

Pollution Prevention and Waste Management

Each year, the EPA’s Toxics Release Inventory (TRI) Program receives information from more than 21,000 facilities on the quantities of TRI-listed chemicals they recycled, combusted for energy recovery, treated for destruction, and disposed of or otherwise released both on and off site as part of their normal operations. These quantities are collectively referred to as [production-related waste managed](#).

Looking at production-related waste managed over time helps track facilities’ progress in reducing the amount of chemical waste generated and in adopting waste management practices that are preferable to disposing of or otherwise releasing waste into the environment.

Pollution prevention (P2) is an essential component of sustainable manufacturing practices. EPA encourages facilities to first reduce or eliminate the use of TRI-listed chemicals and the creation of chemical waste through source reduction, or P2, activities such as material substitutions and process modifications. For waste that is generated, the preferred management method is recycling, followed by combustion for energy recovery, treatment, and, as a last resort, disposal or other release of the chemical waste into the environment in a safe manner. This order of preference is consistent with the national policy established by the [Pollution Prevention Act of 1990](#), and is illustrated in the graphic above.



2020 Highlights

- TRI facilities implemented 2,779 new source reduction activities to reduce pollution at its source.
- Facilities managed 28.3 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 5.0 billion pounds (22%) since 2011, driven by a 6.6-billion-pound (76%) increase in recycling.

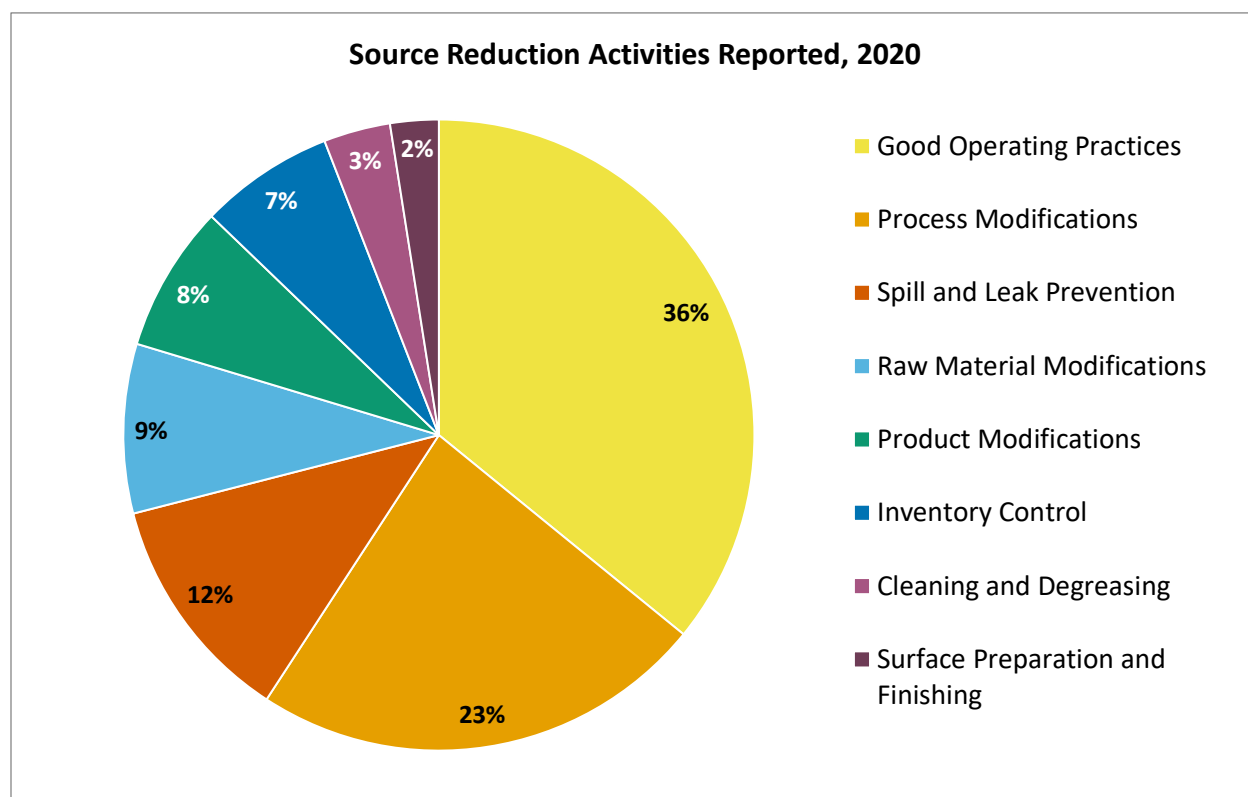
TRI Data Considerations

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

Source Reduction Activities

Facilities are required to report new source reduction activities that they initiated or fully implemented during the reporting year. Source reduction (P2) activities eliminate or reduce the use of TRI-listed chemicals and the creation of chemical waste. Other waste management practices, such as recycling and treatment, refer to how chemical waste is managed after it is created and are not source reduction activities.

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. For more information, see the [TRI Source Reduction Reporting Fact Sheet](#).



Note: Facilities report their source reduction activities by selecting from a list of codes that describe their activities. These codes fall into one of eight categories listed in the graph legend and are defined in the [TRI Reporting Forms and Instructions](#).

- In 2020, 1,188 facilities (6% of all facilities that reported to TRI) implemented a combined 2,779 new source reduction activities for 176 chemicals and chemical categories.
- For each chemical form submitted, facilities select from 49 types of source reduction activities across the eight categories shown in the graph. The most reported source reduction category is Good Operating Practices.

- For example, a motor vehicle parts manufacturer reduced the amount of nickel waste produced by implementing quality improvement procedures to reduce manufacturing defects. [[Click to view facility details in the TRI P2 Search Tool](#)]
- Facilities also report the methods by which they identified the source reduction opportunities. In 2020, the most reported methods were participative team management and internal pollution prevention audits.

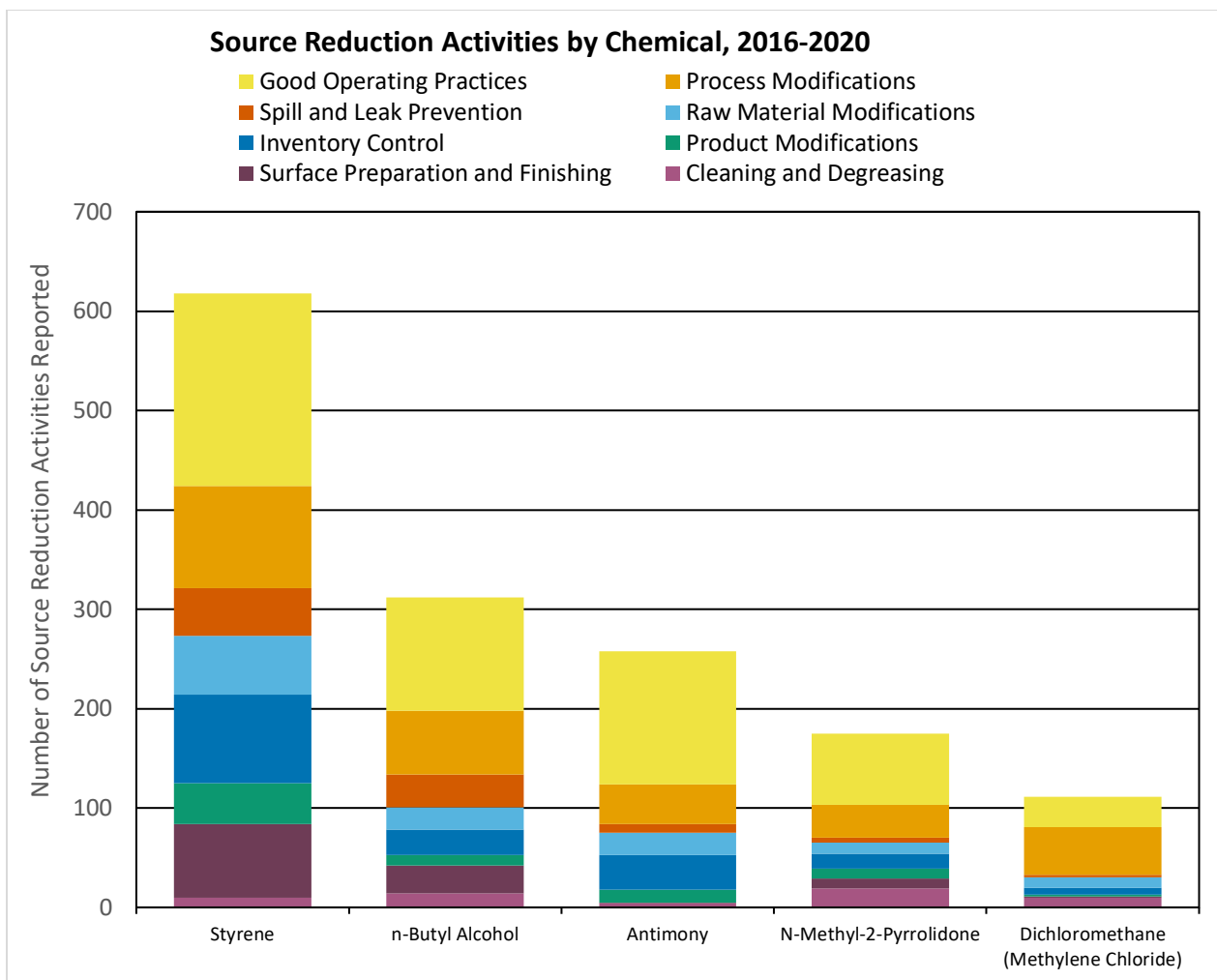
Additional Resources

- See the TRI [P2 Data Overview Factsheet](#) for more information on source reduction reporting in recent years.
- Note that 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 or subsidized P2 assessment with a P2 expert. Visit the [P2 Resources for Business webpage](#) for more information.

Source Reduction Activities by Chemical and Industry

Source Reduction Activities by Chemical

This figure shows 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 2016 to 2020. 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 codes that describe their activities. These codes fall into one of eight categories listed in the graph legend and are defined in the [TRI Reporting Forms and Instructions](#).

From 2016 to 2020:

- TRI facilities reported 19,224 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, N-methyl-2-pyrrolidone (NMP), and dichloromethane (DCM, also known as methylene chloride).
- The type of source reduction activities implemented for these chemicals varied depending on the chemicals' characteristics and how they are used. For example:
 - **Process Modifications**, including optimizing reaction conditions and modifying equipment, layout, or piping, can help reduce the amount of solvents such as dichloromethane (DCM) and *n*-butyl alcohol needed for a process.
 - **Raw Material 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 in electronics, batteries, and as a component of flame retardants.
 - **Inventory Control** includes activities to reduce excess stores of chemicals, reducing waste from disposal of expired materials. Chemicals such as styrene may degrade over time, especially when exposed to heat, light, or air.

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

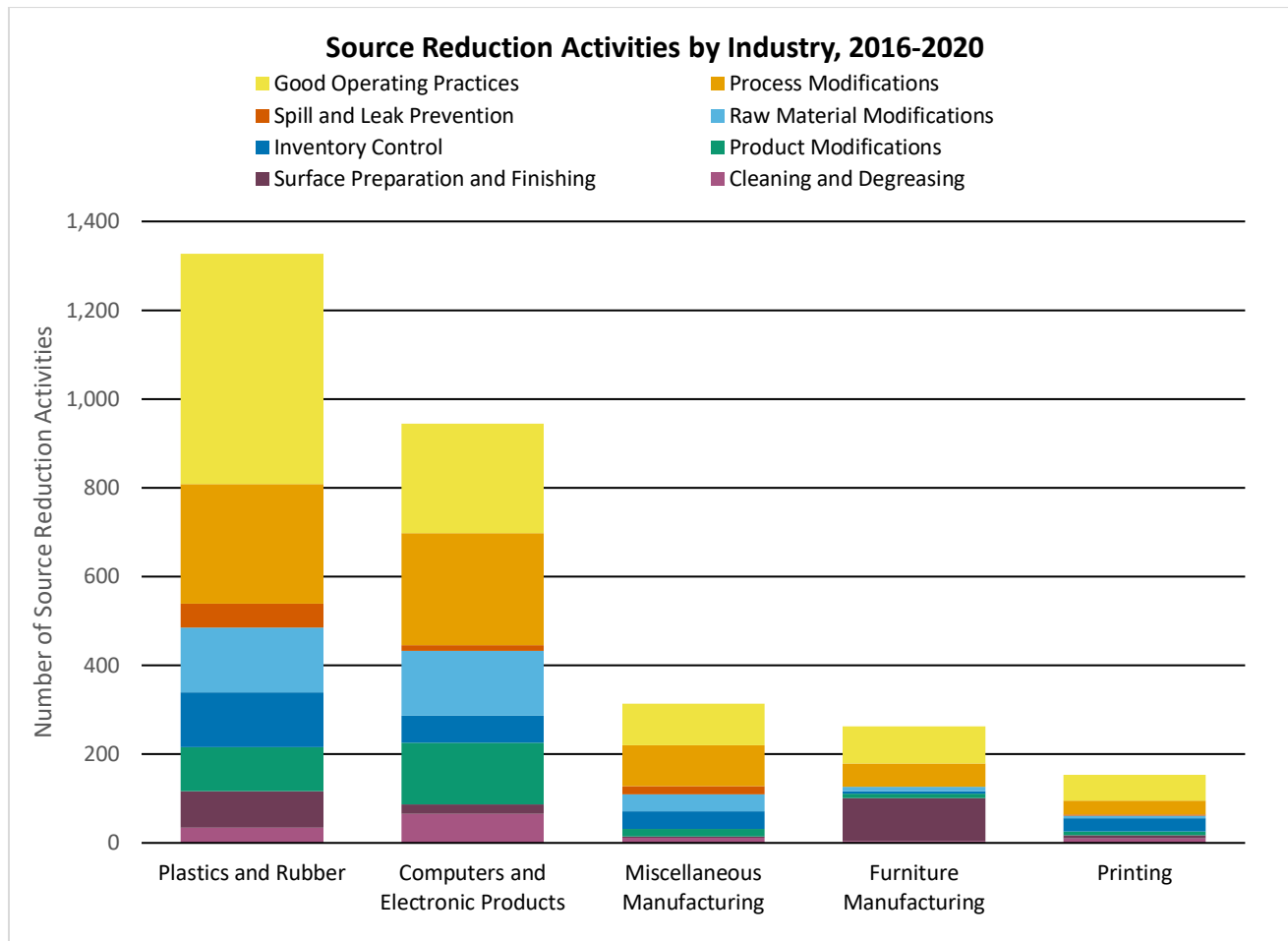
Examples of optional source reduction information for 2020:

- **Styrene:** A plastic products manufacturer reduced styrene waste by purchasing materials from their vendor with lower styrene content than their previous product. [[Click to view facility details in the TRI P2 Search Tool](#)]
- **Antimony and antimony compounds:** A plastic products manufacturer changed production schedules to reduce the amount of antimony scrap produced during product changeovers. [[Click to view facility details in the TRI P2 Search Tool](#)]
- ***n*-Butyl alcohol:** A kitchen cabinet manufacturer eliminated use of a solvent-based stain which contained *n*-butyl alcohol and switched to a water-based stain. [[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 industries with the highest source reduction reporting rates over the last five years by the types of activities these sectors implemented.



Note: 1) Limited to industries with at least 100 source reduction activities reported from 2016 to 2020. 2) Facilities report their source reduction activities by selecting from a list of codes that describe their activities. These codes fall into one of eight categories listed in the graph legend and are defined in the [TRI Reporting Forms and Instructions](#).

From 2016 to 2020:

- The five industry sectors with the highest source reduction reporting rates were plastics and rubber products, computers and electronic products, miscellaneous manufacturing (e.g., medical equipment), furniture manufacturing, and printing.
- For most sectors, Good Operating Practices was the most frequently reported type of source reduction activity. Other commonly reported source reduction activities varied by sector. For example, computers and electronic products manufacturers frequently

reported modifications to their raw materials and products, 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 2020:

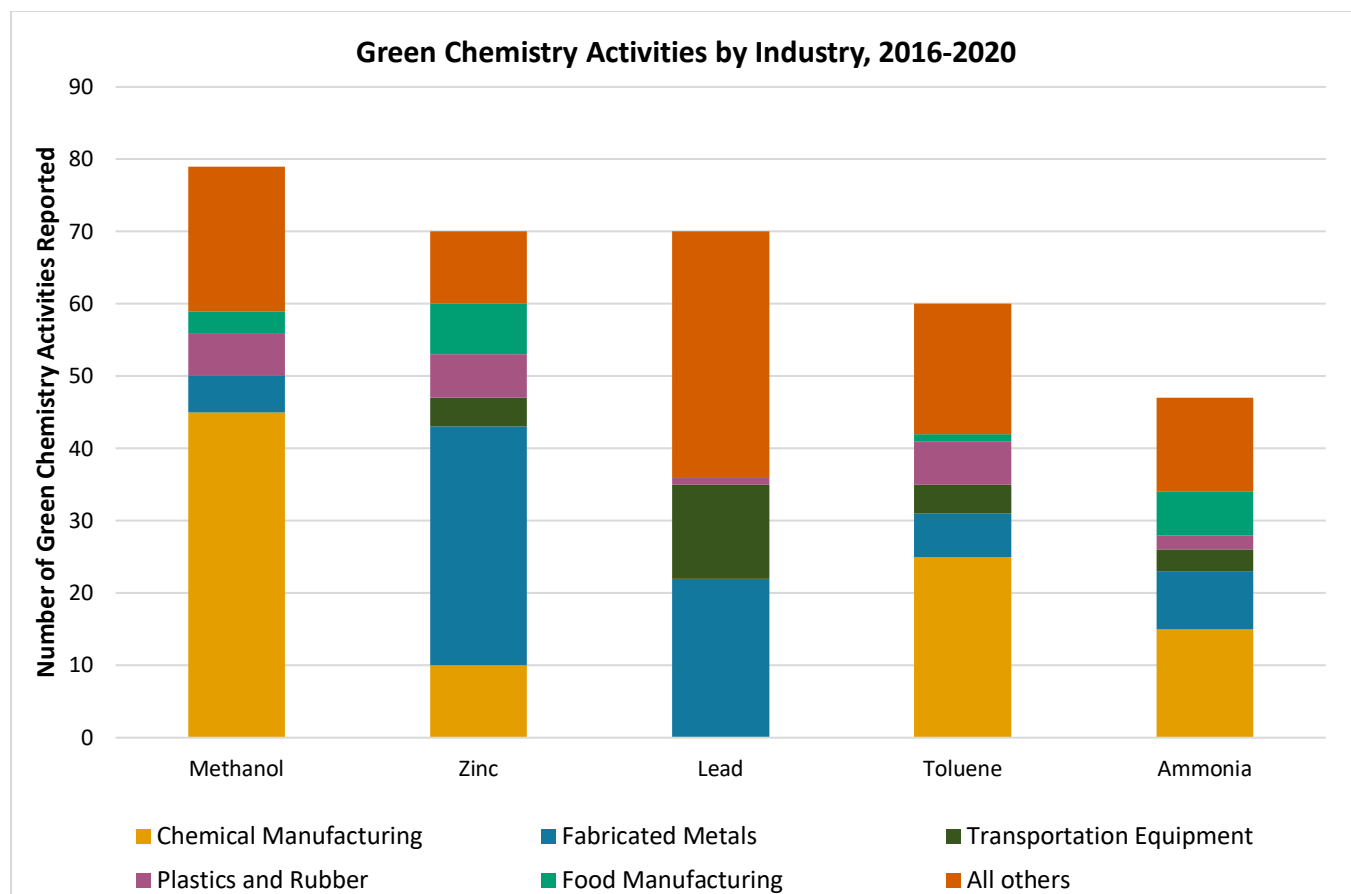
- **Plastics and Rubber Products Manufacturing:** A plastic products manufacturer reduced its ethylbenzene waste by replacing ethylbenzene in paints and solvents with a more environmentally friendly option. [[Click to view facility details in the TRI P2 Search Tool](#)]
- **Miscellaneous Manufacturing:** A surgical and medical instrument manufacturer reduced nitric acid waste by implementing software improvements to reduce downtime. [[Click to view facility details in the TRI P2 Search Tool](#)]
- **Furniture Manufacturing:** A wood cabinet manufacturer replaced a line of colors with new colors which contain little to no xylene compared with the old line. [[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 chemical products that are safer and processes that use safer inputs, minimal energy and are efficient (i.e., minimize the creation of waste). In the waste management hierarchy, green chemistry is one way to achieve source reduction. Advancements in green chemistry allow industry to prevent pollution at its source by, for example, designing or modifying manufacturing processes to optimize use of resources and reduce the creation of TRI chemical waste.

Six of the TRI source reduction codes facilities can choose from are specific to green chemistry activities, although green chemistry practices may also fit under other codes. This figure shows the chemicals where facilities implemented green chemistry practices at the highest rates over the last five years by sector. Several examples follow the figure.



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

- Since 2016, facilities have reported 1,011 green chemistry activities for 109 TRI chemicals and chemical categories.

- Green chemistry activities were reported most frequently for methanol, zinc and zinc compounds, lead and lead compounds, toluene, and ammonia.
- 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, toluene, and ammonia. For example:
 - An adhesives manufacturer removed methanol from most of its product formulations by replacing it with another, not TRI-reportable, chemical. [[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 metal anodizing, plating, and polishing facility installed an electronic Key Performance Indicator board to monitor cycle time and reduce the amount of zinc used per cycle. [[Click to view facility details in the TRI P2 Search Tool](#)]

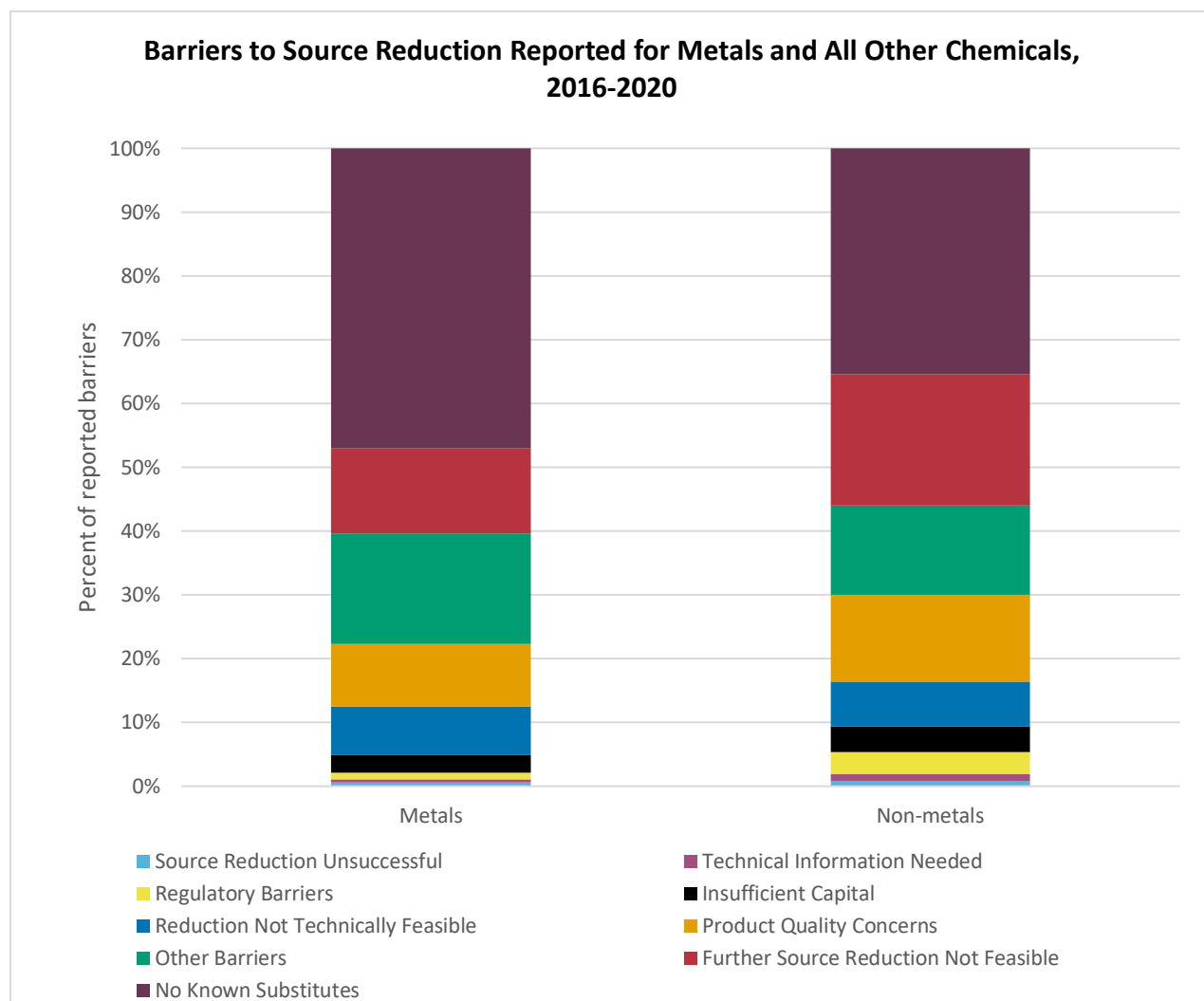
Additional Resources

Source reduction activities such as green chemistry activities are the preferred way to reduce the creation of chemical wastes. 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*](#).

Reported Barriers to Source Reduction

Facilities also 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 that have knowledge of source reduction practices and those that are seeking additional assistance. This figure shows the types of barriers facilities reported for metals and for all other (non-metal) TRI chemicals.



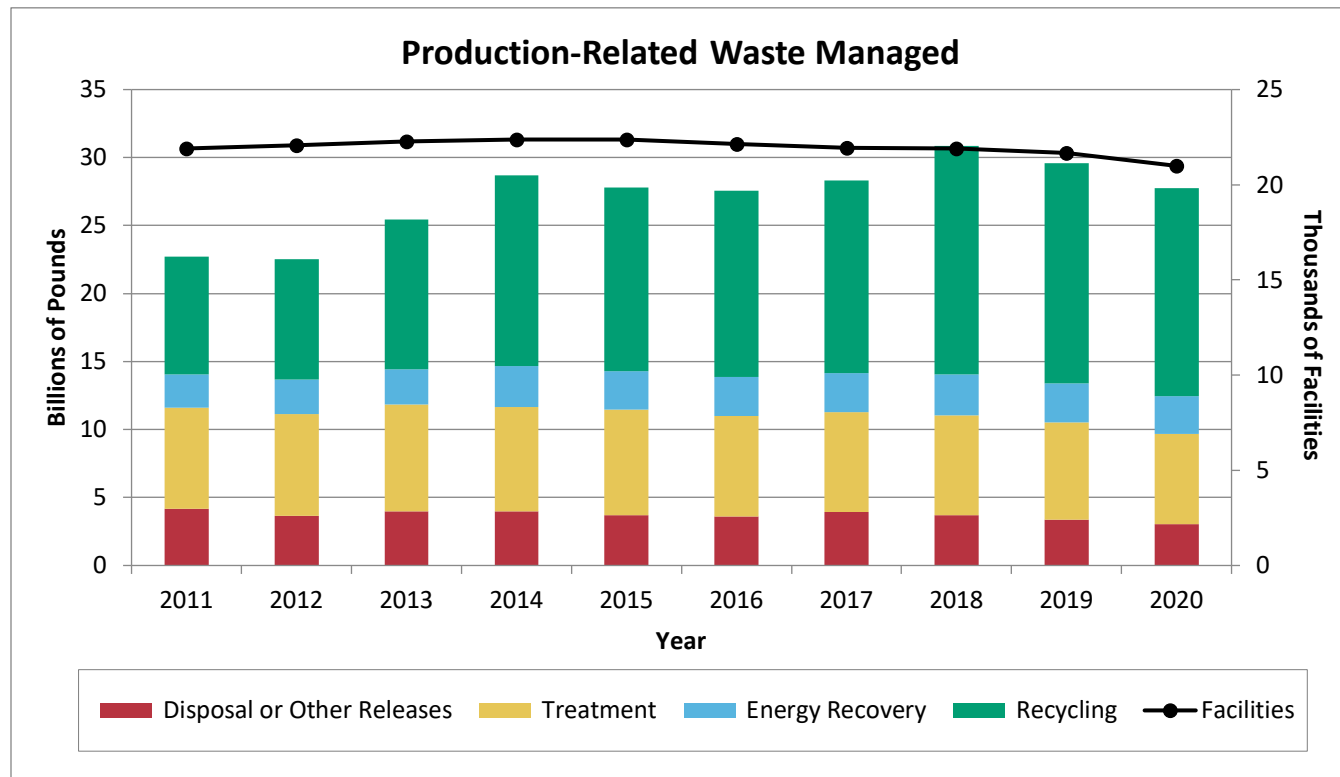
Note: Facilities have the option to report barriers to source reduction by selecting from nine codes. These codes are defined in the [TRI Reporting Forms and Instructions](#).

From 2016 to 2020:

- Facilities reported barriers to implementing source reduction for 329 chemicals and chemical categories.
- The barrier *no known substitutes* was the most frequently reported barrier for both metals and non-metals.
- 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 why they could not implement source reduction activities. Examples include:
 - An iron and steel mill reported that mercury is contained in trace quantities in the scrap used for steel production and no equivalent substitutes are available. [[Click to view facility details in the TRI P2 Search Tool](#)]
 - An organic chemical manufacturer reported that chromium is a component of a catalyst that does not currently have a viable alternative based on process limitations. [[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 glass container manufacturer reported that it is already maximizing the use of recycled glass, or cullet, to reduce lead-containing waste and lead emissions from production, and that further reductions are not feasible. [[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](#).

Waste Management

Facilities report the quantities of TRI-listed chemicals they dispose of or otherwise release into the environment as a result of normal industrial operations. In addition, facilities report the quantities of these chemicals that they manage through preferred methods including recycling, combusting for energy recovery, and treating for destruction. This figure shows the 10-year trend in these quantities, collectively referred to as [production-related waste managed](#).



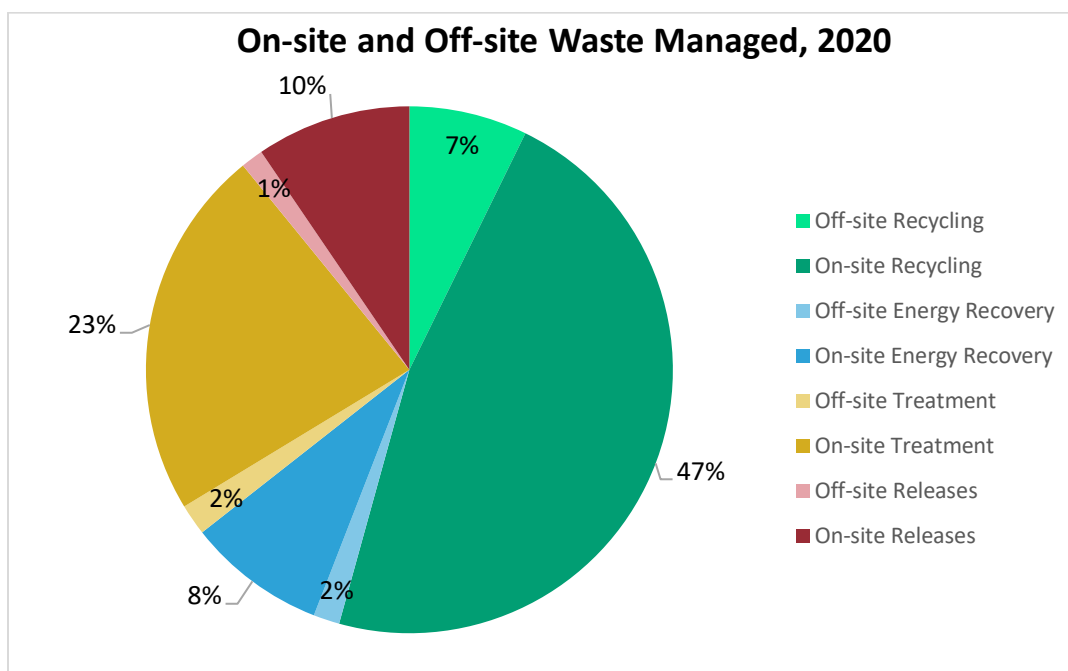
Note: For comparability, trend graphs include only those chemicals that were reportable to TRI for all years presented.

From 2011 to 2020:

- Since 2011, production-related waste managed increased by 5.0 billion pounds (22%), driven by increased recycling.
 - Disposal and other releases decreased by 1.1 billion pounds (-27%).
 - Treatment decreased by 793 million pounds (-11%).
 - Energy recovery increased by 298 million pounds (12%).
 - Recycling increased by 6.6 billion pounds (76%), 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 4% since 2011. 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.
- Note that the 2020 TRI data reflect chemical waste management activities that occurred during calendar year 2020, which may have been impacted by the COVID-19 public health emergency, which began in the U.S. in early 2020.

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 2020.



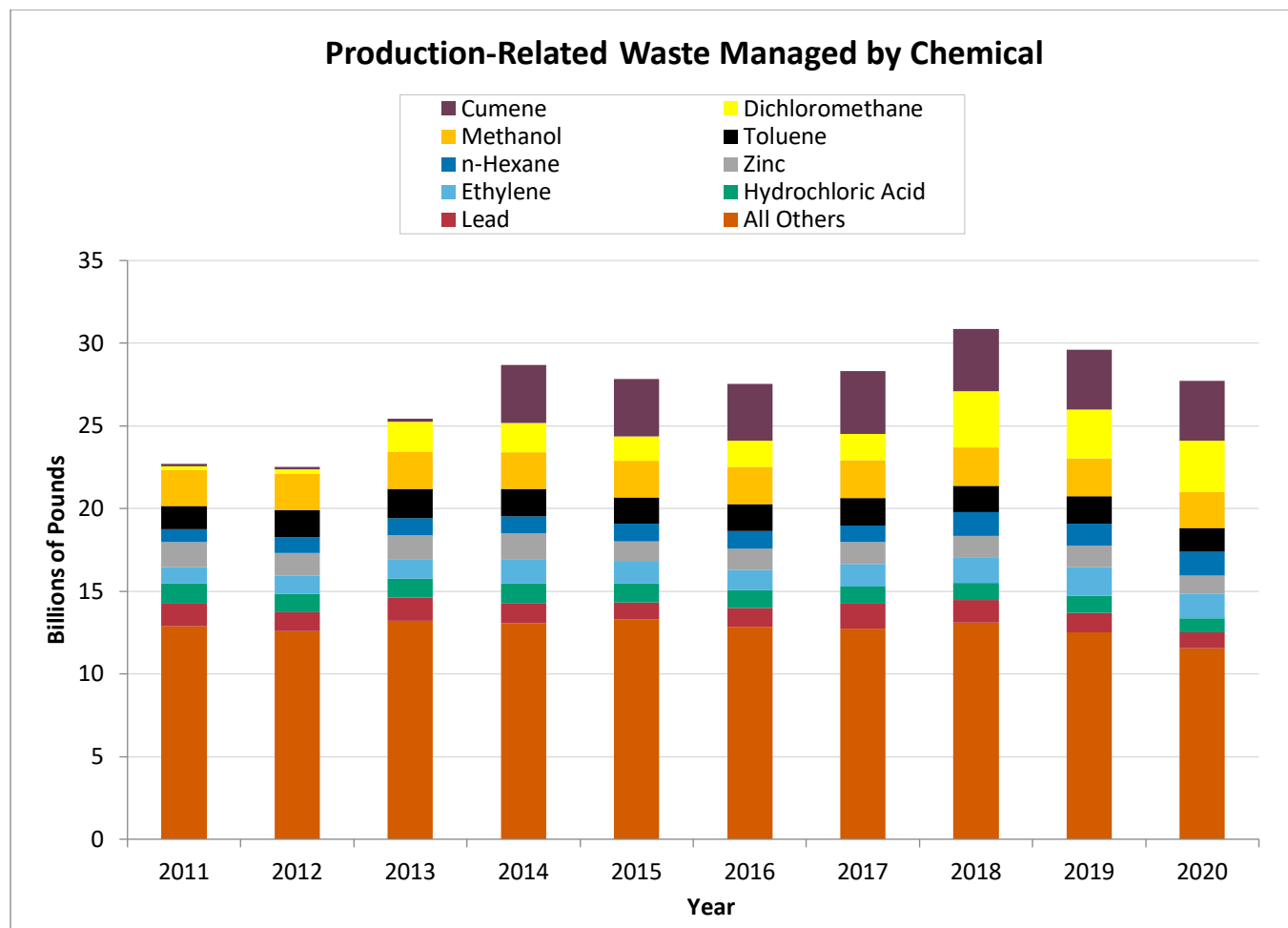
For 2020, 88% of production-related waste was managed on site.

- 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 off site for recycling.
- The 2020 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 that were managed as waste in the greatest quantities from 2011 to 2020.



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 2011 to 2020:

- Facilities reported production-related waste managed for more than 500 chemicals and chemical categories from 2011 to 2020. The chart above shows the nine chemicals that had the largest quantities of production related waste. Together, management of these chemicals represents 53% of the total production-related waste quantities reported to TRI.

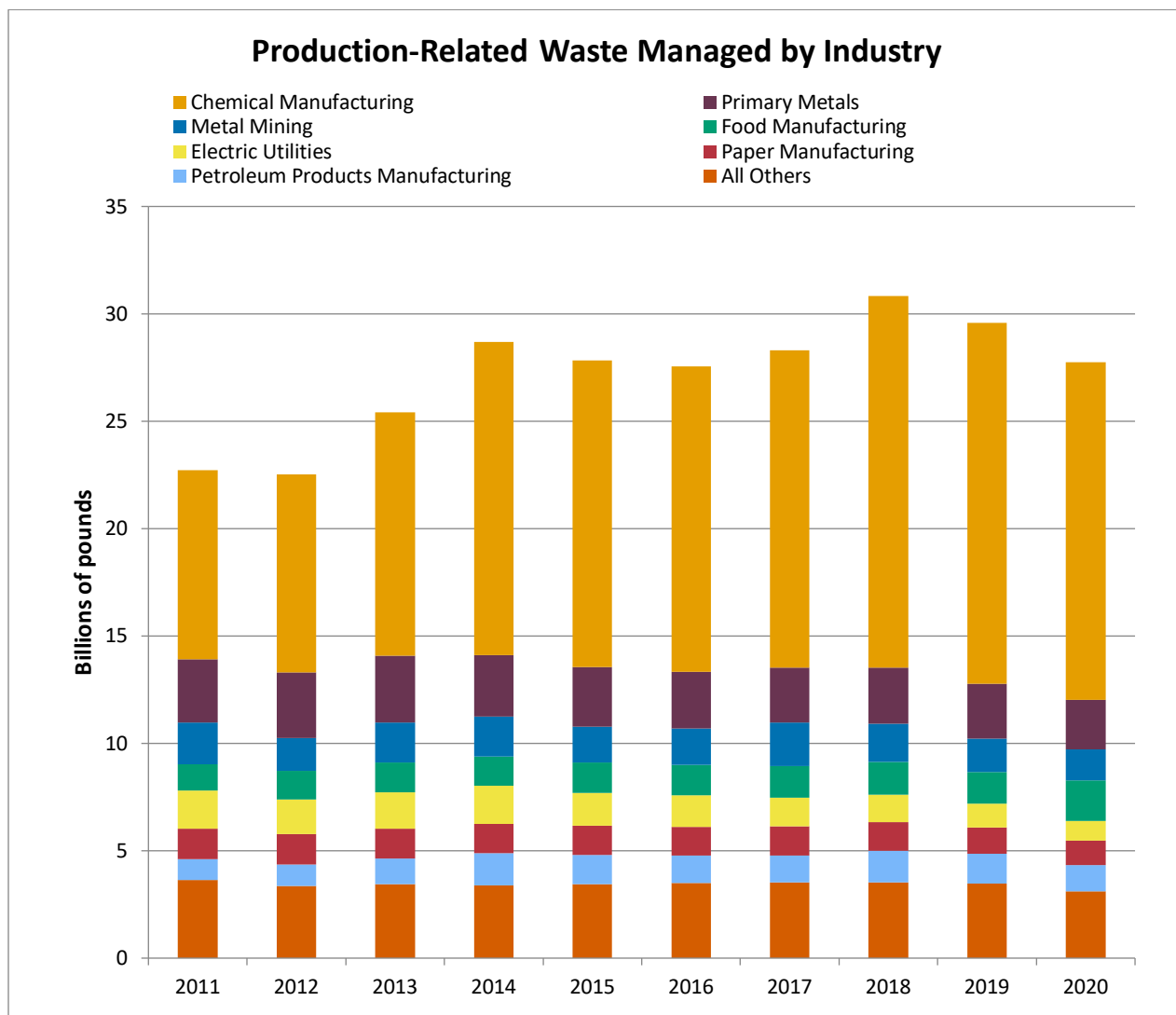
- Of the chemicals shown above, facilities reported increased quantities of waste managed for: cumene, methanol, dichloromethane (methylene chloride), toluene, ethylene, and *n*-hexane.
 - Waste managed of ethylene increased by 471 million pounds (47%).
 - Dichloromethane waste managed increased over 10-fold, due to 2 facilities that started recycling large quantities of the chemical, one starting in 2013 and the other starting in 2018.
 - Cumene recycling increased over 20-fold, mostly driven by one facility reporting recycling over 3.4 billion pounds of cumene annually from 2014 to 2020. [[Click to view facility details in the TRI P2 Search Tool](#)]
 - *n*-Hexane waste managed increased by 630 million pounds (78%) mostly driven by one soybean processing facility which has reported more than 750 million pounds of *n*-hexane recycling annually since 2012. [[Click to view facility details in the TRI P2 Search Tool](#)]
 - Methanol waste managed increased by 12.6 million pounds (1%)
 - Toluene waste managed increased by 51.8 million pounds (4%)

From 2019 to 2020:

- Quantities of TRI chemical waste decreased for numerous chemicals, including:
 - Ethylene decreased by 305 million pounds (-17%)
 - Lead and lead compounds decreased by 237 million pounds (-20%)
 - Toluene decreased by 214 million pounds (-13%)
 - Zinc and zinc compounds decreased by 144 million pounds (-11%)
 - Hydrochloric acid decreased by 144 million pounds (-14%)
 - Methanol decreased by 92 million pounds (-4%)
- Quantities of TRI chemical waste managed increased for other chemicals including:
 - Dichloromethane waste increased by 130 million pounds (4%)
 - *n*-Hexane increased by 100 million pounds (8%)
- Quantities of cumene waste managed remained about the same (<1% change).

Waste Managed by Industry

This figure shows the industry sectors that managed the most TRI chemical waste from 2011 to 2020.



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

From 2011 to 2020:

- The percent contribution of each of the top sectors to production-related waste managed has remained relatively constant since 2011 with the exception of chemical manufacturing, which accounted for 39% of all production-related waste managed in 2011 and increased to 57% in 2020.
- Three of the sectors shown in the graph increased their quantity of waste managed:

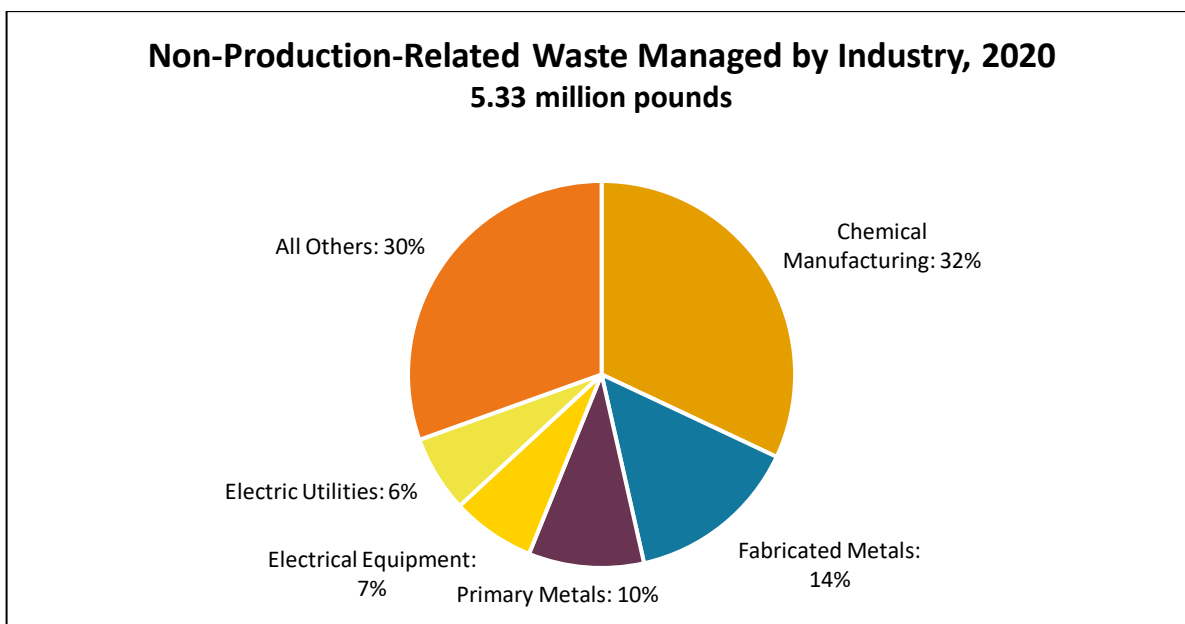
- Chemical manufacturing increased by 6.9 billion pounds (79%)
- Food manufacturing increased by 700 million pounds (58%)
- Petroleum products manufacturing increased by 260 million pounds (27%)
- The quantity of waste generated in some industries fluctuates considerably from year to year due to changes 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 2019 to 2020:

- Industry sectors that reported the greatest changes in waste management quantities were:
 - Chemical manufacturing decreased by 1.1 billion pounds (-7%)
 - Petroleum products manufacturing decreased by 556 million pounds (-29%), mostly driven by decreases in quantities of hydrogen sulfide treated. Note that hydrogen sulfide was not reported prior to reporting year 2012 and is not included in the chart above.
 - Food manufacturing increased by 452 million pounds (31%)

Non-Production-Related Waste

Non-production-related waste refers to quantities of Toxics Release Inventory (TRI) chemicals disposed of or released, or transferred off site for disposal, treatment, energy recovery, or recycling, as the result of one-time events rather than due to standard production activities. These events may include remedial actions, catastrophic events such as natural disasters, or other one-time events not associated with normal production processes. Non-production-related waste is included in a facility’s total disposal or other releases but is not included in its production-related waste managed. The following graph shows the quantities of non-production-related waste reported to TRI for 2020.



- For 2020, 479 facilities reported a total of 5.3 million pounds of one-time, non-production-related releases of TRI chemicals. This represents 0.02% of total waste managed in 2020.
- Non-production-related waste from all facilities has been below 20 million pounds every year since 2011, except for 2013 when one facility reported a one-time release of 193 million pounds.



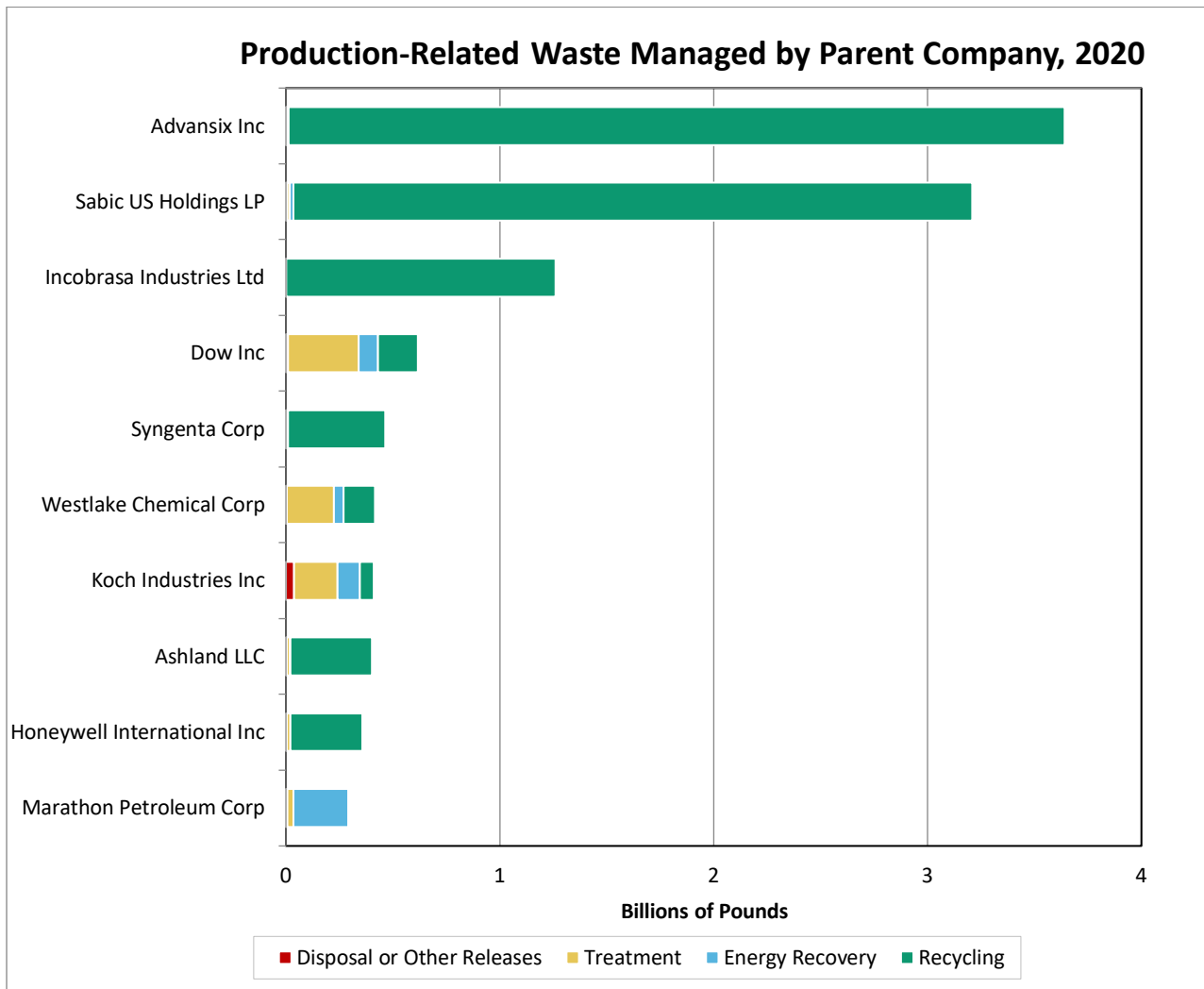
Waste Managed by Parent Company

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.

Waste Managed by Parent Company

This figure shows the parent companies whose facilities reported the most production-related waste managed for 2020. 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 types or degree of source reduction opportunities as the activities at manufacturing facilities.

Note that these manufacturing facilities manage most of their waste through EPA's preferred waste management methods—recycling, energy recovery, or treatment—rather than releasing it into the environment.



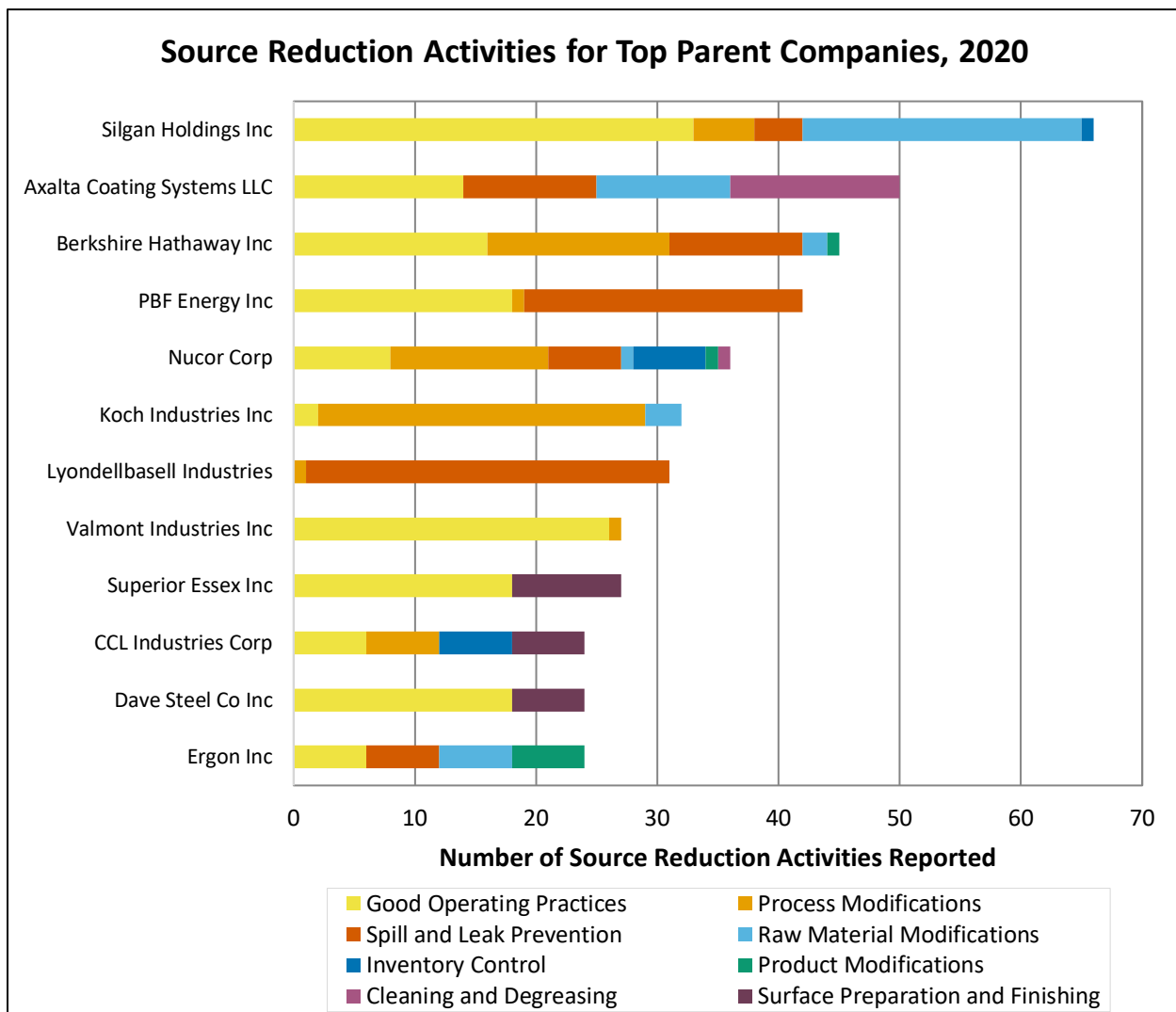
Notes: 1) This figure uses EPA's standardized parent company names. 2) To view facility counts by parent company, hover over the bar graph. 3) One facility, Incobrasa Industries Ltd, does not report a parent company but it is included in this figure because it reported a comparable quantity of production-related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

Four of these parent companies reported implementing new source reduction activities in 2020. Some reported additional (optional) descriptive information about their source reduction activities. For example, a Honeywell International Inc. facility trains and qualifies manufacturing employees on manufacturing processes and chemical use to conserve chemicals and sustain product quality. [[Click to view facility details in the TRI P2 Search Tool](#)]

Source Reduction Activities by Parent Company

This figure shows the parent companies whose facilities implemented the most source reduction activities for 2020. 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.

Facilities report their source reduction activities by selecting codes that describe their activities. These codes fall into one of eight categories listed in the graph legend and are defined in the [TRI Reporting Forms and Instructions](#).



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



Good Operating Practices, such as improving maintenance scheduling and installation of quality monitoring systems, are the most commonly reported types of source reduction activities for these parent companies. Spill and Leak Prevention and Process Modifications are also commonly reported.

Some of the facilities in these parent companies submitted additional optional text in their TRI reporting forms that describes their pollution prevention activities. For example, a plastics material and resin manufacturing facility owned by Berkshire Hathaway Inc. electropolished thermowells to smooth the surfaces and prevent product build-up that would become waste.

[\[Click to view facility details in the TRI P2 Search Tool\]](#)

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.](#)