in the chemical manufacturing sector.



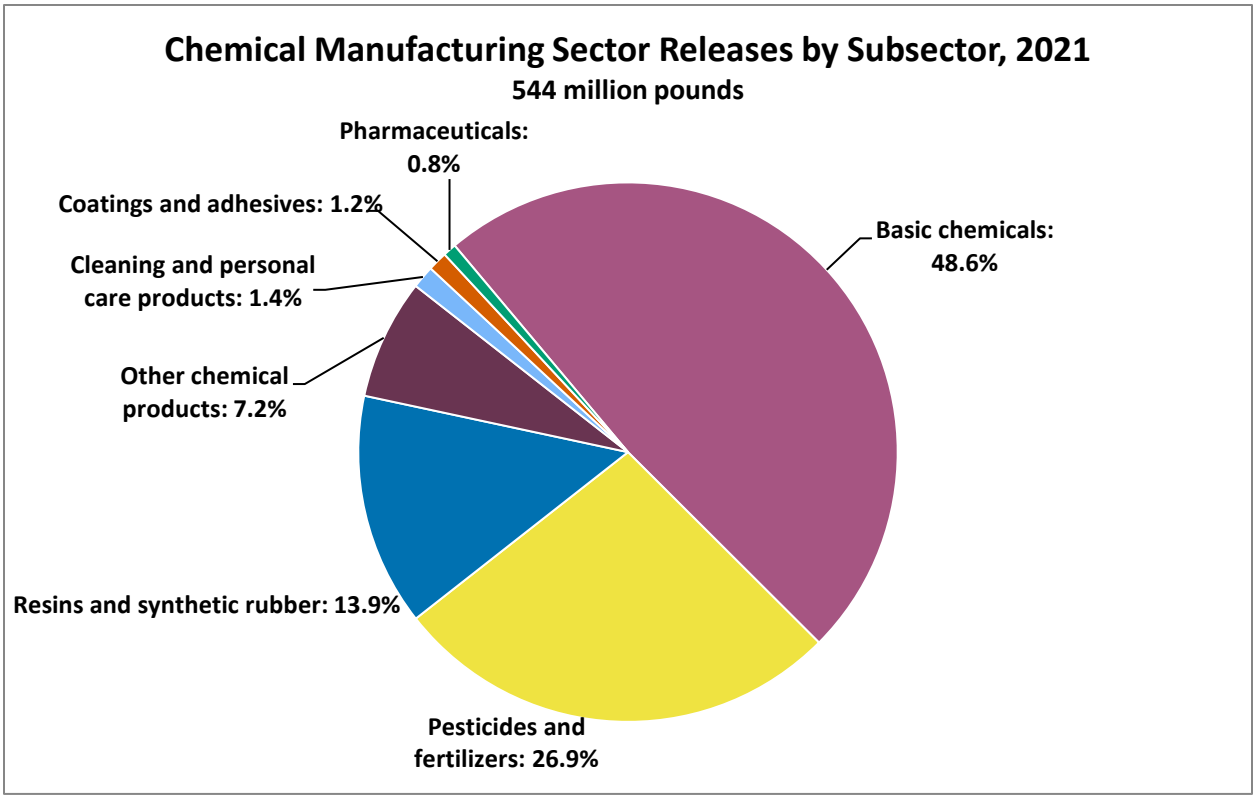
Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2012 to 2021:

- Releases reported by facilities in the chemical manufacturing sector increased by 2%.
- Quantities of off-site releases and other disposal and on-site land releases increased, while on-site air releases and surface water discharges decreased.

From 2020 to 2021:

- Releases increased by 63 million pounds (13%), driven by one facility reporting a large increase in land disposal of hydrogen fluoride and another facility reporting a large increase in off-site disposal of zinc compounds.
- For 2021, 1,119 of the 3,404 chemical manufacturing facilities were in the basic chemicals manufacturing subsector, which accounted for almost half (49%) of the chemical manufacturing sector's releases.



Source Reduction in the Chemical Manufacturing Sector:

Although the chemical manufacturing sector has consistently managed the most production-related waste of any TRI-covered sector, 325 facilities (10% of facilities) in this sector initiated 866 source reduction activities in 2021. The most common types of source reduction activities were Process and Equipment Modifications and Operating Practices and Training. For example:

- A pharmaceutical preparation manufacturer gradually reduced its 1,2,4-trimethylbenzene inventory and migrated to a just-in-time (JIT) material supply process. [Click to view facility details in the TRI P2 Search Tool]

- A basic organic chemical manufacturer used less nitrobenzene by developing a production schedule that minimized equipment and material changes. [Click to view facility details in the TRI P2 Search Tool]

Several chemical manufacturing facilities reported source reduction activities that resulted in reducing both TRI chemical wastes and greenhouse gas emissions. For example, one facility discontinued use of a coal-fired boiler, which resulted in a reduction in hydrochloric acid released to the environment [Click to view facility details in the TRI P2 Search Tool]

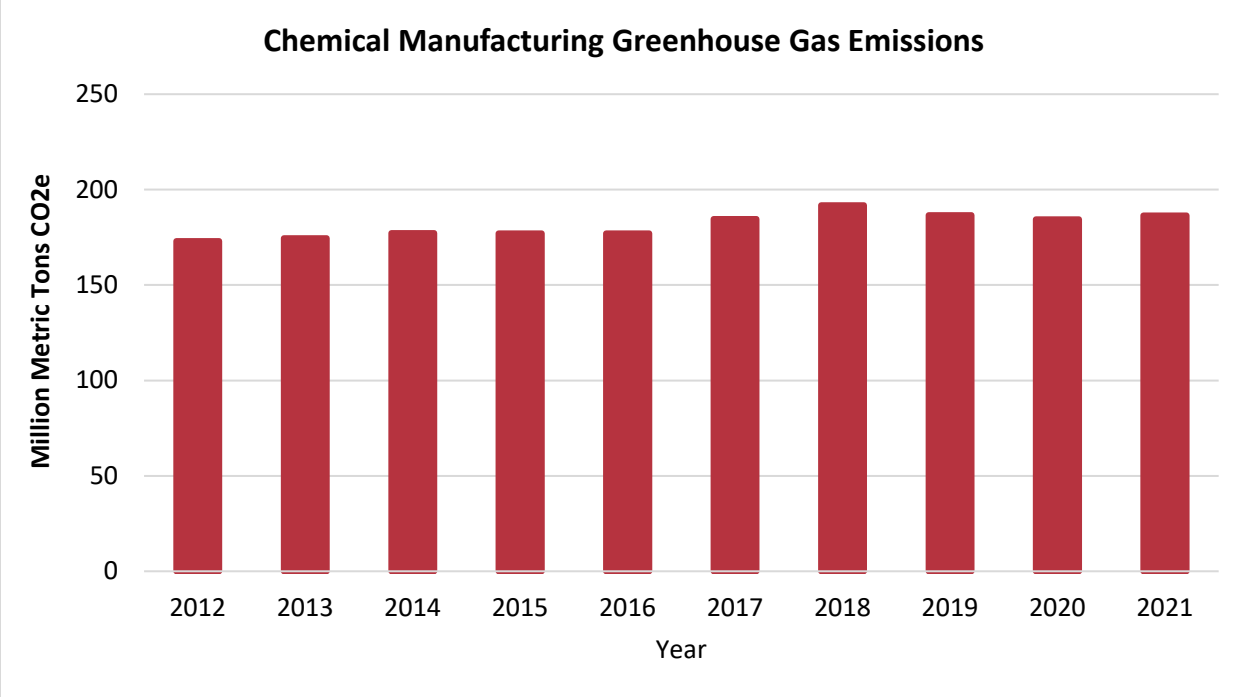
Additional Resources

- To find more examples of chemical manufacturers' source reduction activities and the source reduction barriers they reported, visit TRI's P2 Search Tool.
- EPA's Smart Sectors Program is partnering with chemical manufacturing trade associations to develop sensible approaches to industrial operations that better protect the environment and public health.
- For more information on how this and other industry sectors can choose safer chemicals, visit EPA's Safer Choice Program.
- EPA supports the adoption of green chemistry practices that reduce the environmental impacts from this sector, including reductions in the use of toxic chemicals, water, and electricity.
- Facilities interested in exploring P2 opportunities or getting technical assistance can contact their regional P2 coordinator. Find the P2 coordinators for your state and region.

Greenhouse Gas Reporting in the Chemical Manufacturing Sector

While many chemical releases are required to be reported to the TRI, the TRI Program does not cover all chemicals released by industrial activities. Notably, most greenhouse gas (GHG) emissions are not reported to the TRI. Greenhouse gas emissions increase the concentration of these gases in the atmosphere, which alter the amount of heat trapped by the Earth's atmosphere and contribute to climate change. These elevated concentrations and their effect on climate are reasonably anticipated to endanger the public health and welfare of current and future generations.

EPA's Greenhouse Gas Reporting Program (GHGRP) tracks facility-level emissions from the largest U.S. sources of GHGs. The chart below shows GHG emissions reported to the GHGRP by facilities in the chemical manufacturing sector from 2012 to 2021.



- Note that while TRI typically collects chemical release data in units of pounds, the GHGRP collects GHG emissions data in units of metric tons of carbon dioxide equivalents ($MTCO_2e$). This chart shows GHG emissions in $MTCO_2e$.

- The chemical manufacturing sector reported emissions of 186.5 million $MTCO_2e$ for 2021, an 8% increase since 2012.
- For 2021, 3,404 facilities in this sector reported to the TRI and 459 facilities in the sector reported to the GHGRP. Of the 459 facilities in this sector that reported to the GHGRP, most also reported to the TRI Program.

Additional Resources

- To explore the data reported to EPA on GHG emissions, see the Facility Level Information on GreenHouse gases Tool (FLIGHT).
- EPA's Understanding Global Warming Potentials webpage provides further information on GWPs, how they are used, and how they differ by GHG.
- For more details on the chemical manufacturing sector's GHG emissions, visit GHGRP Chemicals.
- The TRI P2 Search Tool lets you compare facilities' waste management reported to TRI and their GHG emissions reported to the GHGRP.

What are carbon dioxide equivalents (CO_2e)?

Different GHGs can have different effects on the Earth's warming; Global Warming Potential (GWP) values allow for comparisons of the global warming impacts of different gases. $MTCO_2e$ is a weighted measurement that considers the tonnes of the gases and their associated global warming potentials.

Plastics Product Manufacturing

This section examines how TRI chemical wastes are managed within the plastics product manufacturing sector (defined as facilities reporting their primary NAICS code as 3261).

The plastics lifecycle consists of many steps, including petroleum and natural gas extraction; petrochemical refining; chemical, polymer, and plastic product manufacturing; the use of plastics by consumers, industry, and others; and end-of-life scenarios such as waste management or disposal into the environment outside of waste management systems. This profile is focused on the management of TRI chemical waste and environmental releases from the plastic product manufacturing stage of the plastics lifecycle.

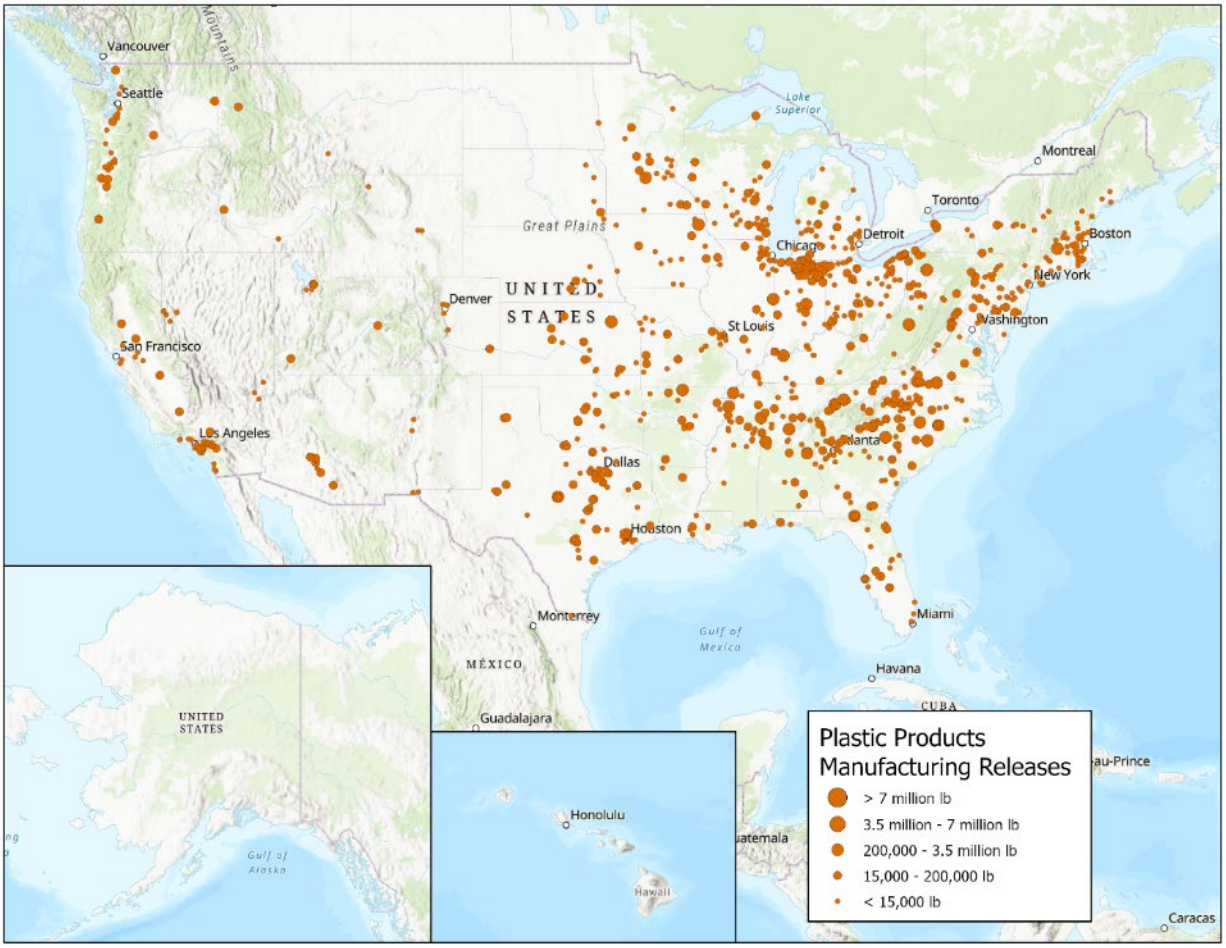
Facilities in the plastics product manufacturing sector make intermediate products (e.g., rolls of laminated sheets or casings for TVs and radios) as well as products we use every day, such as bottles and bags for packaging, and pipes and flooring for construction, among many others. The sector takes new or recycled polymers and forms them into plastic products using a variety of molding or casting processes. Other sectors use intermediate products from the plastic products manufacturing sector to make consumer products like medical devices, electronics, and furniture.

This profile does not include the manufacture or assembly of plastic goods in other sectors such as battery casings, diapers, or appliances. It also does not address the management of plastic waste, discarded plastic products in the environment, or other end of life scenarios for plastic products. Additionally, this profile does not address management of TRI chemical waste from upstream processes such as the manufacturing of monomers or chemical additives like flame

retardants or plasticizers such as phthalates. As with all TRI analyses, the information in this profile is limited to facilities that meet TRI reporting requirements and manage listed chemicals in excess of certain thresholds.

Inclusion of plastics product manufacturing in the National Analysis provides insights into how TRI chemical wastes are managed during the product manufacturing phase of the plastics lifecycle. This analysis highlights opportunities to learn more, including examples of successful pollution prevention and how TRI chemicals are managed in communities across the country.

This map shows the locations of the plastics product manufacturing facilities that reported to TRI for 2021, sized by their releases. Click on a facility for details on its TRI reporting.

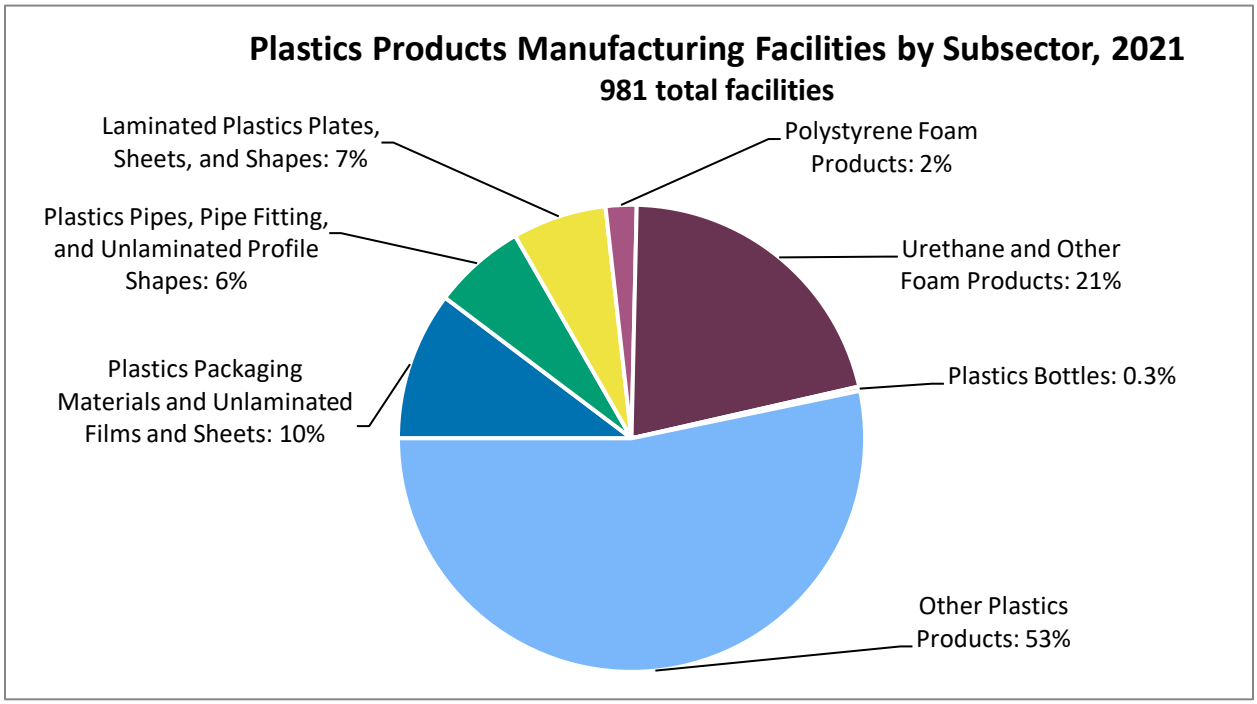


Plastics Product Manufacturing Facilities Reporting to TRI, 2021

View Larger Map

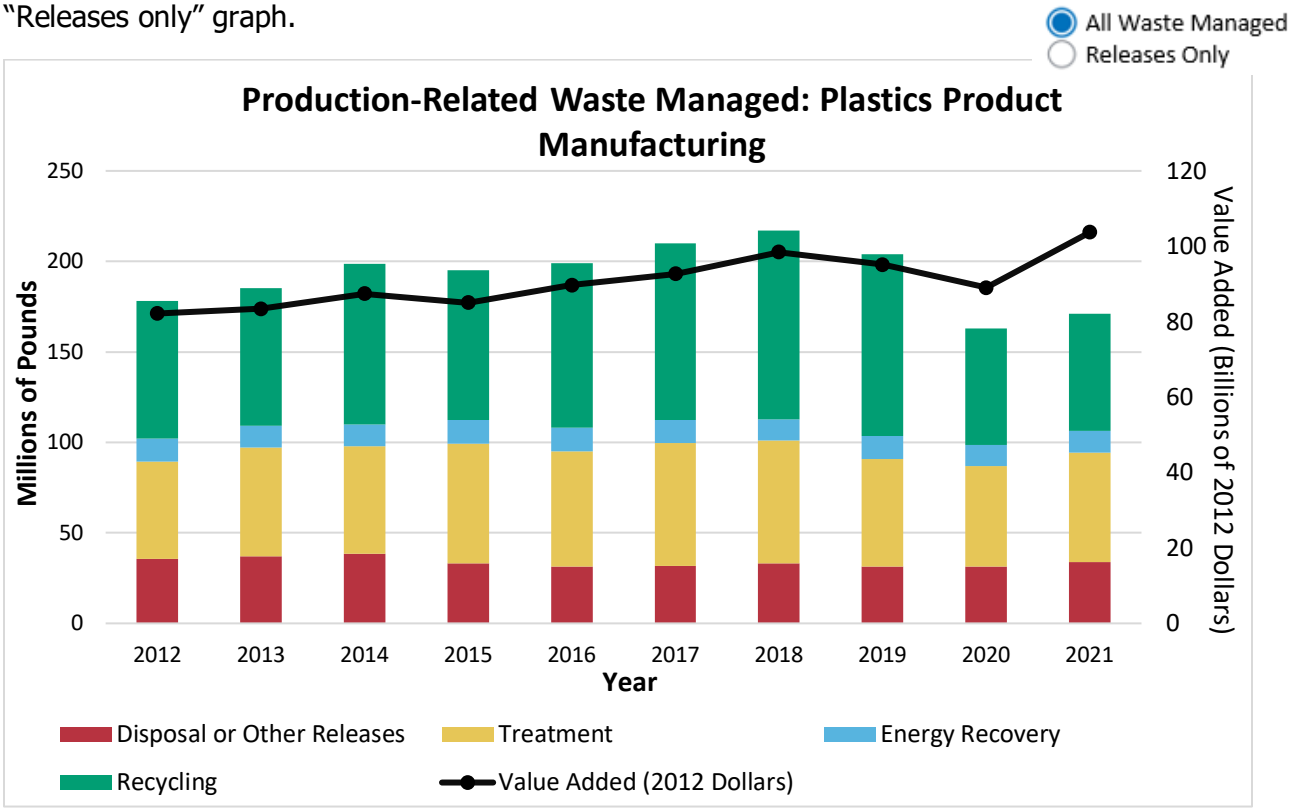
For 2021, 981 facilities in the plastics product manufacturing sector reported to TRI. The majority of the sector's releases of TRI chemicals were to air (89% for 2021), a higher proportion than almost any other sector. Releases were dominated by styrene, which accounted

for about half of the sector's air releases each year from 2012 to 2021. The chart below shows the number of facilities by plastics products subsector that reported to TRI for 2021.



Plastics Product Manufacturing Waste Management Trend

The following graph shows the 10-year trend in quantities of TRI chemical waste managed through recycling, energy recovery, treatment, and disposal or other releases by facilities in the plastics product manufacturing sector. For more details on quantities released, toggle to the "Releases only" graph.



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

From 2012 to 2021:

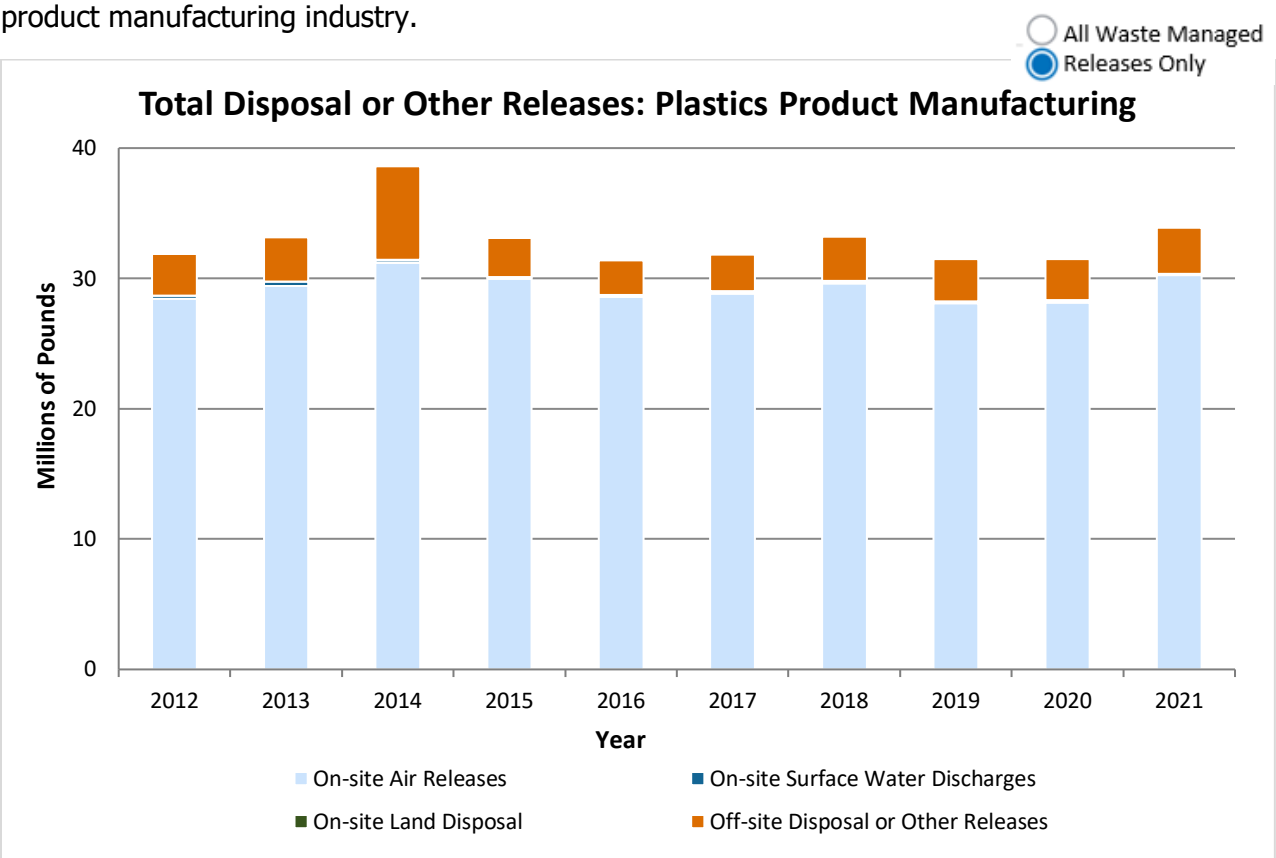
- Quantities of production-related waste managed by the plastics product manufacturing sector fluctuated from 2012 to 2019 before decreasing from 2019 to 2020. Value added by the sector increased by 26% from 2012 to 2021.
- Waste managed decreased by 7.1 million pounds (-4%) since 2012, mainly driven by an 11-million-pound decrease in quantities of waste recycled over this time period.
    - The decrease in recycling from 2019 to 2020 was largely driven by decreased quantities of trichloroethylene recycled at one plastic film and sheet manufacturing facility.
    - Quantities of TRI chemical waste recycled, combusted for energy recovery, and disposed of or otherwise released decreased, while quantities treated increased.

From 2020 to 2021:

- Total waste managed at plastics product manufacturing facilities increased by 8.4 million pounds (5%), driven by increases in treatment and disposal or other releases. Meanwhile, value added by this sector increased by 16%.
- In 2021, the top chemicals contributing to production-related waste were styrene, *n*-hexane, and xylene.

Plastics Product Manufacturing Releases Trend

The following graph shows the quantities of TRI chemicals released by facilities in the plastics product manufacturing industry.



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

From 2012 to 2021:

- TRI chemical releases by the plastics product manufacturing sector have fluctuated, with an overall increase of 2.1 million pounds (6%) driven mainly by releases to air.
- Air releases increased by 1.8 million pounds (6%) and off-site disposal increased by 387,000 pounds (12%). Releases to water and to land combined made up less than 1% of the sector's releases.

- About 90% of the plastics product manufacturing sector's releases have been to air each year since 2012.

From 2020 to 2021:

- Releases increased by 2.4 million pounds (8%).
- A few facilities tend to drive releases. For example, almost one-fifth of the sector's air releases in 2021 came from just two facilities.
- In 2021, over half of releases reported by the plastics product manufacturing sector were of styrene (57%).

Source Reduction in the Plastics Product Manufacturing Sector:

In 2021, 113 facilities in the sector initiated 178 source reduction activities to reduce TRI chemical use and waste creation. The most reported type of source reduction activity was Operating Practices and Training, followed by Process and Equipment Modifications. For example:

- A plastics product manufacturer reduced the number of formulas in its process, resulting in less styrene-containing waste being generated during formula changeovers. [Click to view facility details in the TRI P2 Search Tool]
- Another plastics product manufacturer is reducing methyl methacrylate emissions by implementing a closed molding process. [Click to view facility details in the TRI P2 Search Tool]

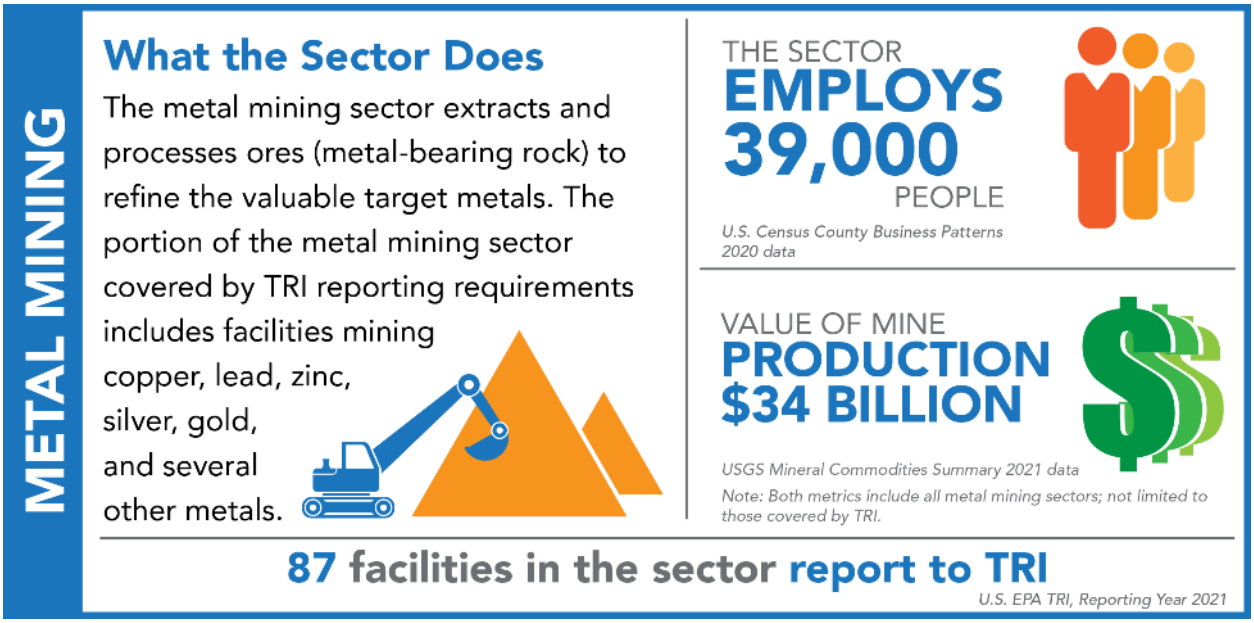
Comments submitted by facilities also point to consideration of sustainable design and the use of alternative chemicals and materials to reduce or eliminate the use of TRI chemicals. To learn more about the reporting and implementation of green chemistry at TRI facilities, see the TRI Green Chemistry and Green Engineering Reporting page.

To learn about reductions in styrene releases from facilities in the plastic products manufacturing sector, see the Pollution Prevention Spotlight.

To find other examples of the sector's source reduction activities and the source reduction barriers they face, visit TRI's P2 Search Tool.

Metal Mining

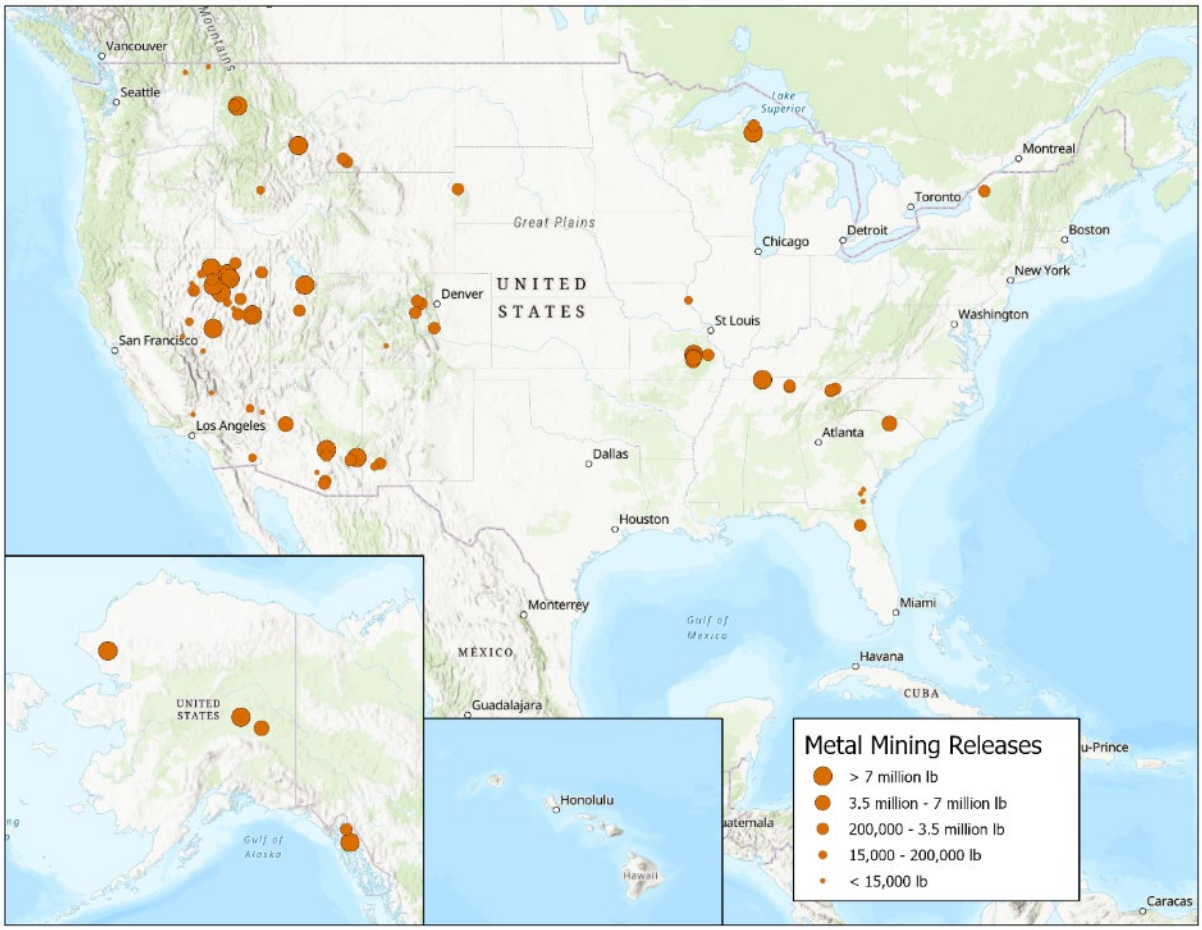
This section examines how TRI chemical wastes are managed by facilities in the metal mining sector (defined as facilities reporting their primary NAICS code as 2122).



Although the number of metal mines reporting to TRI makes up only a small portion of the total number of facilities that report to TRI, the sector accounted for 44% of all releases reported to TRI for 2021.

This map shows the locations of the metal mining facilities that reported to TRI for 2021, sized by their releases. Click on a facility for details on its TRI reporting.

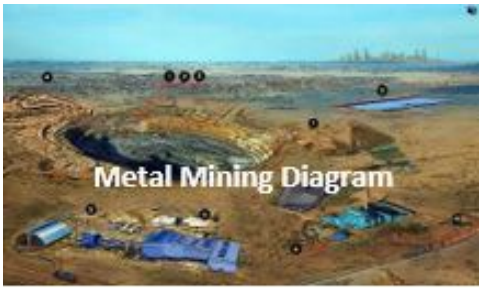
Note: Mines are shown on this map based on their longitude/latitude, which may be miles from the city identified on the mine's TRI reporting forms. Mines can qualify their location relative to the city by noting the distance in the street address data field of their TRI reporting forms.



Metal Mines Reporting to TRI, 2021

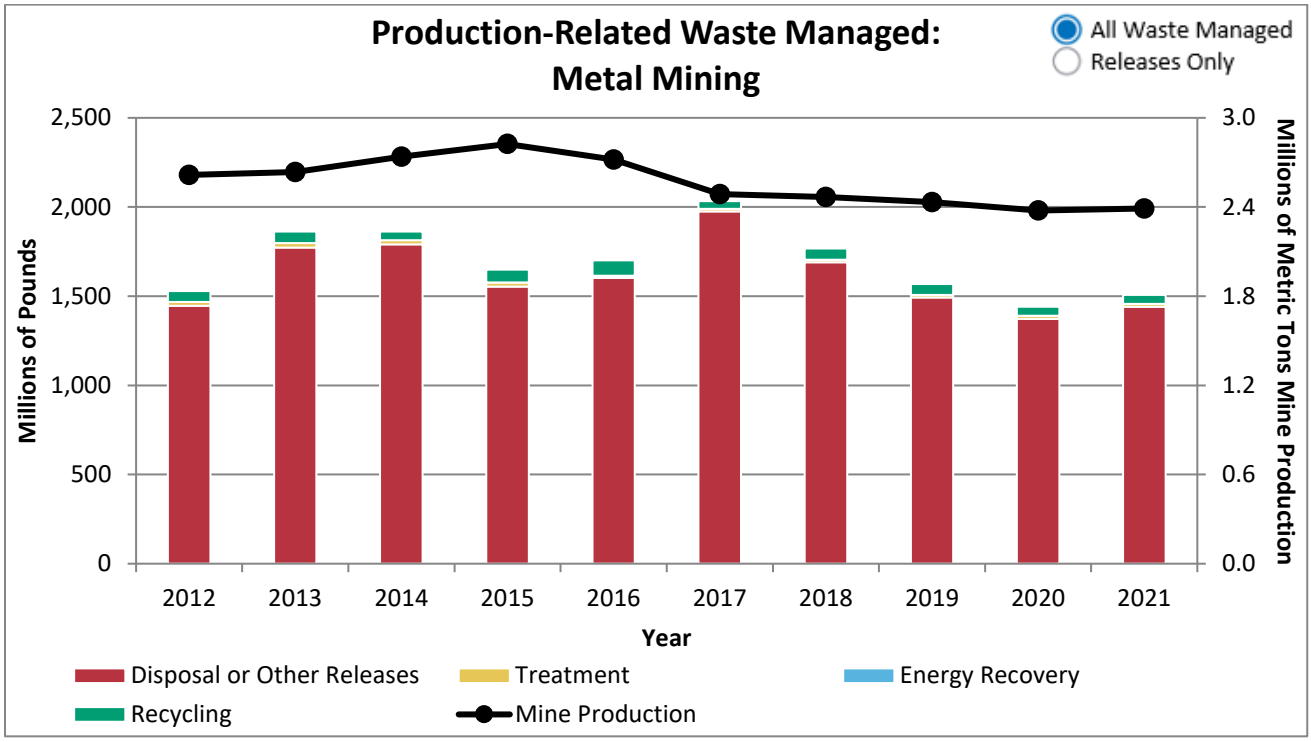
View Larger Map

For 2021, 87 metal mining facilities reported to the TRI. Most are in the western states, where copper, silver, and gold mining are most common. Farther east, some metal mines in Missouri and Tennessee extract zinc and lead. U.S. mining operations generate metals that are used in a wide range of products, including automobiles, electric and industrial equipment, jewelry, and decorative objects. The extraction and processing of these minerals generate large amounts of on-site land disposal, primarily of metal-bearing rock (called ore) and waste rock. To learn more about metal mining operations and their TRI reporting, explore the interactive metal mining diagram.



Metal Mining Waste Management Trend

The following graph shows the quantities of TRI chemical waste managed by the metal mining industry from 2012 to 2021, mainly in the form of on-site land disposal. The nature of metal mining operations limits the feasibility of other methods of waste management. For more details on quantities released, toggle to the "Releases Only" graph.



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

From 2012 to 2021:

- The quantity of waste managed by the metal mining sector fluctuated year to year and does not closely follow the sector's production (as reported by the United States Geological Survey).
- Mining facilities often cite changes in the chemical composition of the ore they extract as one reason for annual fluctuations in the quantities of waste they manage. In some cases, small changes in the ore's composition can impact whether TRI chemicals in ore qualify for a concentration-based TRI reporting exemption in one year but not in the next year or vice versa.

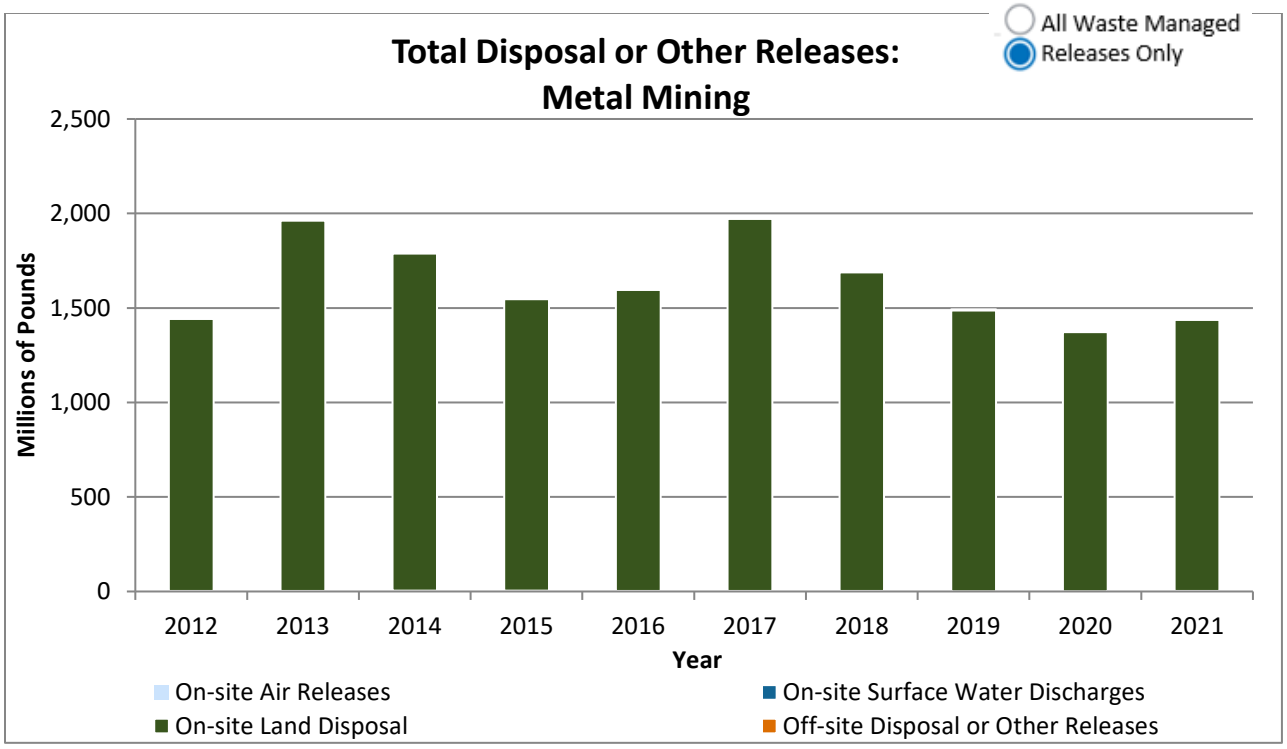
From 2020 to 2021:

- The quantity of TRI chemical waste managed by this sector increased by 67 million pounds (5%).

- During 2021, 96% of the metal mining sector's production-related waste was disposed of or otherwise released. Most of this waste consisted of metals, which were primarily disposed of to land on site at the mine.

Metal Mining Releases Trend

The following graph shows the 10-year trend in quantities of TRI chemicals released by the metal mining industry, primarily through on-site land disposal.



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

From 2012 to 2021:

- More than 99% of the metal mining sector's releases of TRI chemicals were on site and to land. Quantities of on-site land disposal by metal mines have fluctuated from year to year.
    - Facilities have the option to indicate whether reported land releases represent disposal of TRI chemicals in waste rock piles. For 2021, waste rock piles accounted for at least 44% of the on-site land disposal of TRI chemicals at metal mines.
- The quantity of TRI chemicals released alone is not an indicator of health risks posed by the chemicals, as described in the Potential Risks from TRI Chemicals section. For more

information, see the document, Factors to Consider When Using Toxics Release Inventory Data.

In 2021:

- Among the sectors reporting to TRI, the metal mining sector reported the largest quantity of waste disposed of or otherwise released, accounting for 44% of total TRI releases and 68% of on-site land disposal for all industries.
- The chemicals released in the greatest quantities by metal mines were zinc, lead, and arsenic compounds.

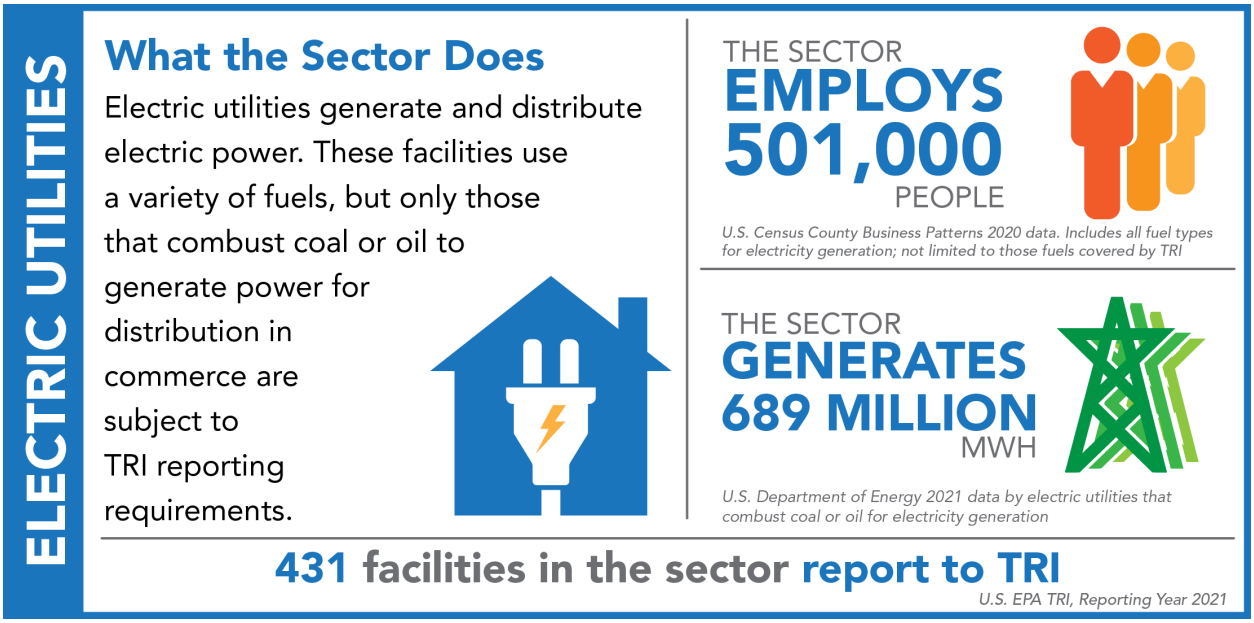
Source Reduction in the Metal Mining Sector:

Unlike manufacturing, the nature of mining—the necessary movement and disposal of large volumes of rock to access the target ore—does not lend itself to source reduction. To find examples of metal mining source reduction activities and the source reduction barriers mining facilities face, visit the TRI P2 Search Tool.

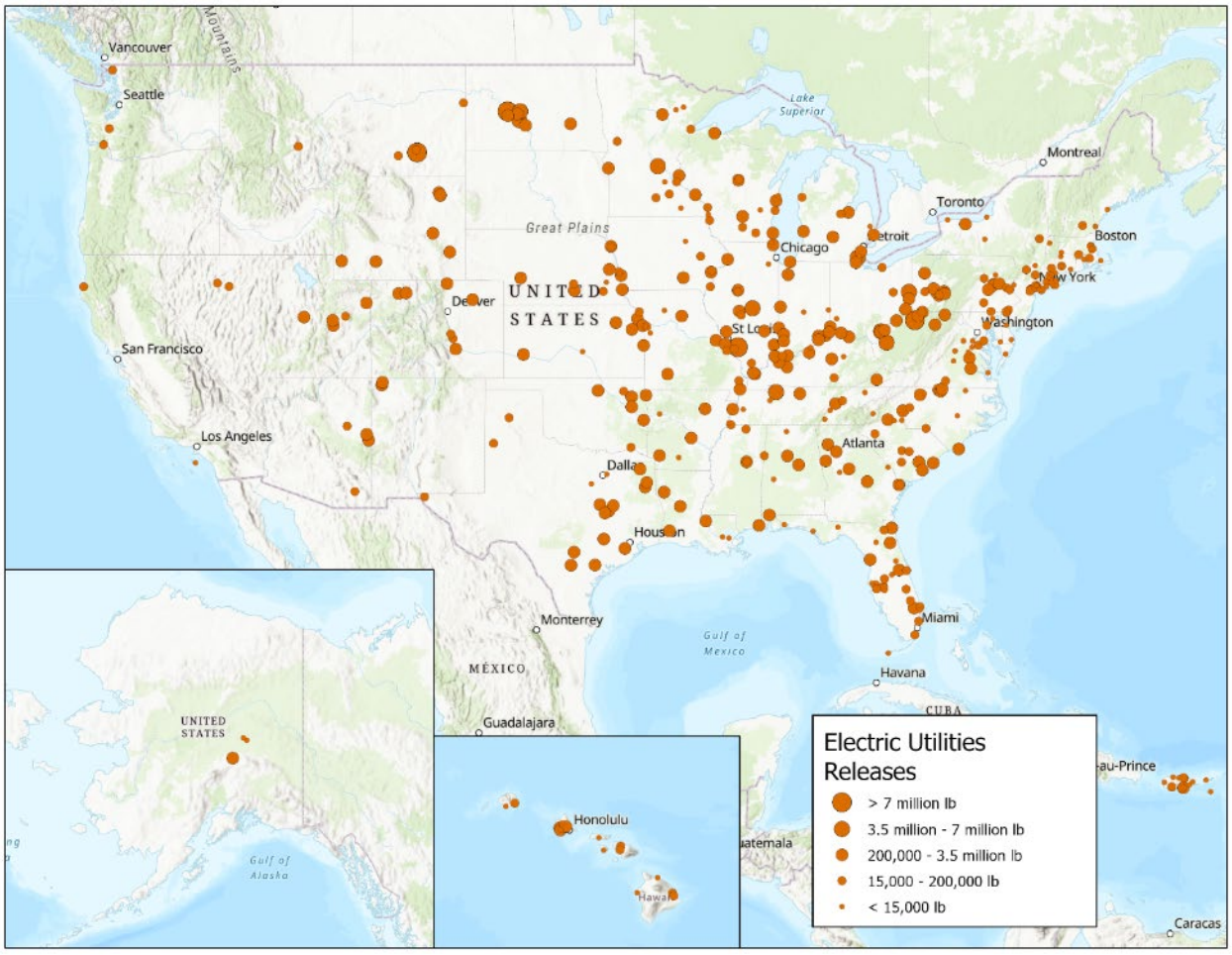
EPA's Smart Sectors Program is partnering with the mining sector to develop sensible approaches to better protect the environment and public health.

Electric Utilities

This section examines how TRI chemical wastes are managed in the electric utilities sector (defined as facilities reporting their primary NAICS code as 2211).



This map shows the locations of the electric utilities that reported to TRI for 2021, sized by their releases. Click on a facility for details on its TRI reporting.



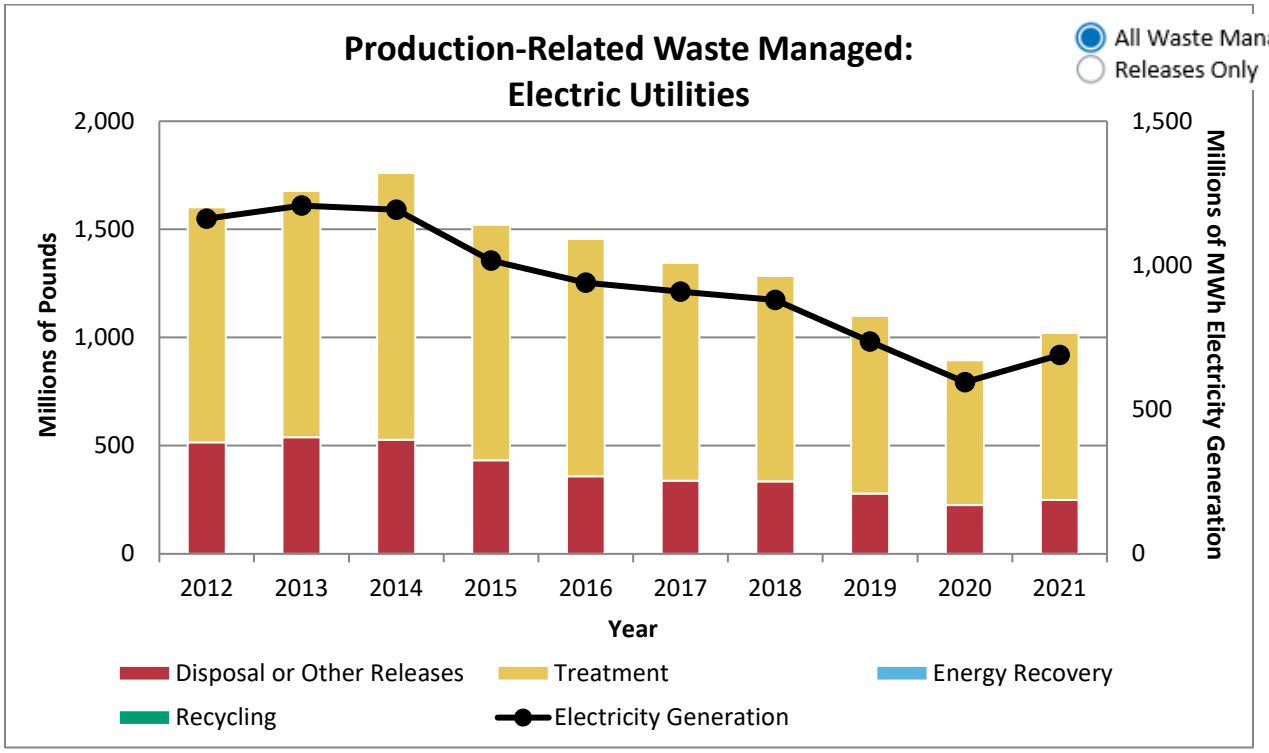
Electric Utilities Reporting to TRI, 2021

View Larger Map

For 2021, 431 electricity generating facilities reported to TRI. Facilities in the sector use different fuels to produce electricity, but only those that combust coal or oil to generate electricity for distribution in commerce are subject to TRI reporting requirements.

Electric Utilities Waste Management Trend

The following graph shows the 10-year trend in quantities of TRI chemical waste that electric utility facilities managed, primarily through treatment or release. For more details on quantities released, toggle to the "Releases Only" graph.



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

From 2012 to 2021:

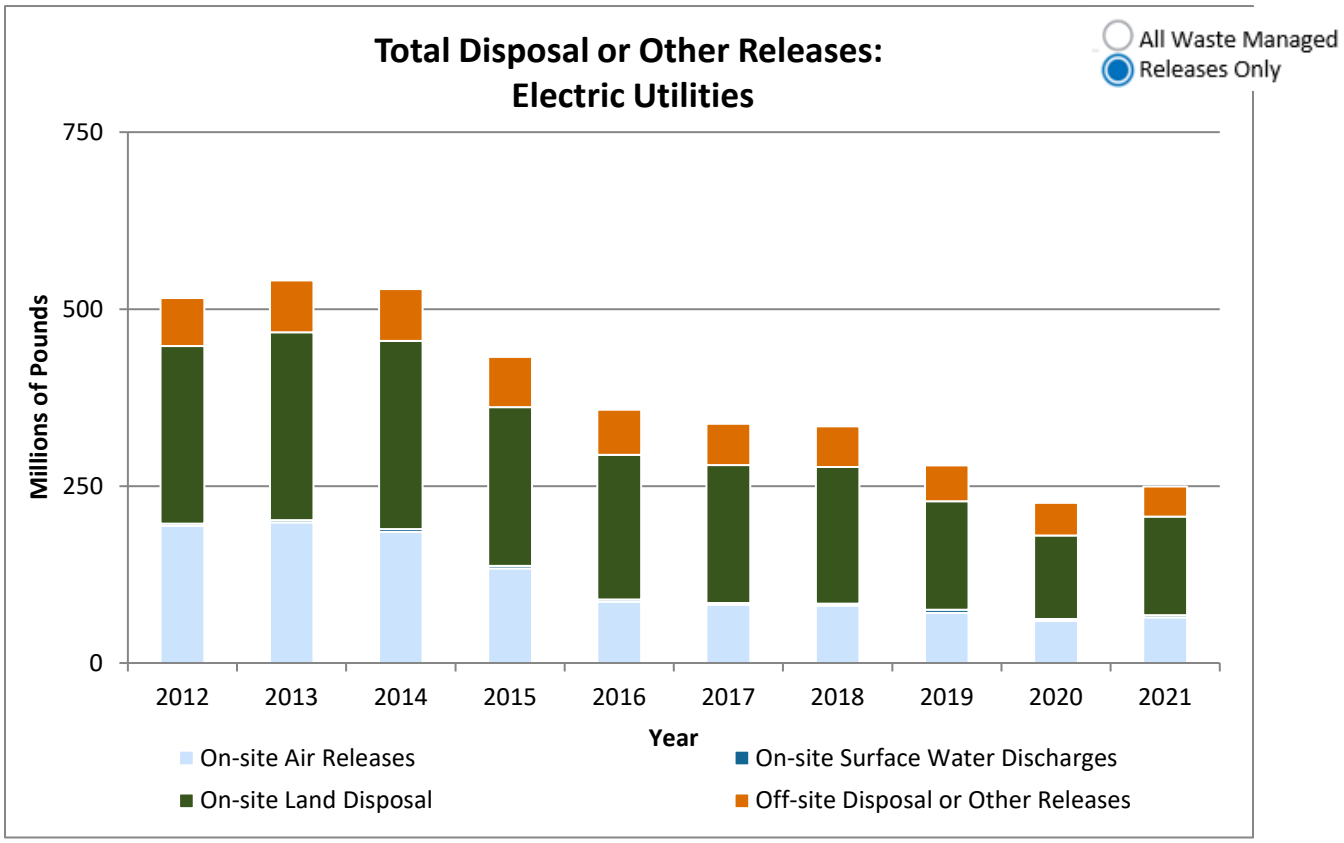
- Quantities of waste managed decreased by 584 million pounds (-36%) since 2012, driven by reduced releases and treatment.
- Net electricity generation by electric utilities from coal and oil fuels decreased by 41% (as reported by the U.S. Department of Energy's Energy Information Administration). Note that only facilities that combust coal or oil to generate electricity are covered under TRI reporting requirements.
    - Data from the Energy Information Administration indicate that the mix of energy sources for U.S. electricity generation has changed over time. Natural gas and renewable energy sources account for an increasing share of U.S. electricity generation, while coal-fired electricity generation has declined. Use of oil for electric power generation continues to contribute a small percentage of total U.S. electricity generation.

In 2021:

- Three-quarters of the sector's production-related waste was treated, while approximately one-quarter was released into the environment.
    - This contrasts with 2012, when about one-third of the waste from this sector was released into the environment. This trend is due in part to increased installation of air pollution control devices that treat TRI-reportable chemicals.

Electric Utilities Releases Trend

The following graph shows the annual quantities of TRI chemicals released by electric utilities.



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

From 2012 to 2021:

- Releases from the electric utilities sector decreased by 266 million pounds (-52%). This decrease was driven by a 129-million-pound (-67%) decrease in air releases and a 111-million-pound (-44%) decrease in on-site land disposal. Surface water discharges and off-site disposal also decreased, but to a lesser extent.

From 2020 to 2021:

- Releases by electric utilities increased by 23 million pounds (10%), driven by increased disposal of barium compounds in on-site landfills.

Source Reduction in the Electric Utilities Sector:

In the electric utilities sector, 13 facilities (3%) initiated source reduction activities in 2021 to reduce their use of TRI chemicals and creation of wastes containing TRI chemicals. Some facilities reported process improvements to increase efficiency, which may lead to reduced greenhouse gas emissions as well as reduced TRI chemical wastes.

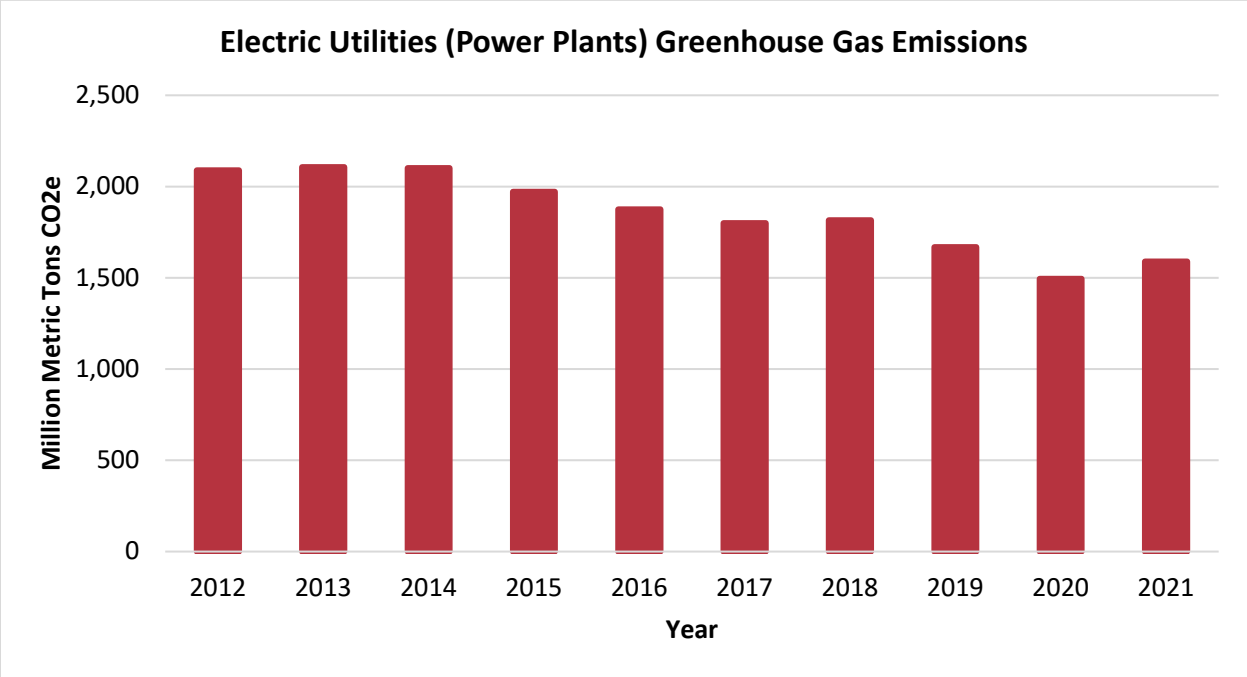
To find examples of electric utilities' source reduction activities and the source reduction barriers they face, visit TRI's P2 Search Tool.

EPA's Smart Sectors Program is partnering with this sector to develop sensible approaches to industrial operations that better protect the environment and public health.

Greenhouse Gas Reporting in the Electric Utilities Sector

While many chemical releases are required to be reported to the TRI, the TRI Program does not cover all chemicals released by industry. Notably, most greenhouse gas (GHG) emissions are not reported to the TRI. Greenhouse gas emissions increase the concentration of these gases in the atmosphere, which alter the amount of heat trapped by the Earth's atmosphere and contribute to climate change. These elevated concentrations and their effect on climate are reasonably anticipated to endanger the public health and welfare of current and future generations.

EPA's Greenhouse Gas Reporting Program (GHGRP) tracks facility-level emissions from the largest U.S. sources of GHGs. Under the GHGRP, the Power Plants Sector consists predominantly of facilities that produce electricity by combusting fossil fuels, such as coal, oil, and natural gas, or biomass. The sector also includes facilities that produce steam, heated air, or cooled air by combusting fuels. The chart below shows GHG emissions reported to the GHGRP by facilities in the Power Plants sector from 2012 to 2021.



- Note that while TRI typically collects chemical release data in units of pounds, the GHGRP collects GHG emissions expressed in quantities expressed as metric tons of carbon dioxide equivalents ($MTCO_2e$). This chart shows GHG emissions in $MTCO_2e$.
- In 2021, 1,326 facilities in the Power Plants sector submitted GHG reports while 431 facilities in this sector reported to TRI. Some facilities report to only one of these programs due to different applicability requirements. In particular, TRI covers only electric utilities that combust coal or oil to generate electricity (i.e., natural gas power plants are not covered by TRI) while the GHGRP covers all power plants that meet the applicability requirements, including natural gas-fueled power plants.

What are carbon dioxide equivalents (CO_2e)?

Different GHGs can have different effects on the Earth's warming; Global Warming Potential (GWP) values allow for comparisons of the global warming impacts of different gases. MTCO2e is a weighted measurement that considers the tonnes of the gases and their associated global warming potentials.

- Total reported GHG emissions from the sector were 1,589 million $MTCO_2e$ in 2021, which represented more than half of total direct emissions reported to the GHGRP.
- From 2012 to 2021, GHG emissions from this sector have decreased by 24%. According to data from the U.S. Department of Energy's Energy Information Administration, use of renewables, such as wind and solar, and of natural gas increased during this time while the use of coal decreased. These trends likely contributed to the decreased emissions from this sector.

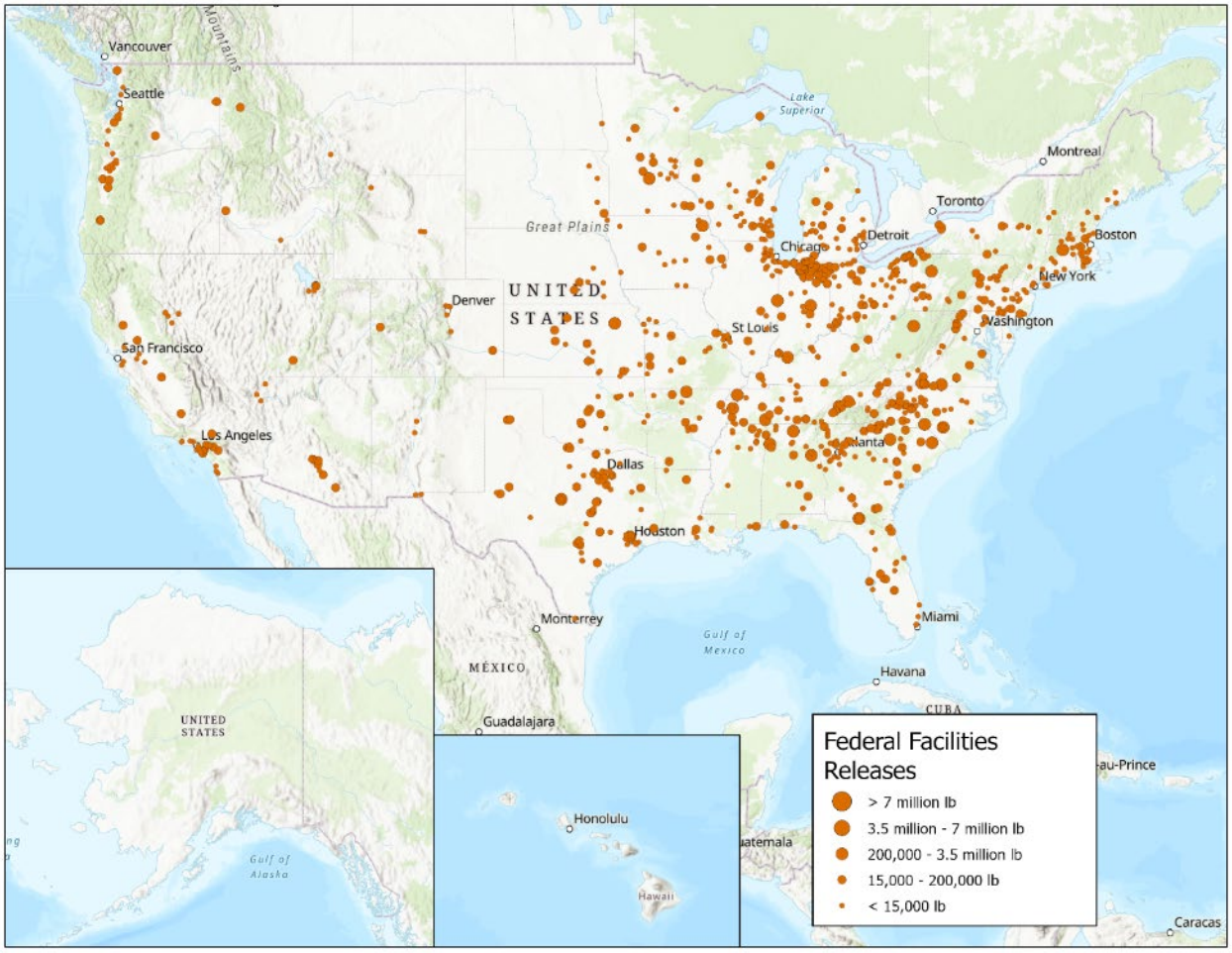
Additional Resources

- To explore the data reported to EPA on GHG emissions, see the Facility Level Information on GreenHouse gases Tool (FLIGHT).
- EPA's Understanding Global Warming Potentials webpage provides further information on GWPs, how they are used, and how they differ by GHG.
- For more details on the electric utility sector's GHG emissions, visit GHGRP Power Plants.
- The TRI P2 Search Tool lets you compare facilities' waste management reported to TRI and their GHG emissions reported to the GHGRP.

Federal Facilities

All federal facilities, including facilities operated by the EPA, the Department of Defense, and the Department of the Treasury, are subject to TRI reporting requirements, regardless of the type of operations at the facility.

This map shows the locations of 446 federal facilities that reported to TRI for 2021, sized by their releases. Click on a facility for details on its TRI reporting.

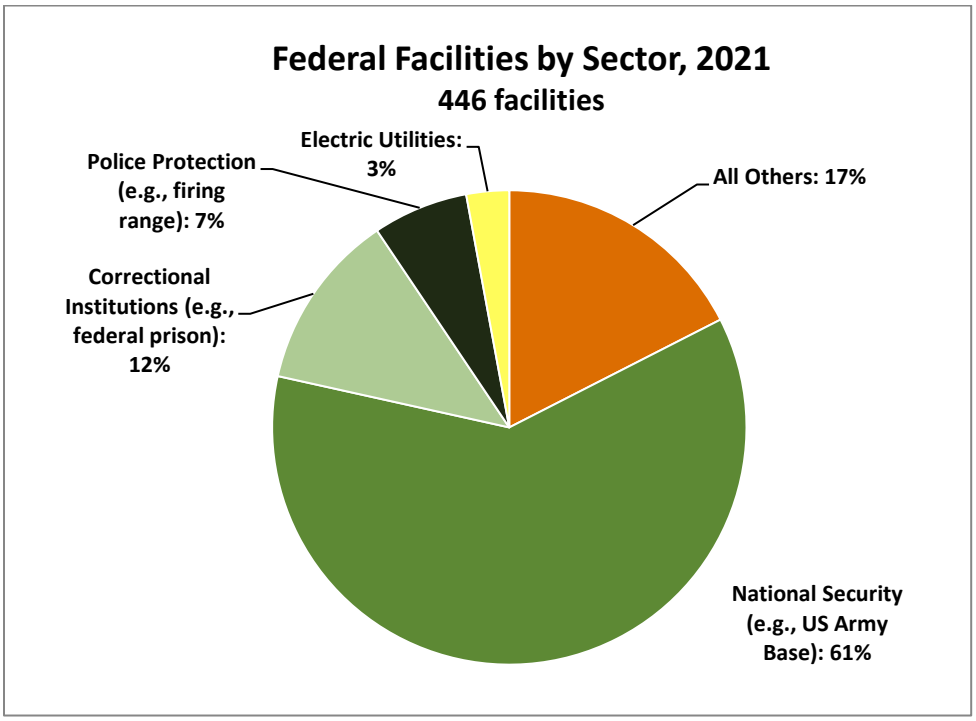


Federal Facilities Reporting to TRI, 2021

View Larger Map

Federal Facilities by Industry

The following chart shows the number of federal facilities reporting to TRI by sector for 2021.

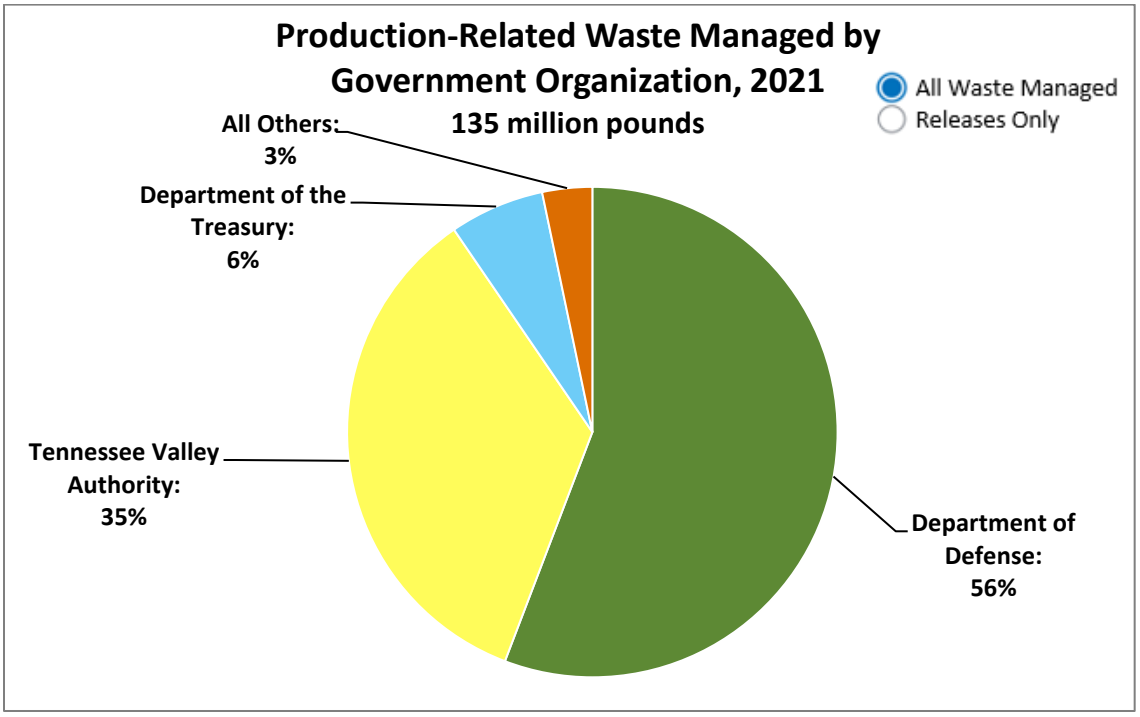


For 2021, 446 federal facilities in 39 different types of operations (based on their 6-digit NAICS codes) reported to TRI. All federal facilities are subject to TRI reporting requirements regardless of industry sector, so the TRI database only includes data from federal facilities for some sectors. Most federal facilities are in such sectors, including military bases; correctional institutions; and police protection, such as training sites for border patrol stations. Almost two-thirds of federal facilities were in the National Security sector, which includes Department of Defense facilities such as Army and Air Force bases.

As with non-federal facilities, the type of activities occurring at federal facilities determines the amount of chemical waste managed and the management methods used. Some activities occurring at federal facilities are similar to those at non-federal facilities, such as electricity production. In other cases, federal facilities may report waste managed from specialized activities. For example, the federal facilities included under police protection and correctional institutions almost exclusively reported for lead and lead compounds, likely due to the use of lead ammunition on their firing ranges.

Waste Management by Federal Facilities

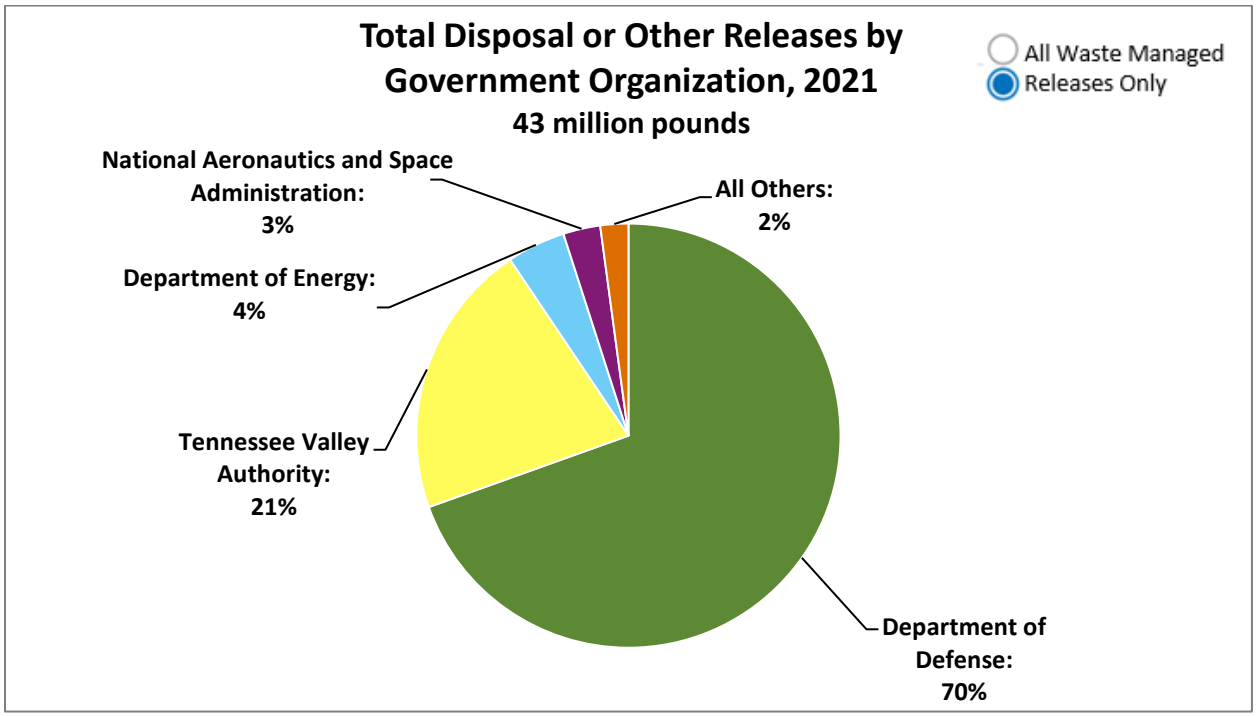
The following pie chart shows the percentages of total TRI chemical waste managed through recycling, energy recovery, treatment, and disposal or other releases by federal government organizations in 2021. For more details on quantities released, toggle to the "Releases Only" graph.



- The types of waste reported by federal facilities vary by the type of operation. For example:
  - The Tennessee Valley Authority, a government-owned electric utility, provides power to southeastern states. 84% of its reported waste was hydrochloric and sulfuric acid, which were mostly treated on site.
  - The Department of the Treasury facilities reporting to TRI are mints for manufacturing currency and, accordingly, they report metals (e.g., copper and nickel) to TRI. Almost all of their metal waste was recycled off site.

Releases by Federal Facilities

The following graph shows the percentages of TRI chemicals released by federal government organizations in 2021.



- Most of the Department of Defense's releases were on-site releases of nitrate compounds to water and on-site land disposal of metals and metal compounds.
- The chemicals released by the Tennessee Valley Authority are similar to the chemicals released by other electric utilities that report to TRI. On-site land disposal of barium compounds and air releases of sulfuric acid make up a large portion of releases from the Tennessee Valley Authority and other electric utilities.

Source Reduction at Federal Facilities:

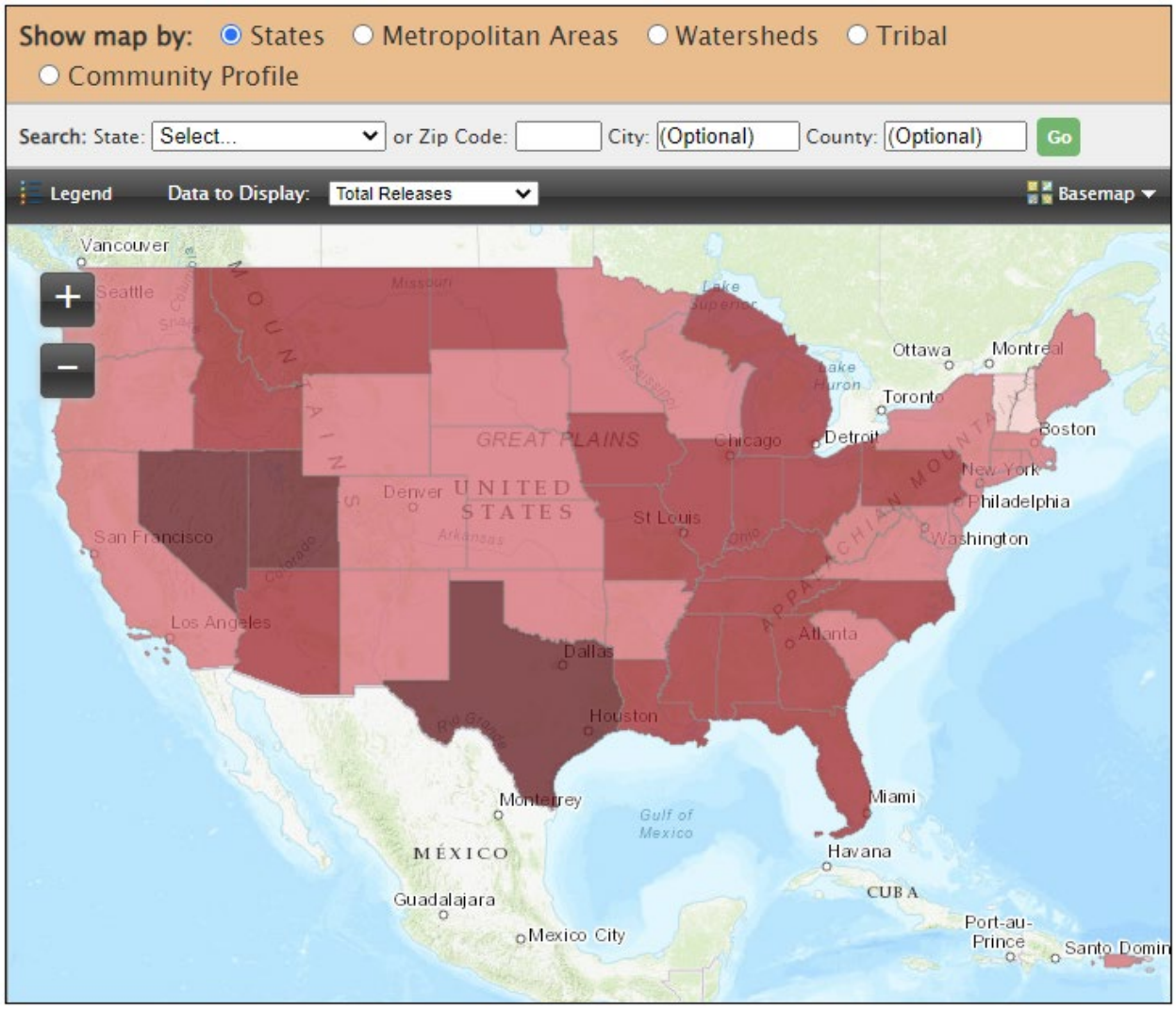
Federal facilities' operations are diverse and few focus on manufacturing processes. Due to the varied functions, operations at some federal facilities are better suited to source reduction strategies than others. For the 2021 reporting year, 27 federal facilities (6%) reported implementing source reduction activities.

Federal facilities have often reported difficulties when trying to reduce their use of lead because it is contained in ammunition used at National Security and Park Service facilities. For 2021, several federal facilities reported using non-lead ammunition in accordance with National Park Service policy to do so where feasible.

To find more examples of federal facilities' source reduction activities and the source reduction barriers they face, visit TRI's P2 Search Tool and select industry sectors such as National Security, Correctional Institutions, or Police Protection from the dropdown menu under "search criteria."

Where You Live

Use the geographical selections bar above the map to show the releases of Toxics Release Inventory (TRI) chemicals reported throughout the United States for 2021.



Click on any location on the map to see detailed information.

View Larger Map

You can also view TRI facility locations along with the demographic characteristics of the communities where they are located. Use the toggle option to display the "Community Profile," which shows community demographics using EPA's demographic index or supplemental demographic index. Use the Data to Display dropdown to select the metric to display. Use the Search bar to generate a fact sheet about an area of interest.

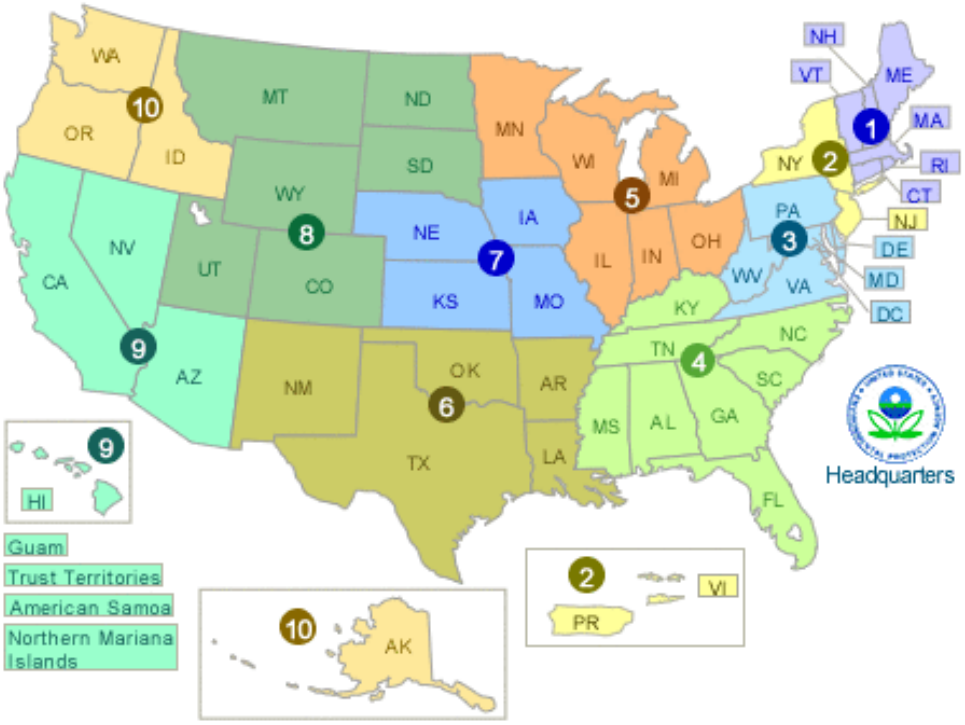
In addition to viewing maps based on release quantities, you can also view maps based on risk-screening scores, which are estimates of relative potential risks to human health following exposure to TRI chemicals. These unitless risk-screening scores (RSEI Score) are generated by EPA's Risk-Screening Environmental Indicators (RSEI) model and allow you to compare the relative potential for human health impacts across various locations. For more on RSEI, see the Potential Risks from TRI Chemicals section.

TRI Data Considerations

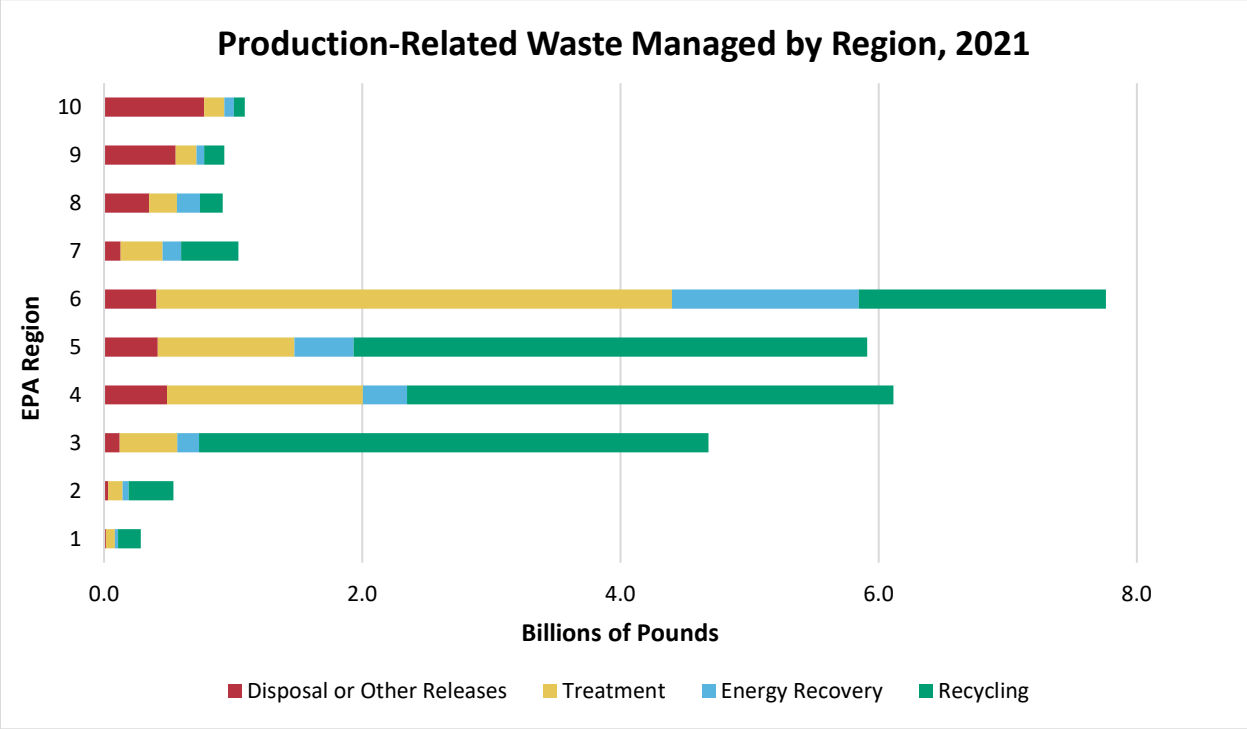
As with any dataset, there are many factors to consider when using the TRI data. Find a summary of key factors associated with data used in the National Analysis in the Introduction. For more information see *Factors to Consider When Using Toxics Release Inventory Data*.

EPA Regions

EPA has 10 regional offices, each of which is responsible for multiple states and in some cases, territories and tribes.



EPA regions vary in size, population, and the types of facilities located in each. This results in significant differences in TRI chemical waste management practices and quantities, as shown in the figure below.



The differences in quantities of production-related waste managed among the regions are largely explained by the types and number of industrial facilities located in each region. For example:

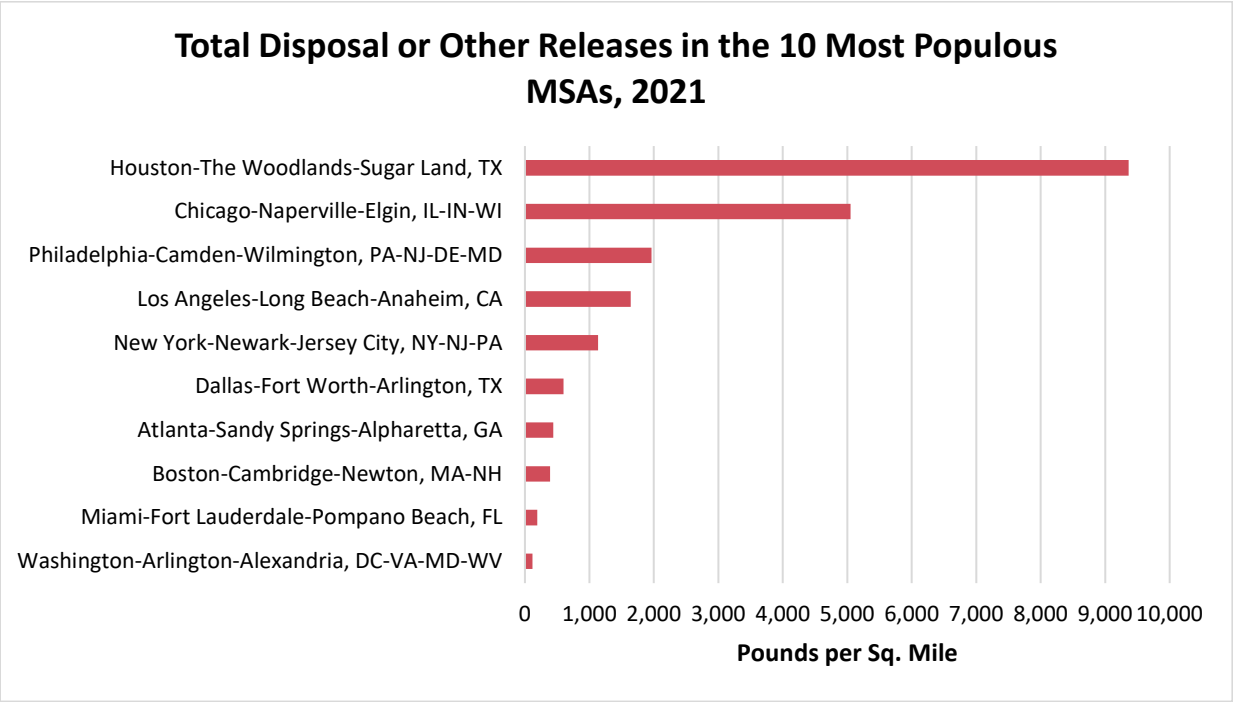
- **Region 10** reported more releases for 2021 than any other region, amounting to 777 million pounds.
    - Release quantities in this region were driven by one metal mine in Alaska.
- In **Regions 8, 9, and 10**, the metal mining sector accounted for more releases than any other sector.
    - Metal mines tend to report high releases due to the large quantities of metals disposed of on site to land. The extraction and processing of minerals generates large amounts of on-site land disposal, as large amounts of metal-bearing rock (called ore) and waste rock are moved and processed.
    - Metal mines manage very little of their waste through treatment, combustion for energy recovery, or recycling. As a result, regions with significant metal mining operations tend to have higher releases but lower production-related waste compared to other regions.
- Releases in **Region 7** were also driven in part by metal mines, although only five metal mining facilities in the region reported to TRI for 2021.

- **Region 6** reported the most waste managed, driven by facilities in the chemical manufacturing sector. This sector also accounted for more of the region's releases than any other sector.
- Production-related waste managed in **Regions 3, 4, and 5** was driven by recycling in the chemical and food manufacturing sectors. These regions all have one or two facilities reporting high quantities (i.e., more than a billion pounds) of chemicals recycled on site for 2021.
- **Regions 4 and 5** had the most facilities reporting for 2021: 4,569 and 5,253 facilities, respectively. Combined, almost half of all facilities that reported to TRI are in these two regions.
- **Regions 1 and 2** had the lowest releases and total production-related waste managed. Nationally, most releases and waste managed are reported by facilities in the metal mining, chemical manufacturing, primary metals manufacturing, electric utilities, food manufacturing, or hazardous waste sectors. Relatively few facilities in these sectors operate in **Regions 1 and 2**, contributing to lower release and waste management quantities in these two regions.

States and Metropolitan Areas

For TRI purposes, "states" includes all U.S. territories. For 2021, facilities located in all 56 states and territories reported to the TRI Program. Texas, Ohio, and California had the most facilities report to TRI, and together accounted for 20% of the total number of facilities that reported for 2021.

Approximately 81% of the U.S. population and many of the industrial and federal facilities that report to TRI are in urban areas. "Metropolitan Statistical Areas" (MSAs) are defined by the Office of Management and Budget (OMB) and consist of one or more socially and economically integrated adjacent counties, cities, or towns.

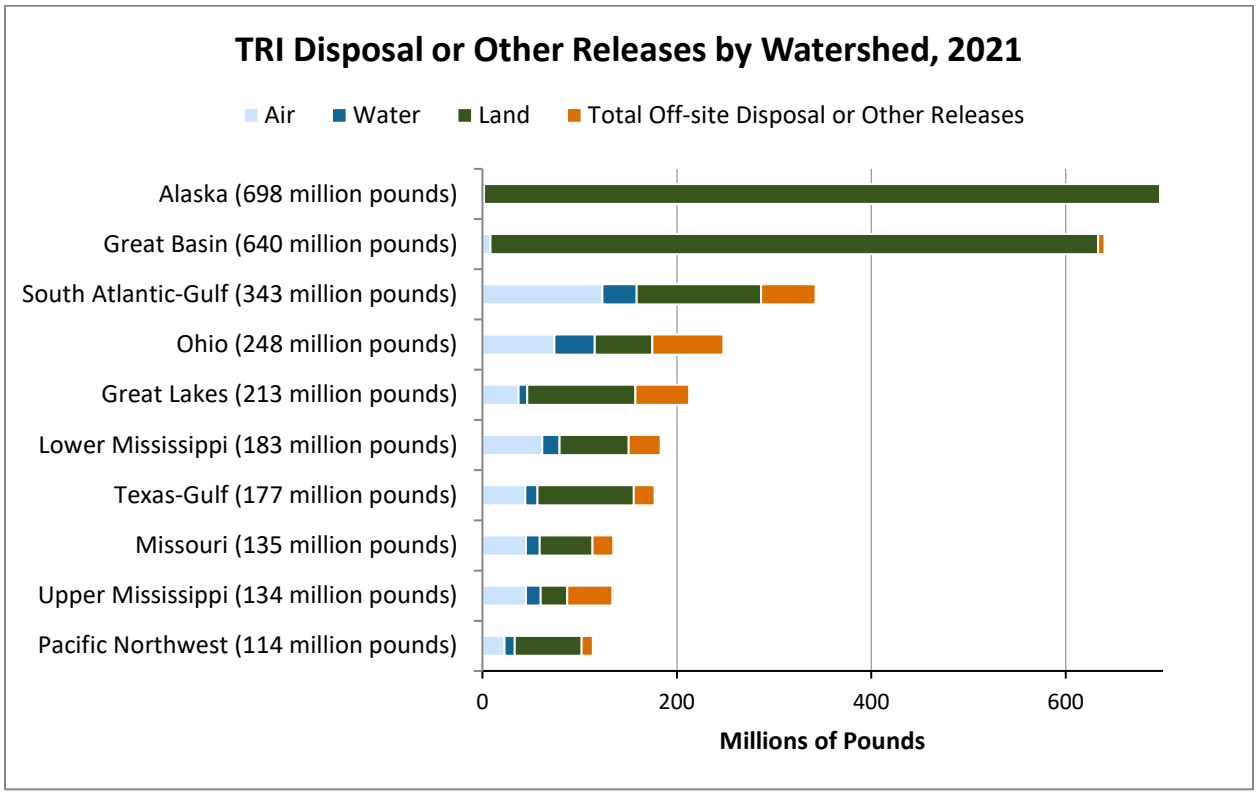


Watersheds

To assess U.S. water resources, the U.S. Geological Survey (USGS) divides the nation into 22 hydrologic regions, or watersheds, based on the flow of water throughout the country. Each watershed represents a major river drainage area (e.g., the Missouri region) or combines rivers' drainage areas (e.g., the Texas-Gulf region which includes several rivers draining into the Gulf of Mexico).

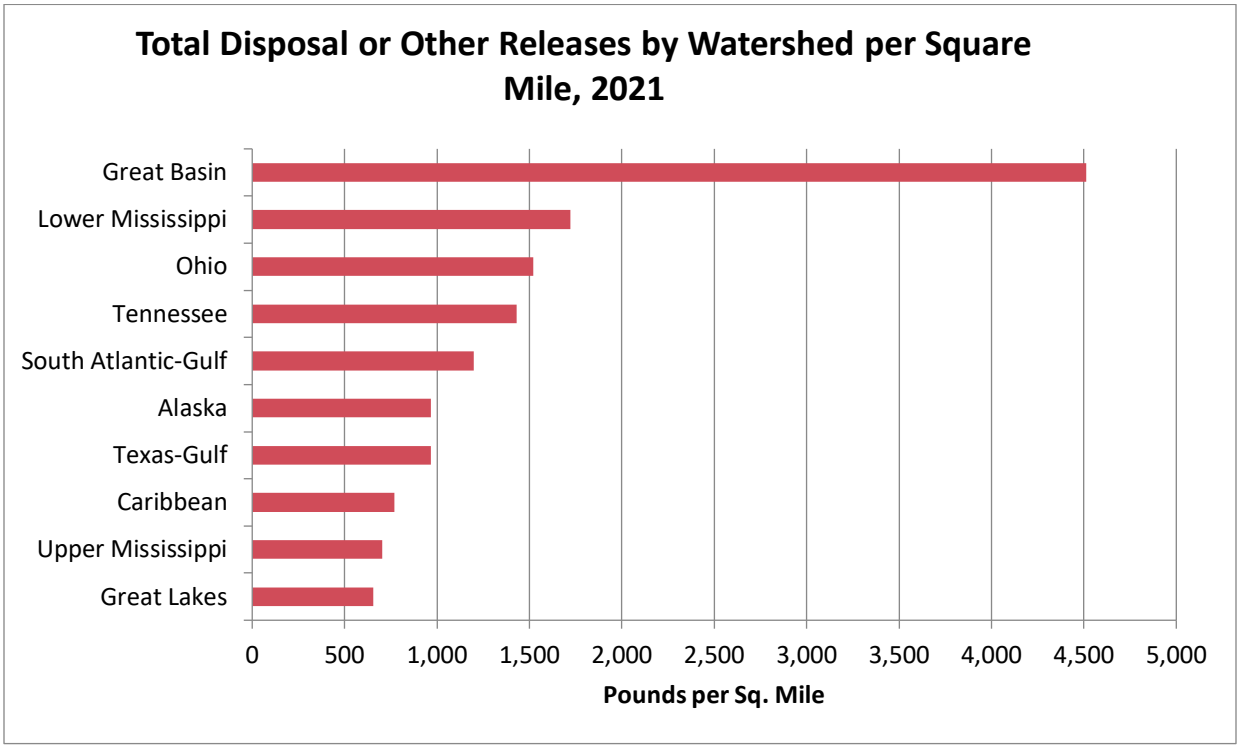
Even locations that are far from bodies of water are part of a hydrologic region because chemicals released to groundwater, land, or air can be washed or carried long distances to surface waters. These discharges can affect living resources within an aquatic ecosystem. For example, some chemicals can persist in the environment and accumulate in the tissues of fish and other wildlife. These chemicals can become more concentrated as predators farther up the food chain eat these organisms, which may ultimately cause health problems for wildlife and humans.

All 22 watersheds are displayed in the Where You Live map. The chart below shows the ten watersheds with the most TRI chemical releases for 2021. Releases were the greatest in the Alaskan and Great Basin regions. In these regions, most releases were from metal mines.



Note: Chart shows the ten watersheds with the most TRI chemical releases in pounds.

The chart below shows the ten watersheds with the most TRI chemical releases per square mile. Releases per square mile are greatest in the Great Basin region, which encompasses much of Nevada and Utah. Releases from metal mines make up 91% of the releases in this region.



Note: Chart shows the ten watersheds with the most TRI chemical releases in pounds per square mile.

Tribal Communities

Under EPA policy, the agency works with federally recognized tribes on a government-to-government basis to protect the land, air, and water in Indian Country and Alaska Native villages and to support tribal assumption of program authority. Facilities located in Indian Country that meet TRI reporting requirements must indicate the appropriate three-digit Bureau of Indian Affairs (BIA) tribal code on annual TRI reporting forms. These codes identify which tribal land the facility is located on.

In 2021, 39 facilities located on the land of 18 different federally recognized tribes reported to TRI. These facilities collectively managed over 41 million pounds of production-related waste, 9.4 million pounds (23%) of which was disposed of or otherwise released. Of these releases, 54% were disposed on site to land by electric utilities and metal mining facilities. These facilities primarily disposed of metal compounds such as lead and barium. Lead is often present in the mineral ore disposed of by metal mines, and barium is present in coal and oil combusted at electric utilities.

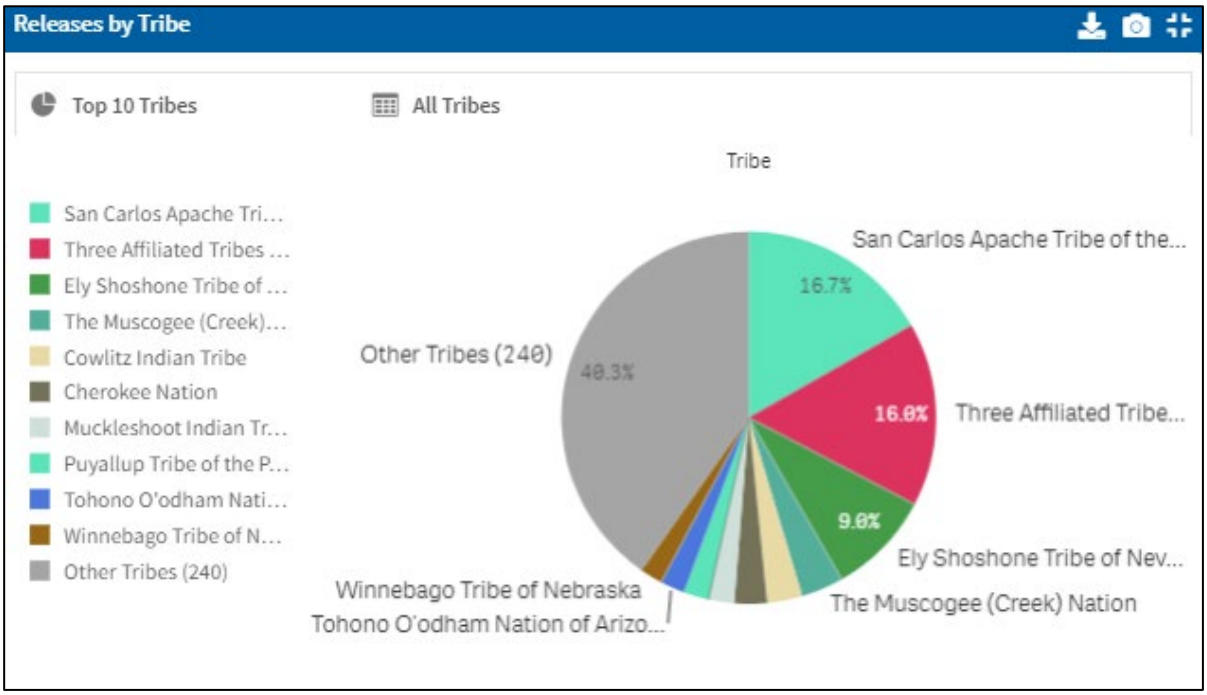
Many more facilities are located within a 10-mile radius of tribal land. 1,997 facilities on or within 10 miles of tribal land reported to TRI for 2021, representing 232 different federally recognized tribes. These facilities collectively managed over 1.18 billion pounds of waste, 193 million pounds (16%) of which were disposed of or otherwise released. Of the releases reported, 56% were released on site by chemical manufacturing, metal mining, and primary metals manufacturing facilities.

The table below provides more details about the types of releases and other waste management reported by facilities on federally recognized tribal lands.

Quick Facts for 2021: Facilities on Tribal Lands

Measure	*Facilities on Tribal Land*	*Facilities on or within 10 miles of tribal land*
Number of Facilities that Reported to TRI	**39**	**1,997**
Number of Tribes with TRI Facilities on Their Lands	18	232
Production-Related Waste Managed	**41.20 million lb**	**1.18 billion lb**
Recycling	20.62 million lb	431 million lb
Energy Recovery	3.25 million lb	132 million lb
Treatment	7.94 million lb	429 million lb
Disposal or Other Releases	9.38 million lb	193 million lb
Total Disposal or Other Releases	**9.38 million lb**	**193 million lb**
On-site	**5.79 million lb**	**156 million lb**
Air	0.52 million lb	59.2 million lb
Water	2,800 lb	12.1 million lb
Land	5.26 million lb	85.2 million lb
Off-site	**3.59 million lb**	**36.8 million lb**

The TRI Toxics Tracker provides an easy way to explore information about waste management and releases of TRI chemicals from facilities on or near tribal lands. An example of the type of TRI information in the Tribal Lands section of the TRI Toxics Tracker is shown in the interactive chart below. Use the buttons in the top row to filter the data by industry sector, chemical, and/or tribe.



The interactive table below lists the federally recognized tribes that had at least one TRI-reporting facility on their lands, along with the total releases and waste managed on the tribe's lands.

Total Disposal or Other Releases on Tribal Lands by Tribe, 2021

	Totals	
	Releases (lb)	Waste Managed (lb)
Totals	9,381,980	41,198,361
Coeur D'Alene Tribe	132,709	132,709
Confederated Tribes and Bands of the Yakama Nation	121,325	125,283
Eastern Band of Cherokee Indians	30,416	53,190
Fort McDowell Yavapai Nation, Arizona	0	22
Gila River Indian Community of the Gila River Indian Reservation, Arizona	119	82,415
Navajo Nation, Arizona, New Mexico, & Utah	1,932,501	5,271,331
Nez Perce Tribe	6	6
Northern Arapaho Tribe of the Wind River Reservation, Wyoming	1,825	1,825
Oneida Nation	1,050	69,979
Puyallup Tribe of the Puyallup Reservation	3,722,529	30,354,654
Rincon Band of Luiseno Mission Indians of Rincon Reservation, California	0	0
Saginaw Chippewa Indian Tribe of Michigan	1,171	402,141
Salt River Pima-Maricopa Indian Community of the Salt River		

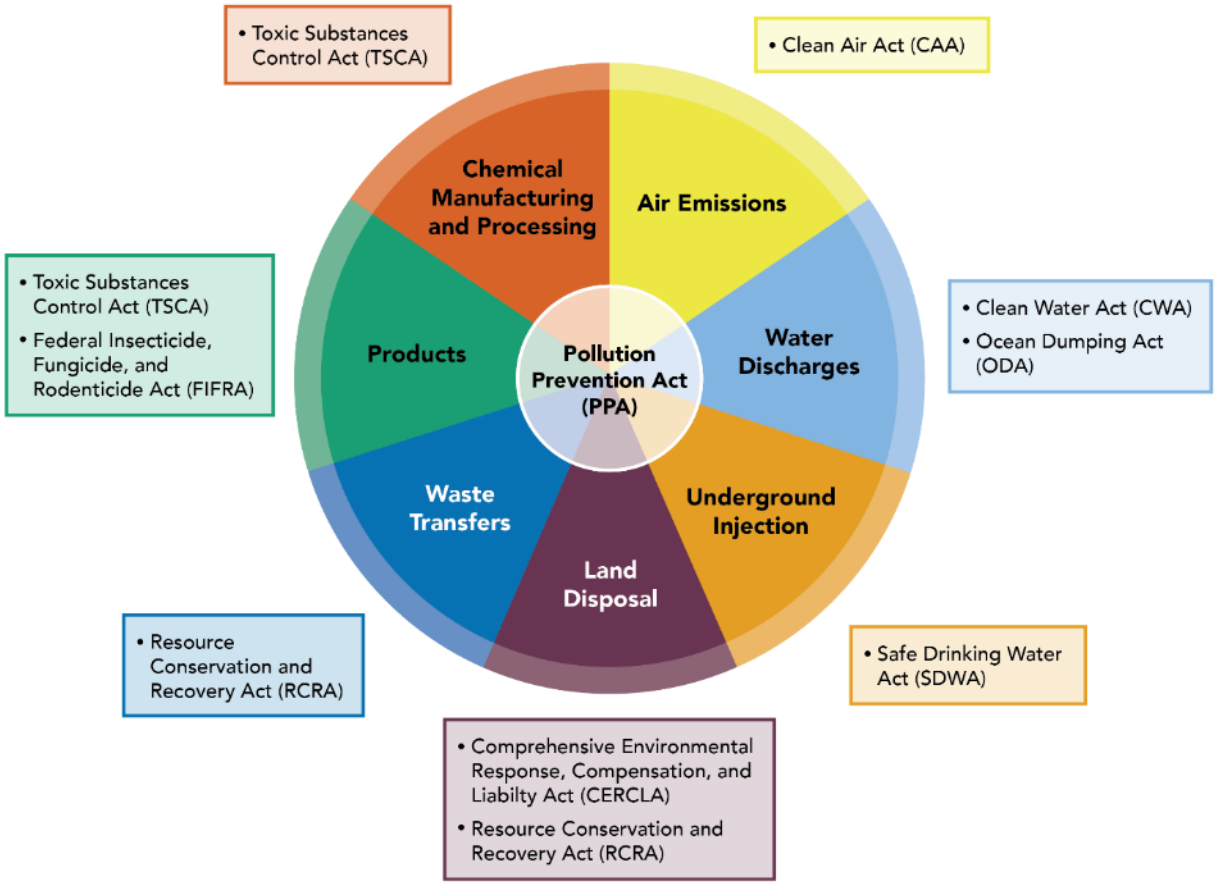
You can also view a fact sheet for each tribe using TRI Explorer.

Additional resources for tribes are available on the TRI for Tribal Communities webpage, including more detailed analyses of TRI data, links to other online tools, and contact information for EPA's Tribal Program Managers.

TRI Connections

The TRI is a powerful resource that provides the public with information about how toxic chemicals are managed by certain facilities in the United States. Beyond the TRI, there are many other EPA programs that also collect information about TRI-listed chemicals and other regulated chemicals. The figure below is an overview of key laws that EPA implements with some associated regulated activities or industrial processes.

While many EPA programs focus on one environmental medium, the TRI Program is unique in that it covers all environmental media by tracking toxic chemical releases to air, water, and land, as well as chemical waste transfers. TRI also tracks other waste management and the implementation of pollution prevention at facilities. Since facilities report annually, TRI is one of EPA's most up-to-date sources of data. The data can be used with other datasets to provide a more complete understanding of national trends in chemical waste management practices.



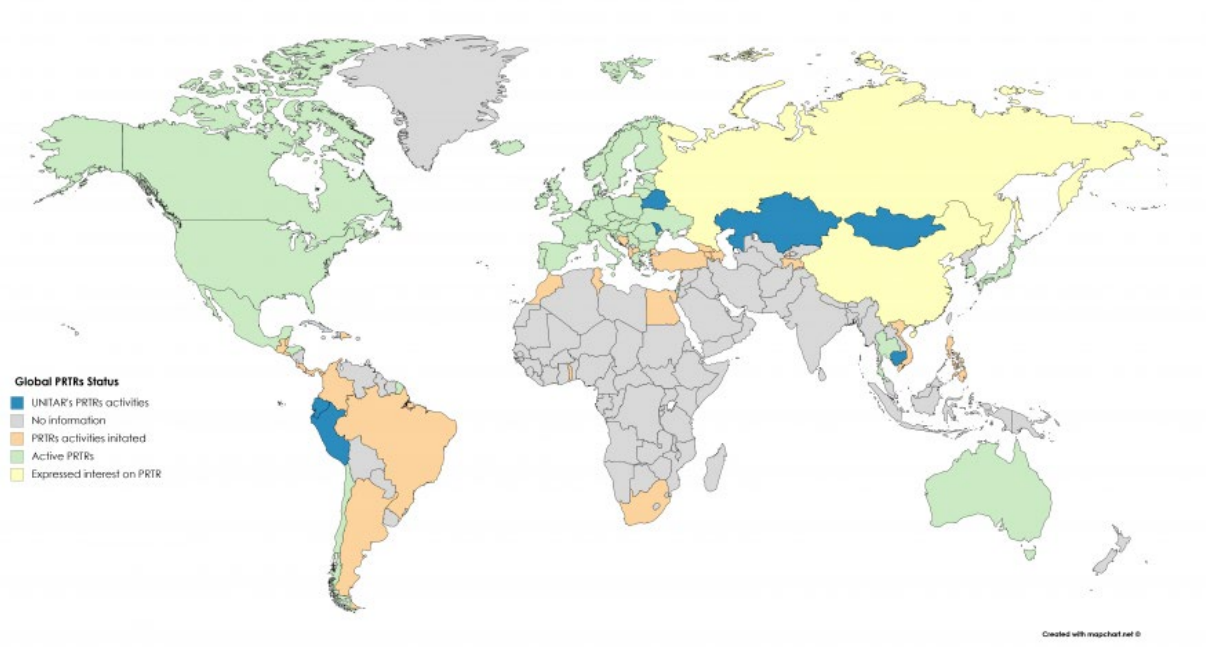
The Emergency Planning and Community Right-to-Know Act (EPCRA) established requirements for emergency planning, preparedness, and reporting on hazardous and

toxic chemicals. EPCRA requires facilities to report environmental releases, waste transfers, quantities of chemicals on site, the type and location of storage of those chemicals, and their use to EPA (via the TRI Program) and to state and local officials. The Pollution Prevention Act (PPA) of 1990 expanded TRI to include information on waste management activities like recycling, combustion for energy recovery, and treatment. The PPA also requires facilities to report newly implemented source reduction activities to TRI. See the More on EPCRA section for details.

Offices across the EPA use TRI data to support their work to protect human health and the environment. These uses include technical analysis for regulation, informing program priorities and projects, and providing information to internal and external stakeholders.

TRI Around the World

In 1986, with the enactment of the Emergency Planning and Community Right-to-Know Act (EPCRA), the TRI was established as the first national Pollutant Release and Transfer Register (PRTR) in the world. Since then, environmental agencies in other countries have implemented their own PRTR programs modeled after the TRI Program. Currently, at least 50 countries have fully established PRTRs or have implemented pilot programs (see map below). With assistance from international organizations like the United Nations Institute for Training and Research (UNITAR), more countries are expected to develop PRTRs, particularly in Asia, South America, and Africa.



Source: United Nations Institute for Training and Research PRTR Global Map

As global PRTR implementation continues to grow, the TRI Program will continue to work with international organizations to:

- Assist in the development of new PRTR programs.
- Promote data standards and core data elements to improve PRTR comparability and harmonization and allow global scale analyses.
- Showcase the usefulness of PRTR data for assessing progress towards sustainability.

See the TRI Around the World webpage for more information on the TRI Program's international partners.

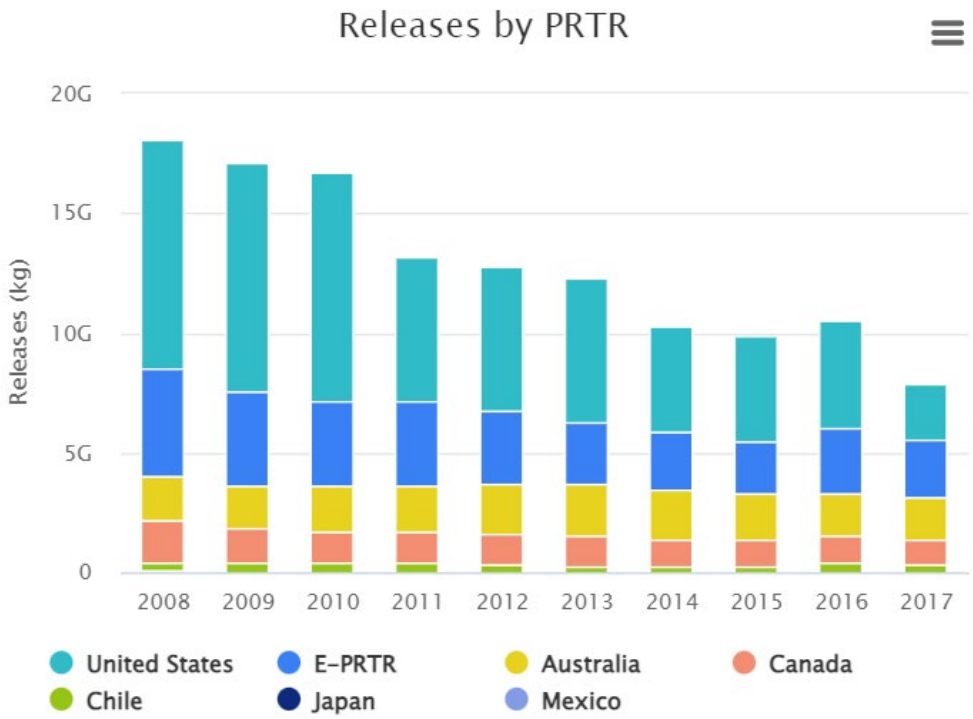
International Project Spotlight: Using PRTR Data to Assess Progress toward the U.N. Sustainable Development Goals

Watch a short video on the report on global PRTRs

Background. The TRI Program collaborates with the Organization for Economic Cooperation and Development (OECD) on PRTR projects, including a project to use global PRTR data to assess progress toward the United Nations' (U.N.) Sustainable Development Goals (SDGs). These goals are designed to "shift the world on to a sustainable and resilient path" by setting targets that encompass the economic, environmental, and social dimensions of sustainability. As stakeholders work toward the SDGs, the U.N. will measure progress using existing data where possible. Existing data sources for tracking some of the SDGs may include countries' PRTR data.

Project Focus. The U.N. SDG Target 12.4 EXIT was identified as most relevant to PRTR data; it focuses on reducing chemical releases to the environment.

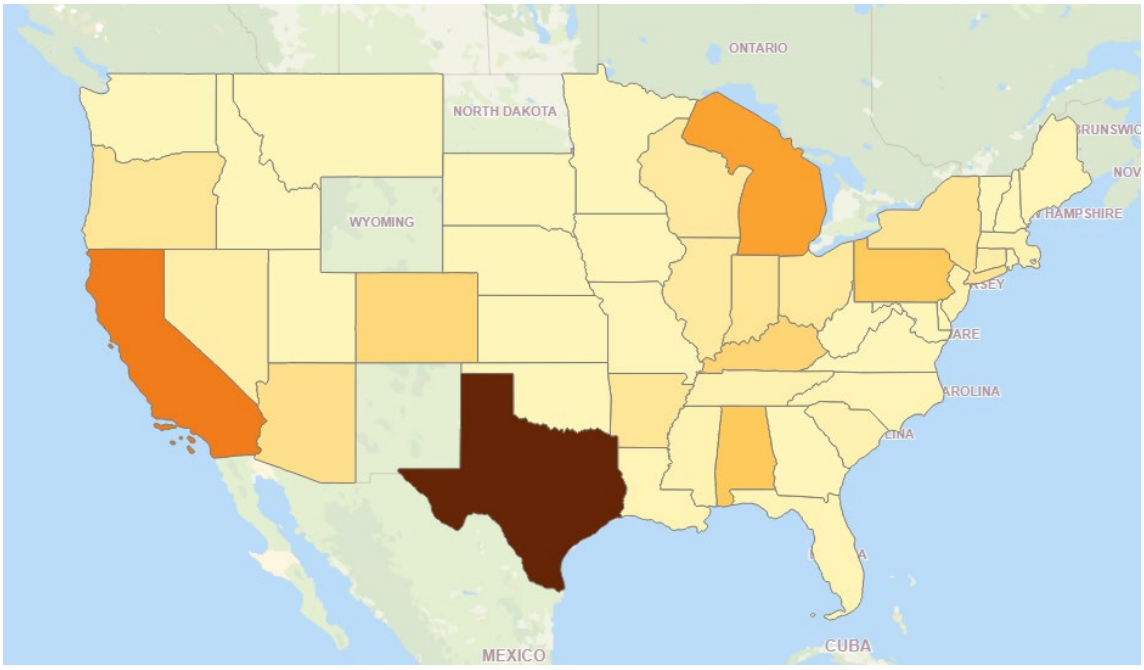
Project Status. OECD published the project report EXIT (including Spanish and Japanese versions of the Executive Summary) based on aggregated data for 14 chemicals from multiple countries to assess progress toward achieving SDG Target 12.4. EPA is working with OECD to define the next steps for building this work. Users can explore the report's underlying data using the interactive data tool on the OECD PRTR webpage.



Note: PRTRs included in the analyses: Australia – National Pollutant Inventory (NPI), Canada – National Pollutant Release Inventory (NPRI), Chile – Registro de Emisiones y Transferencia de Contaminantes (RETC), European Union – European Pollutant Release and Transfer Register (E-PRTR), Japan Pollutant Release and Transfer Register (PRTR), Mexico – Registro de Emisiones y Transferencia de Contaminantes (RETC), United States – Toxics Release Inventory (TRI). *Chemicals included in the analyses*: 1,2-Dichloroethane, Benzene, Cadmium, Chromium, Di-(2-ethylhexyl) phthalate, Dichloromethane, Ethylbenzene, Mercury, Nickel, Particulate matter, Styrene, Sulfur oxides, Tetrachloroethylene, Trichloroethylene.

Mapping Cross-Border Transfers

Facilities must report on the TRI chemicals in wastes they transfer off site for further management at other facilities, including how the chemicals are managed off site and the name and address of the receiving facility. This interactive map shows states with TRI facilities that shipped waste containing TRI chemicals outside of the U.S. Click on a state for more information on these cross-border transfers. Explore the data in more depth in the full TRI National Analysis Dashboard.

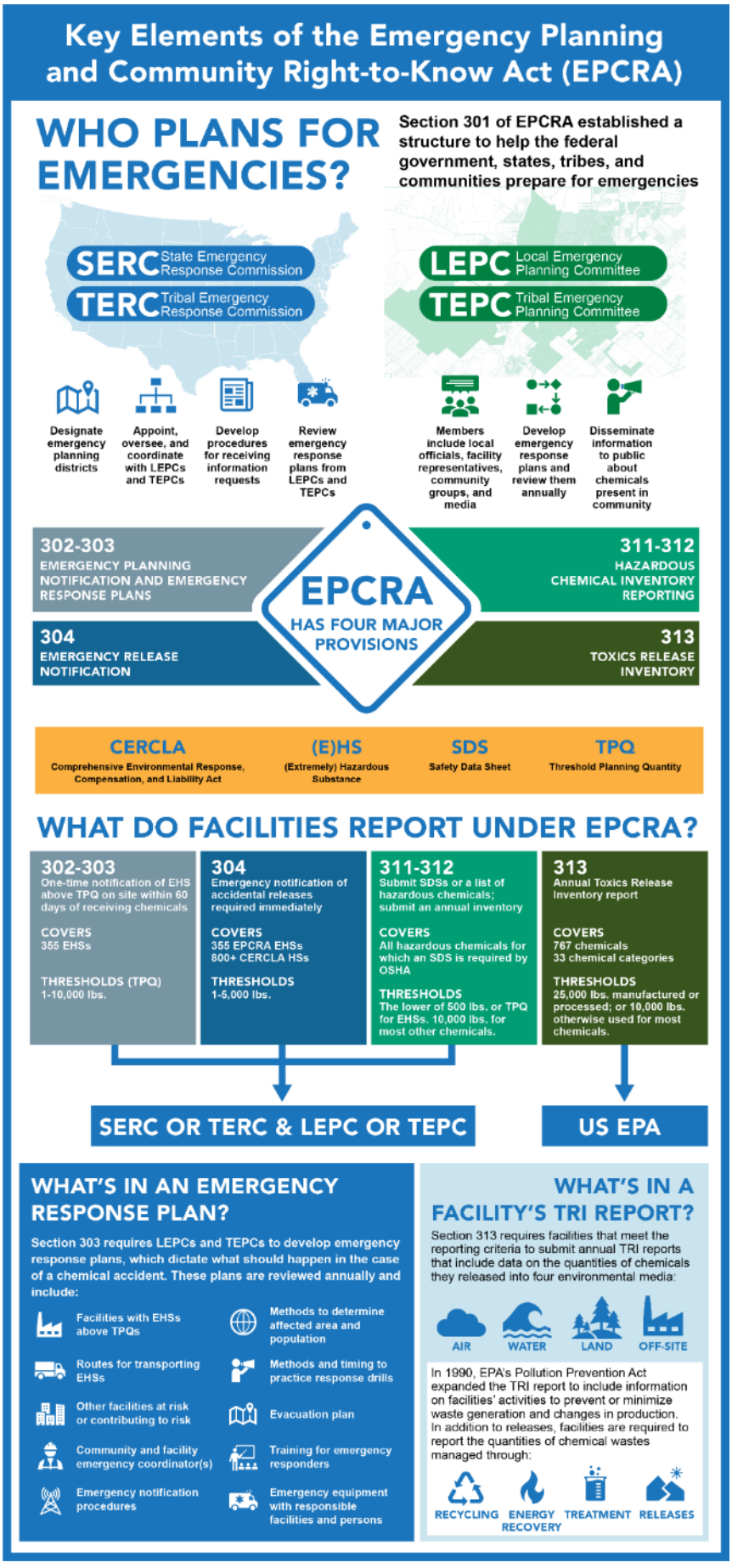


- Transfers of TRI chemical waste to Mexico and Canada accounted for 78% of all cross-border transfers by weight for 2021.
    - Almost all TRI chemical waste transfers (99%) to Mexico were for recycling, primarily of metals and metal compounds. Zinc made up 74% of all transfers to Mexico by weight.
    - Most transfers to Canada were from northeastern and midwestern states. About two-thirds of the TRI chemicals sent to Canada were transferred for recycling. Transfers to Canada were mostly of metals (e.g., copper, manganese) and chemicals commonly used as solvents (e.g., methanol, acetonitrile).
- The North American Commission for Environmental Cooperation (CEC) is an international collaboration between the U.S., Canada, and Mexico focused on environmental issues of common interest. Among other activities, the CEC maintains a database of cross-border transfers among Canada, the U.S., and Mexico based on data from TRI and similar programs in Canada and Mexico.

More on EPCRA

The Emergency Planning and Community Right-to-Know Act (EPCRA) was created in response to what is widely considered the worst industrial chemical disaster in history. Beginning on December 2, 1984, methyl isocyanate gas was accidentally released from a chemical plant in Bhopal, India. That night, thousands of people died and many more were injured. In the following months and years, thousands more died, and survivors of the accident continue to suffer with permanent disabilities. Approximately six months after the Bhopal accident, a serious chemical release occurred at a similar plant in West Virginia. These two events raised concern about lack of local preparedness for chemical emergencies and the availability of information on toxic chemicals.

EPCRA establishes requirements for federal, state and local governments, Indian tribes, and industry regarding **emergency planning** and **"Community Right-to-Know" reporting** on hazardous and toxic chemicals. These requirements are specified in EPCRA's four major provisions, as shown in the figure below. Information collected under EPCRA helps states, tribes, and local communities understand potential chemical hazards at individual facilities and in surrounding neighborhoods. The TRI supports the goals of EPCRA by making information about the management of toxic chemicals available to the public. This information supports informed decision-making by companies, government agencies, non-governmental organizations, communities, and others.

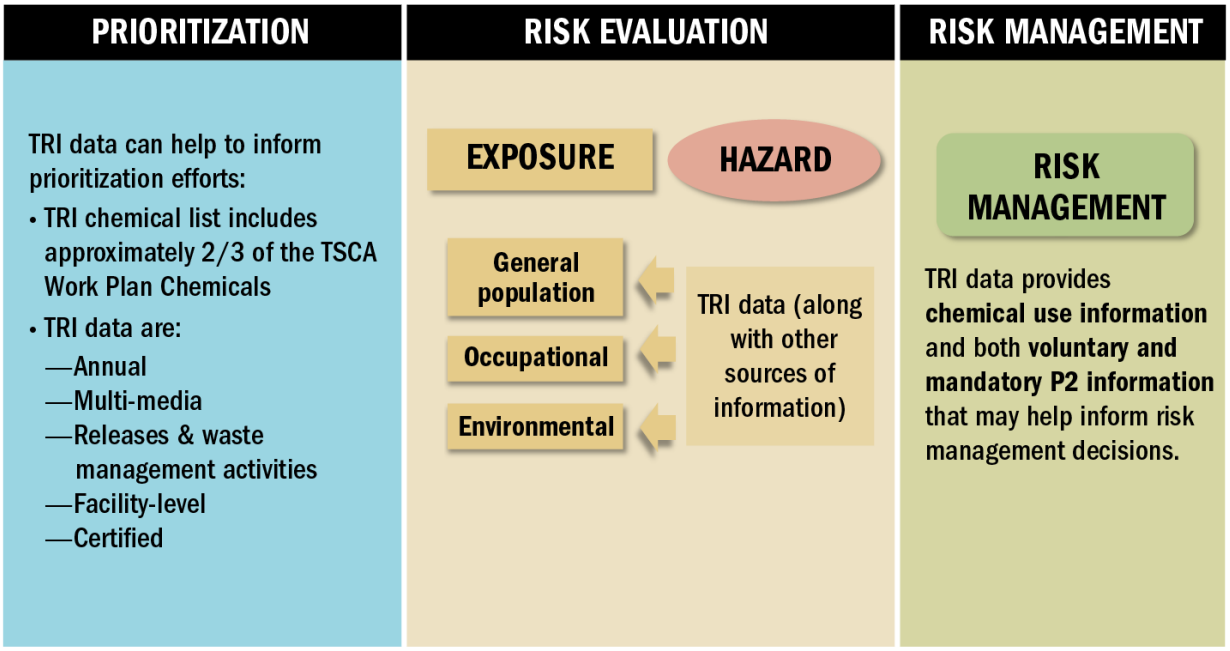

Key Elements of the Emergency Planning and Community Right-to-Know Act (EPCRA)
WHO PLANS FOR EMERGENCIES?
Section 301 of EPCRA established a structure to help the federal government, states, tribes, and communities prepare for emergencies
SERC State Emergency Response Commission
TERC Tribal Emergency Response Commission
LEPC Local Emergency Planning Committee
TEPC Tribal Emergency Planning Committee
Designate emergency planning districts
Appoint, oversee, and coordinate with LEPCs and TEPCs
Develop procedures for receiving information requests
Review emergency response plans from LEPCs and TEPCs
Members include local officials, facility representatives, community groups, and media
Develop emergency response plans and review them annually
Disseminate information to public about chemicals present in community
EPCRA HAS FOUR MAJOR PROVISIONS
302-303 EMERGENCY PLANNING NOTIFICATION AND EMERGENCY RESPONSE PLANS
304 EMERGENCY RELEASE NOTIFICATION
311-312 HAZARDOUS CHEMICAL INVENTORY REPORTING
313 TOXICS RELEASE INVENTORY
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
(E)HS (Extremely) Hazardous Substance
SDS Safety Data Sheet
TPQ Threshold Planning Quantity
WHAT DO FACILITIES REPORT UNDER EPCRA?
302-303 One-time notification of EHS above TPQ on site within 60 days of receiving chemicals
COVERS 355 EHSs
THRESHOLDS (TPQ) 1-10,000 lbs.
304 Emergency notification of accidental releases required immediately
COVERS 355 EPCRA EHSs 800+ CERCLA HSs
THRESHOLDS 1-5,000 lbs.
311-312 Submit SDSs or a list of hazardous chemicals; submit an annual inventory
COVERS All hazardous chemicals for which an SDS is required by OSHA
THRESHOLDS The lower of 500 lbs. or TPQ for EHSs. 10,000 lbs. for most other chemicals.
313 Annual Toxics Release Inventory report
COVERS 767 chemicals 33 chemical categories
THRESHOLDS 25,000 lbs. manufactured or processed; or 10,000 lbs. otherwise used for most chemicals.
SERC OR TERC & LEPC OR TEPC
US EPA
WHAT'S IN AN EMERGENCY RESPONSE PLAN?
Section 303 requires LEPCs and TEPCs to develop emergency response plans, which dictate what should happen in the case of a chemical accident. These plans are reviewed annually and include:
Facilities with EHSs above TPQs
Routes for transporting EHSs
Other facilities at risk or contributing to risk
Community and facility emergency coordinator(s)
Emergency notification procedures
Methods to determine affected area and population
Methods and timing to practice response drills
Evacuation plan
Training for emergency responders
Emergency equipment with responsible facilities and persons
WHAT'S IN A FACILITY'S TRI REPORT?
Section 313 requires facilities that meet the reporting criteria to submit annual TRI reports that include data on the quantities of chemicals they released into four environmental media:
AIR
WATER
LAND
OFF-SITE
In 1990, EPA's Pollution Prevention Act expanded the TRI report to include information on facilities' activities to prevent or minimize waste generation and changes in production. In addition to releases, facilities are required to report the quantities of chemical wastes managed through:
RECYCLING
ENERGY RECOVERY
TREATMENT
RELEASES

TSCA and TRI

The Toxic Substances Control Act (TSCA), as amended by the Frank R. Lautenberg Chemical Safety for the 21st Century Act, is the nation's primary chemicals management law and requires EPA to evaluate the safety of chemicals in commerce. Many of the chemicals EPA selects for evaluation are from the 2014 Update to the TSCA Work Plan, which helps focus and direct EPA's activities. The Agency is required to conduct a transparent, risk-based evaluation process. TRI data serve as an important source of chemical and environmental information for assessing and managing chemicals under TSCA.

The three stages of EPA's process for evaluating the safety of existing chemicals (shown in the graphic below) are prioritization, risk evaluation, and risk management. EPA first **prioritizes** chemicals in commerce through a risk-based screening process. The agency then **evaluates** those chemicals to determine if they present unreasonable risks, and—if EPA identified unreasonable risks—**manages** these risks to protect health and the environment. TRI data may be used for each step in this process.

TRI Data Use in TSCA Chemical Evaluations



Prioritization. Approximately two-thirds of the chemicals identified in the 2014 update of the TSCA Work Plan are also included on the TRI list of chemicals. TRI data can inform EPA's prioritization of chemicals for risk evaluation because the data are collected annually and include facility locations and quantities of TRI chemicals released to air, water, and land, and transferred to off-site locations. In addition, trend analyses of TRI data can help identify

changes over time in the location and quantities of releases, and the types of industrial sectors managing these chemicals.

Risk evaluation. A TSCA risk evaluation of a chemical is a comprehensive evaluation of the risks the chemical poses to human health and the environment. EPA evaluates how the chemical is used during its life cycle, which may include manufacturing, importing, processing, use, distribution in commerce, and disposal. During risk evaluation, EPA is required to assess hazards of and exposures to the chemical in the workplace, to the general population and to environmental receptors (such as plants and animals). TRI and other data are used to support these assessments under TSCA.

Risk Management. If EPA determines that the chemical or certain uses of the chemical pose an unreasonable risk to health or the environment, EPA will manage the risk through regulations or other risk management strategies. These regulatory actions and options may include labels with warnings and instructions for use, recordkeeping or notice requirements, restrictions on certain uses or activities to reduce exposure or environmental releases, or a ban of the chemical entirely. EPA may use TRI data, such as on chemical use and pollution prevention practices, to help inform these risk management decisions.

TSCA Risk Evaluation Update

In 2017, EPA published the scope documents for the initial ten chemicals undergoing risk evaluation under the amended TSCA, of which nine are TRI-reportable chemicals. EPA completed final risk evaluations for these chemicals in 2020 and is currently in the process of developing risk management rulemakings. This marks a major milestone for EPA in its efforts to ensure the safety of existing chemicals in the marketplace through its updated chemical management program.

In 2019, EPA also designated 20 high-priority chemicals to undergo risk evaluation. These chemicals are moving through the process required by TSCA to evaluate any unreasonable risks they may present to human health or the environment. In 2020, EPA published the final scope documents for these 20 high-priority chemical substances, of which 13 are TRI-reportable chemicals.