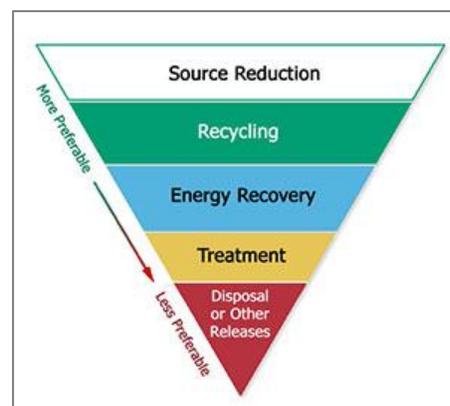


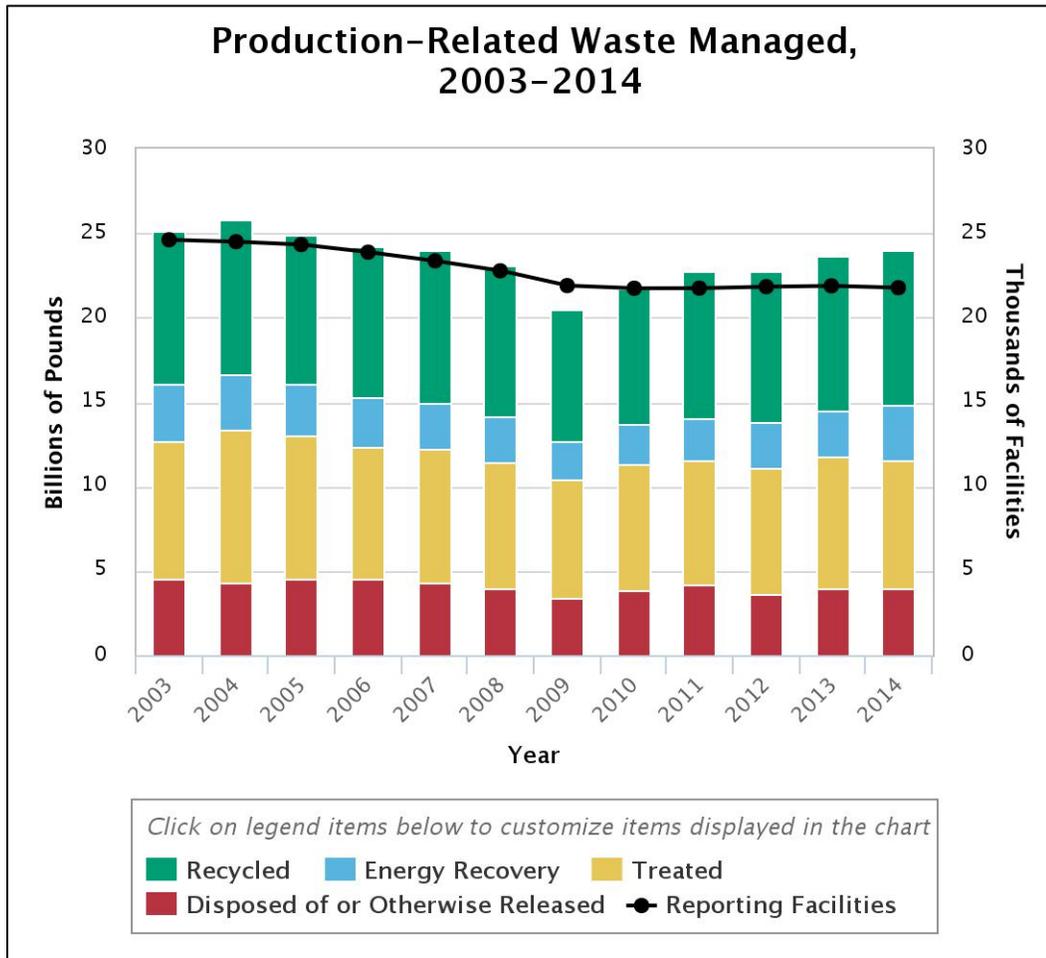
Pollution Prevention and Waste Management

The Toxics Release Inventory (TRI) collects information from facilities on the quantities of toxic chemicals they recycle, combust for energy recovery, treat for destruction, and dispose of or otherwise release on- and off-site. These quantities, in aggregate, are collectively referred to as the quantity of production-related waste managed.

Looking at production-related waste managed over time helps track progress in reducing waste generation and moving toward preferred waste management practices. EPA encourages facilities to first eliminate waste at its source. For waste that is generated, the preferred management method is recycling, followed by burning for energy recovery, treating, and, as a last resort, disposing of or otherwise releasing the waste into the environment. These waste management priorities are illustrated in the waste management hierarchy established by the Pollution Prevention Act (PPA) of 1990. The goal is that, when possible, facilities will shift over time from disposal or other releases toward the preferred techniques in the waste management hierarchy. For the graphs depicting TRI trends over time, 2003 is used as the base year because it is the earliest year in which the reporting requirements are nearly consistent with the current reporting year.



Waste Management Trends

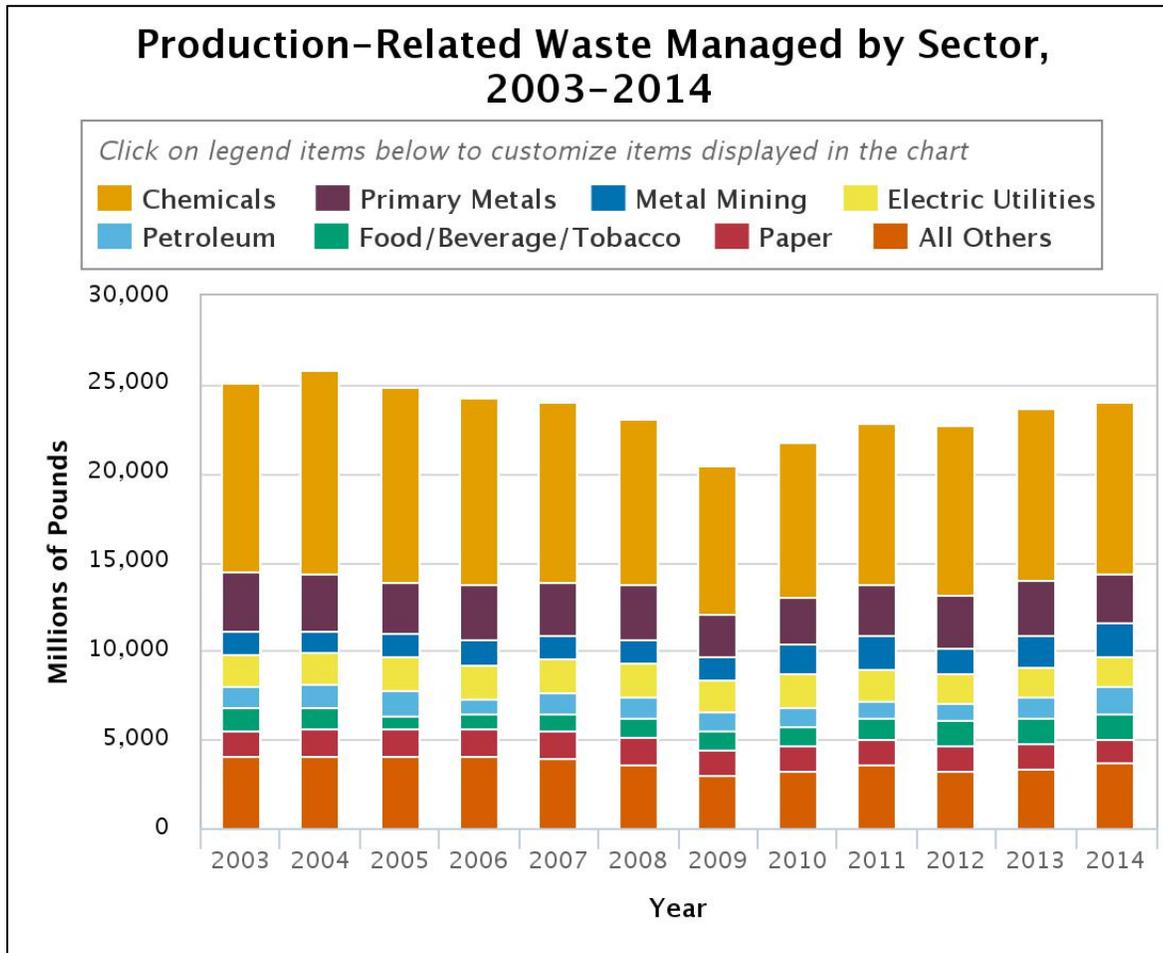


From 2003 to 2014:

- Production-related waste managed by TRI facilities declined by 4% (1.09 billion pounds).
- Disposal and other releases decreased by 661 million pounds (-14%).
- Treatment decreased by 538 million pounds (-7%).
- Energy recovery and recycling held steady with each method changing by less than 2%.
- The number of facilities that report to the TRI Program declined by 12% since 2003, although the count has remained steady at about 21,800 facilities since 2010.
- Since 2009, production-related waste managed has generally been increasing as the U.S. economy has improved.
- Quantities of waste managed in 2014 are similar to what they were in 2007, with little overall change within any waste management method.

Waste Management by Industry Sector

Trend in waste managed by industry sector



This figure shows the seven industry sectors with the most waste managed reported for 2014.

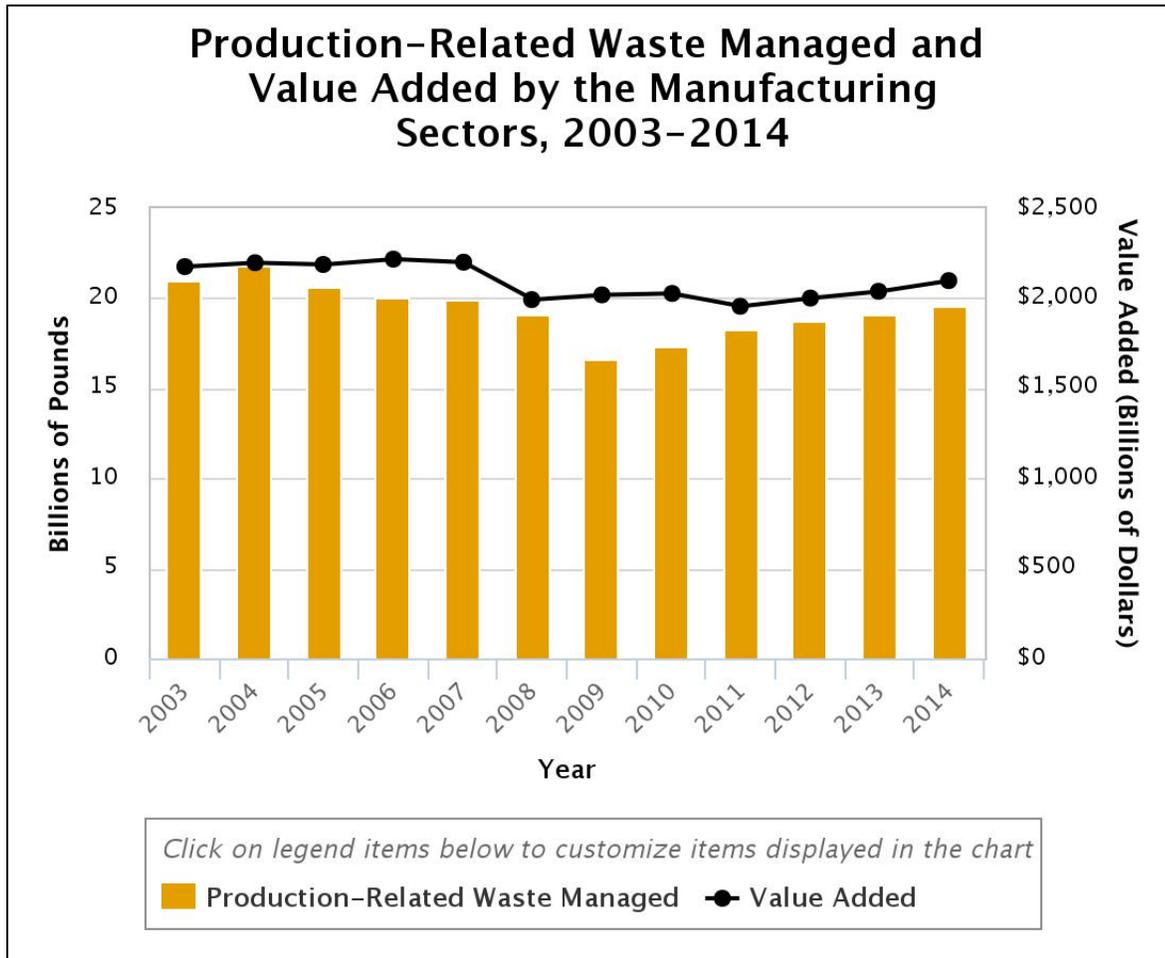
From 2003 to 2014:

- The contribution of each of the top sectors to production-related waste managed has remained relatively constant since 2003.
- Of the seven sectors illustrated above, three increased their quantity of waste managed: metal mining, petroleum, and food/beverages/tobacco.
- Generated waste in some industries fluctuates considerably from year to year, due to changes in production or other factors (e.g., quantities reported by metal mining facilities can change significantly based on changes in the composition of waste rock).

From 2013 to 2014:

- Sectors with the greatest reported increases in overall waste quantities since 2013 are:
 - Petroleum, which increased by 333 million pounds (+28%)
 - Fabricated metals, which increased by 243 million pounds (+40%)
 - Cement, which increased by 165 million pounds (+52%)

Economic and Waste Management Trend for Manufacturing



It is important to consider the influence the economy has on production and production-related waste generation. This figure presents the total pounds in production-related waste managed as reported by the manufacturing sectors each year from 2003-2014 and the manufacturing sector’s “value added” (as shown by the solid black line). “Value added” information is obtained from the [Bureau of Economic Analysis](#) and is used here as a proxy for production within the manufacturing sectors. “Value added” measures the contribution of manufacturing to the nation's Gross Domestic Product (GDP), which represents the total value of goods and services produced annually in the United States.

In 2014:

- While not all of the facilities that report to the TRI Program are in the manufacturing sector, most (88%) are. The manufacturing sector includes sectors such as chemical manufacturing, metals processing, and pulp and paper manufacturing, but excludes mining, electric utilities, and waste management facilities.
- TRI manufacturing facilities accounted for 81% of the reported production-related waste quantities managed.



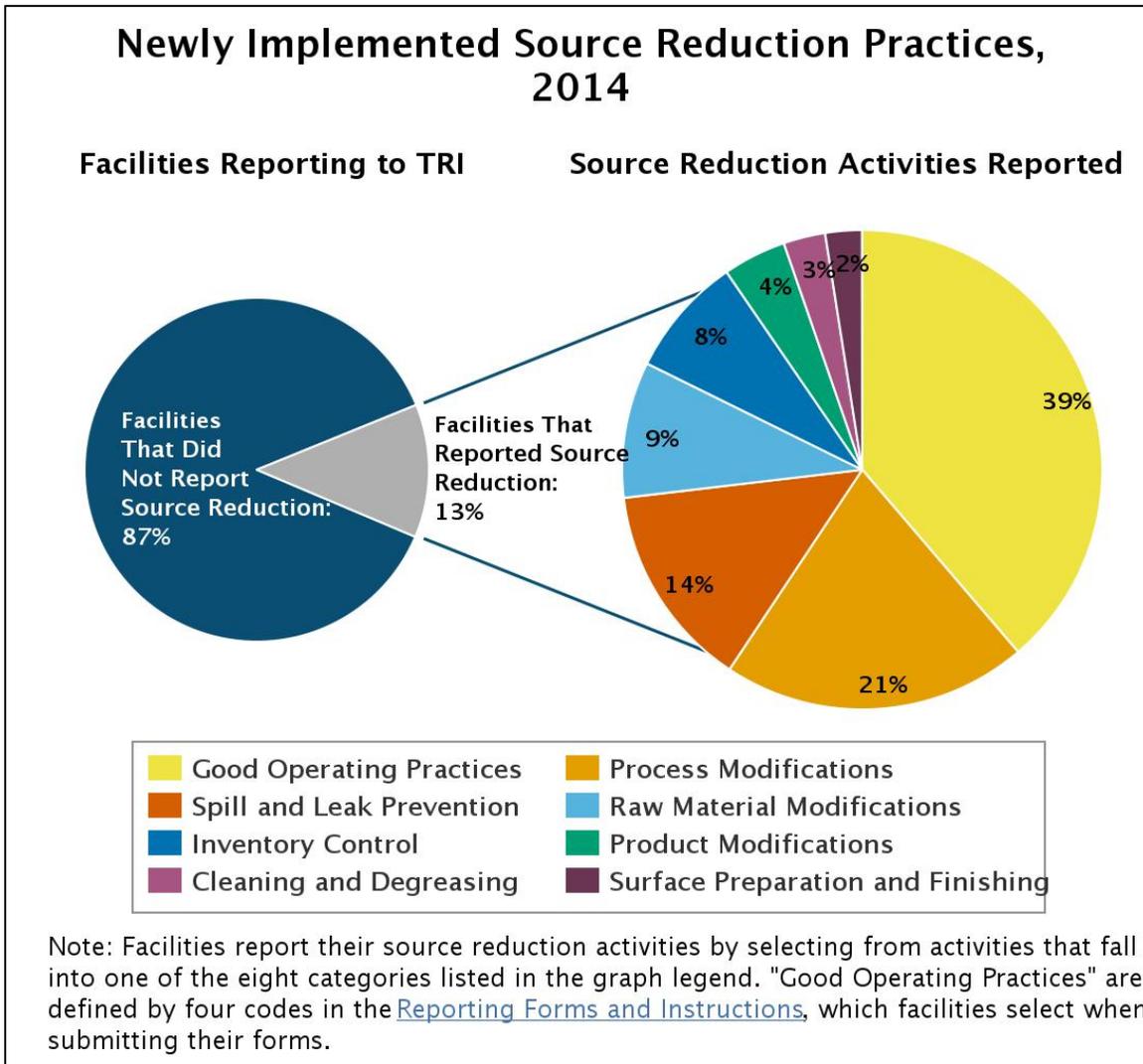
From 2003 to 2014:

- Value added by the manufacturing sectors (adjusted for inflation) decreased by 4%.
- Since waste is decreasing at a rate not proportional to changes in production, as shown in the graph, factors other than production may be contributing to the reductions in production-related waste managed.
 - Other factors such as source reduction and pollution prevention (P2) practices that may have influenced the quantities of production-related waste managed are discussed in the **Source Reduction/Pollution Prevention** section.

More information on production trends for individual sectors, including the electric utility and metal mining sectors, which are not included in the manufacturing sectors, can be found in the **industry sector profiles**.

Source Reduction/Pollution Prevention

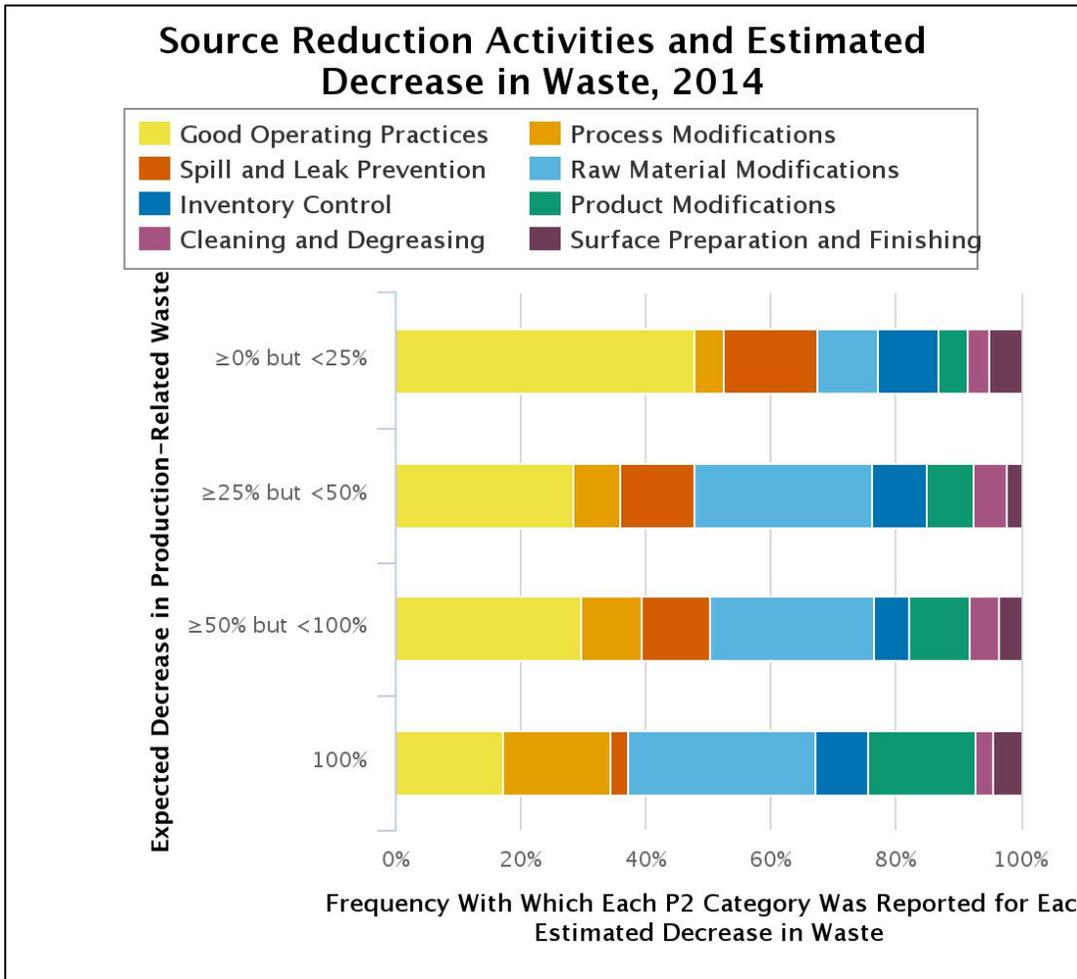
Source Reduction Activities Reported



In 2014:

- 2,732 facilities (13% of all facilities that reported to the TRI Program) reported initiating a total of 8,388 source reduction activities.
- Note that facilities may have ongoing source reduction activities initiated in previous years that are not included in the figure. You can find information on previously implemented source reduction activities by using the [TRI P2 Search Tool](#).

Estimated Release Reduction from Source Reduction



New in Reporting Year 2014, facilities can now provide an estimate of the resulting reduction in the annual amount of the chemical managed as waste (i.e., recycled, treated, used for energy recovery, or released) for each source reduction activity. This figure shows the association between the source reduction activities implemented in 2014 and the estimated annual reductions in chemical waste that facilities expect to achieve in Reporting Year 2015, which varies by activity:

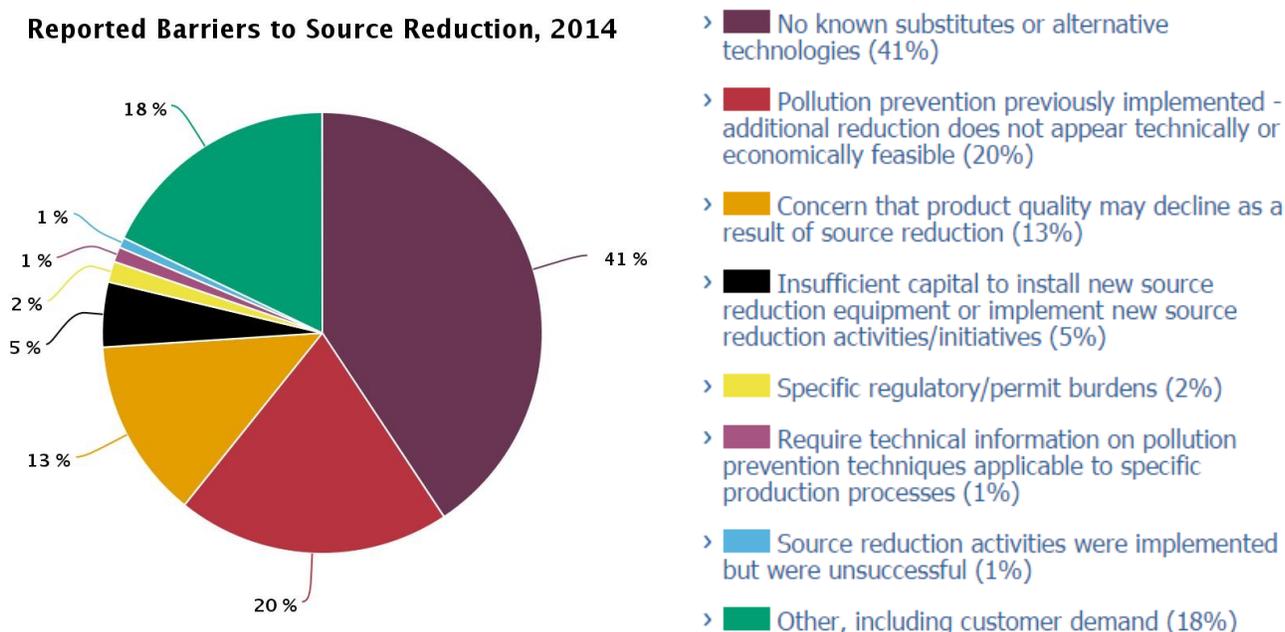
- 30% of the activities reported that were estimated to achieve 100% reduction were Raw Material Modifications (e.g. increasing the purity of raw materials).
- Almost half of the activities expected to achieve less than a 25% reduction were reported as Good Operating Practices.

Barriers to P2

If a facility did not implement new source reduction activities, they can optionally provide information about barriers they faced to source reduction. In 2014, the most common barriers reported were:

- the lack of a substitute or alternative for a chemical or process (41%) and
- previous implementation of source reduction with additional reductions not feasible (20%).

Reported Barriers to Source Reduction, 2014



No known substitutes or alternative technologies (41%)

Example: A battery manufacturer produces nickel-cadmium batteries and as a result cannot eliminate nickel compounds from their product. [[Facility Details](#)]

Pollution prevention previously implemented - additional reduction does not appear technically or economically feasible (20%)

Example: A fabricated metal manufacturer had previously reformulated their paint booth linings and optimized their paint guns to decrease phenol waste. In order to further reduce waste, the facility would need to replace the paint booth linings entirely, which is a significant economic burden that would require additional permitting. [[Facility Details](#)]

Concern that product quality may decline as a result of source reduction (13%)

Example: A steel foundry uses a topping agent that contains aluminum dust, which allows the risers on the casting to stay hot (liquid) long enough to prevent vacuum shrinkage. Using less of the topping agent would negatively impact the casting quality. [[Facility Details](#)]

Insufficient capital to install new source reduction equipment or implement new source reduction activities/initiatives (5%)



Example: A firearms manufacturer has looked into an alternative for their cleaning and degreasing operations, but has found the associated costs to be prohibitive. The alternatives would be either expensive fluorinated solvents or aqueous cleaning, which the facility has insufficient capital.

[\[Facility Details\]](#)

Specific regulatory/permit burdens (2%)

Example: Because of FDA requirements, a pharmaceutical manufacturer is unable to modify their processing methods. [\[Facility Details\]](#)

Require technical information on pollution prevention techniques applicable to specific production processes (1%)

Example: A leather tanning facility is preparing to test a filtering system that would allow recycling of chromium. Although these types of systems have not been effective in the past, the facility continues to investigate the options. [\[Facility Details\]](#)

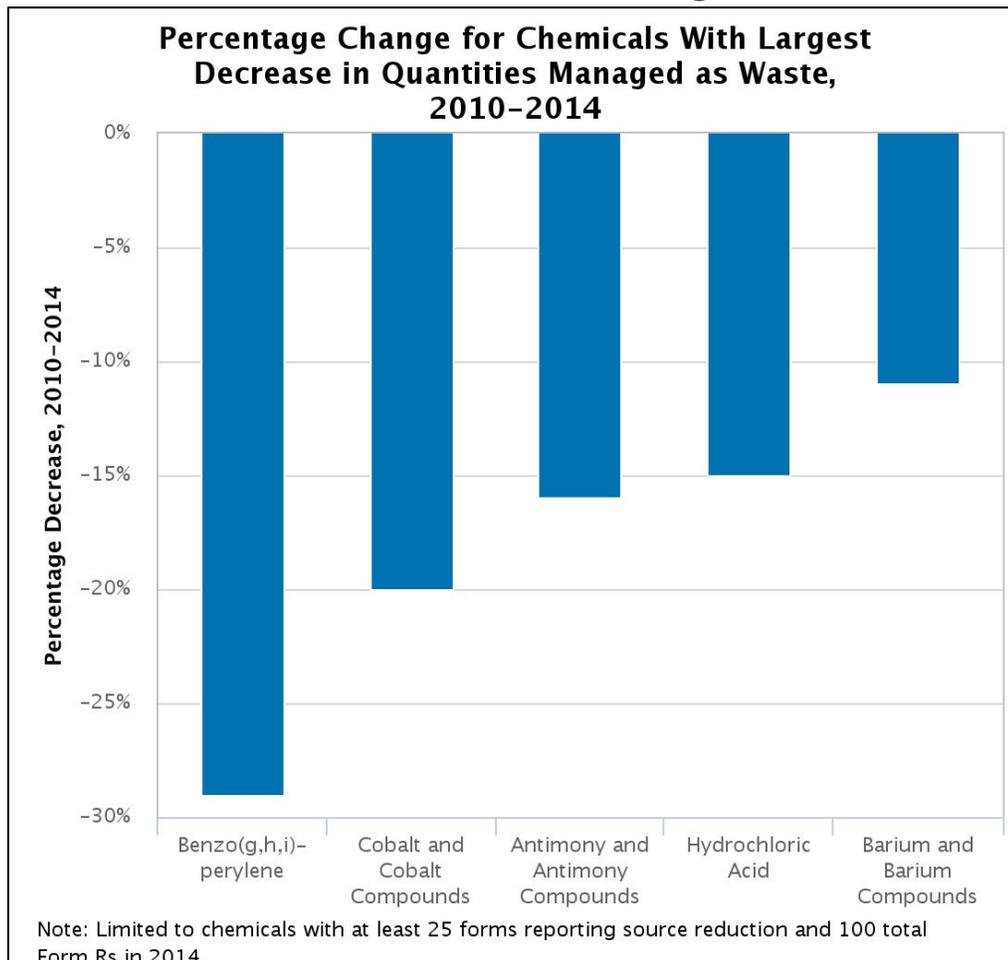
Source reduction activities were implemented but were unsuccessful (1%)

Example: A dairy facility attempted to substitute citric acid for nitric acid, but citric acid has a high biochemical oxygen demand (BOD) content which overwhelmed the POTW where they transferred their waste. As a result, the POTW requested that the facility switch back to nitric acid for their neutralization operations. [\[Facility Details\]](#)

Other, including customer demand (18%)

Example: An electrical equipment manufacturer has already substituted lead solder with tin solder for their newly produced circuit boards. However, they are required to produce lead soldered boards to support older systems under warranty. [\[Facility Details\]](#)

Chemicals with Greatest Decreases in Waste Managed



Source reduction activities implemented by facilities play a significant role in reducing waste generation, although it's important to note that decreases in reported waste management quantities may be caused by many factors, including changes in production levels or estimation methods.

From 2010 to 2014:

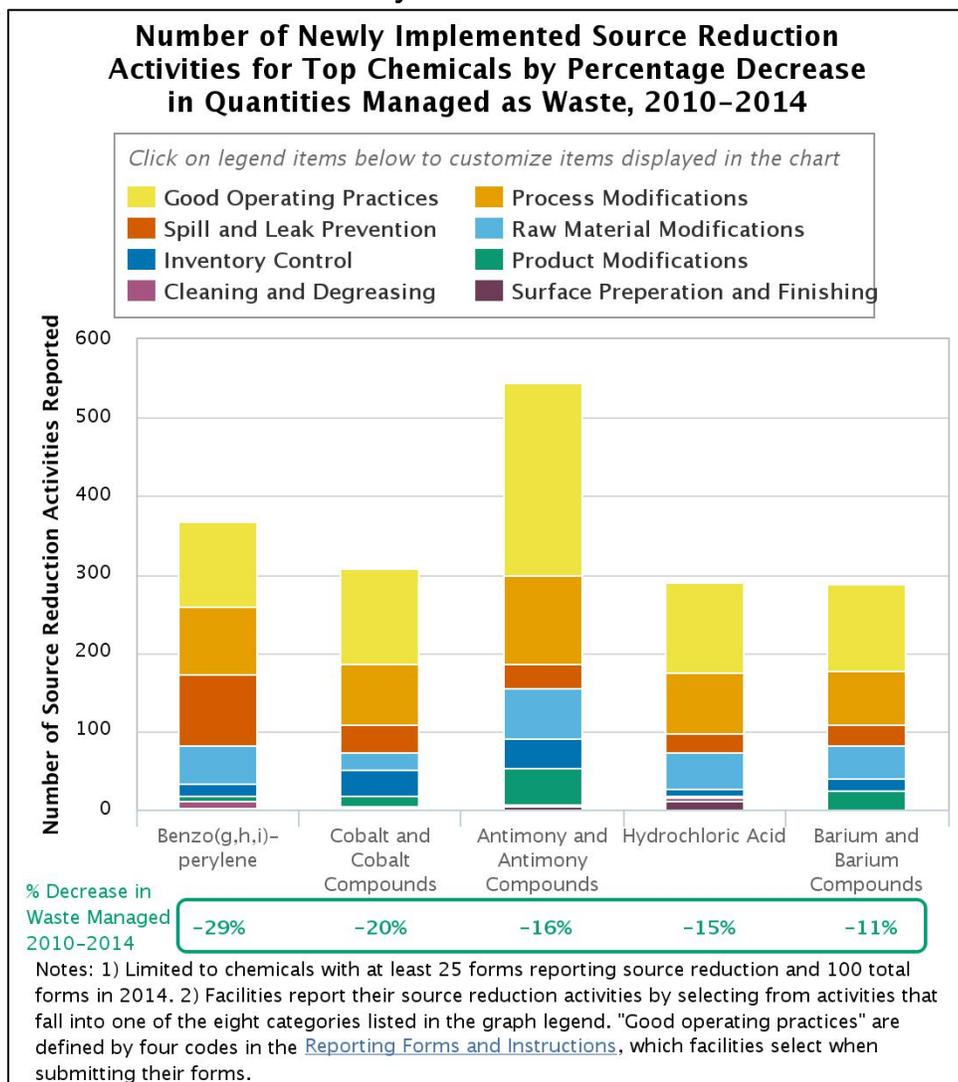
The relationship between source reduction, changes in total waste generation, and chemical releases varies from chemical to chemical. This figure shows the chemicals with the greatest percentage decrease in waste quantities.

- Reducing the generation of total waste through source reduction can also decrease the amount of chemical ultimately released to the environment, as was the case for all of the chemicals shown in the graph with the exception on benzo(g,h,i)perylene.
 - Production-related waste for benzo(g,h,i)perylene decreased by 29% (327 thousand pounds), but releases for this chemical increased by 91 thousand pounds (+143%), driven by releases from one-time events.
- Cobalt (a carcinogen) is managed almost exclusively through recycling at TRI facilities, so source reduction reduces the amount of total chemical waste but does not significantly

decrease chemical releases. While the total quantity of cobalt waste decreased by 20%, releases declined by only 6%.

- Production-related waste of hydrochloric acid decreased by about 15% while releases decreased by 42%, as facilities switched from releasing hydrochloric acid to preferred management methods, such as treatment, and also undertook source reduction activities.

Source Reduction Activities by Chemical



From 2010 to 2014:

- The chemicals with the greatest percentage decrease in production-related waste managed are benzo(g,h,i)perylene, cobalt and cobalt compounds, antimony and antimony compounds, hydrochloric acid, and barium and barium compounds.
- The type of source reduction activity implemented for these chemicals varies depending on their use in industrial operations and the chemical's characteristics. For example, some types of source reduction activities relate to:



- **Spill and leak prevention**, which is commonly reported as a source reduction activity to reduce waste of benzo(g,h,i)perylene, a persistent, bioaccumulative and toxic (PBT) chemical constituent in petroleum products. Common spill and leak prevention activities for this chemical include improving procedures for loading, unloading, and transfer operations at petroleum bulk terminals, and installing overflow alarms or automatic shutoff valves at asphalt product manufacturing facilities.
- **Product modifications**, such as modifying the design or composition of the product, is commonly implemented for antimony or barium compounds, which are incorporated into the product, than for the other chemicals shown.

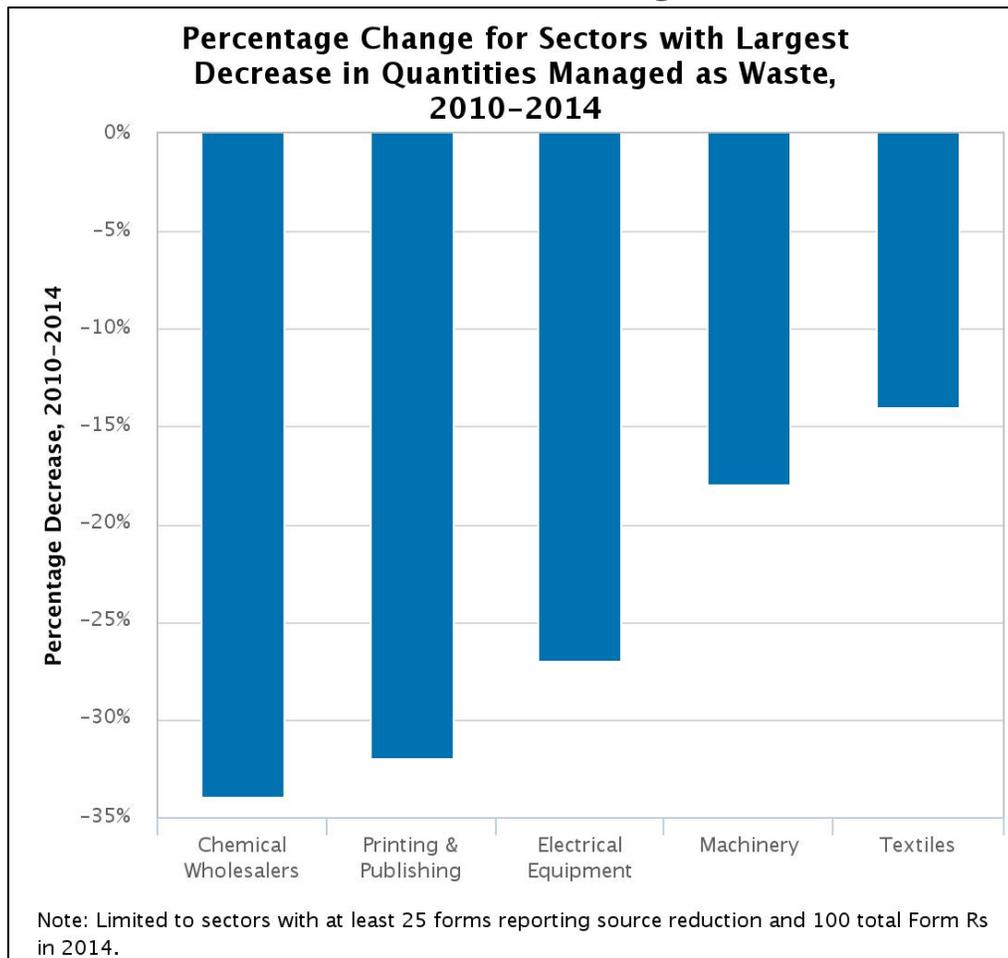
Facilities may also report additional details to the TRI Program about their source reduction, recycling, or pollution control activities.

Examples of additional pollution prevention-related information for 2014:

- **Benzo(g,h,i)perylene:** A medical instrument manufacturer eliminated fuel oil use in an effort to reduce emissions. The change was made in 2014 and resulted in a 10% reduction in benzo(g,h,i)perylene emissions from the previous year. The facility expects they will not have any benzo(g,h,i)perylene emissions in 2015. [[Facility Details](#)]
- **Cobalt and Cobalt Compounds:** A metalworking machinery manufacturer initiated a program to reduce scrap generated by decreasing billet size and forming a crack reduction team. [[Facility Details](#)]
- **Antimony and Antimony Compounds:** A plastics film manufacturer removed Antimony Trioxide from several products to reduce emissions and decrease costs. [[Facility Details](#)]
- **Hydrochloric Acid:** An electric utility installed a selective catalytic reduction system and lime spray dryer halfway through 2014, resulting in a 66% decrease in releases. [[Facility Details](#)]
- **Barium and Barium Compounds:** An organic chemical manufacturer changed its processing reactions to improve yield and reduce filtration loss. [[Facility Details](#)]

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](#).

Sectors with Greatest Decreases in Waste Managed

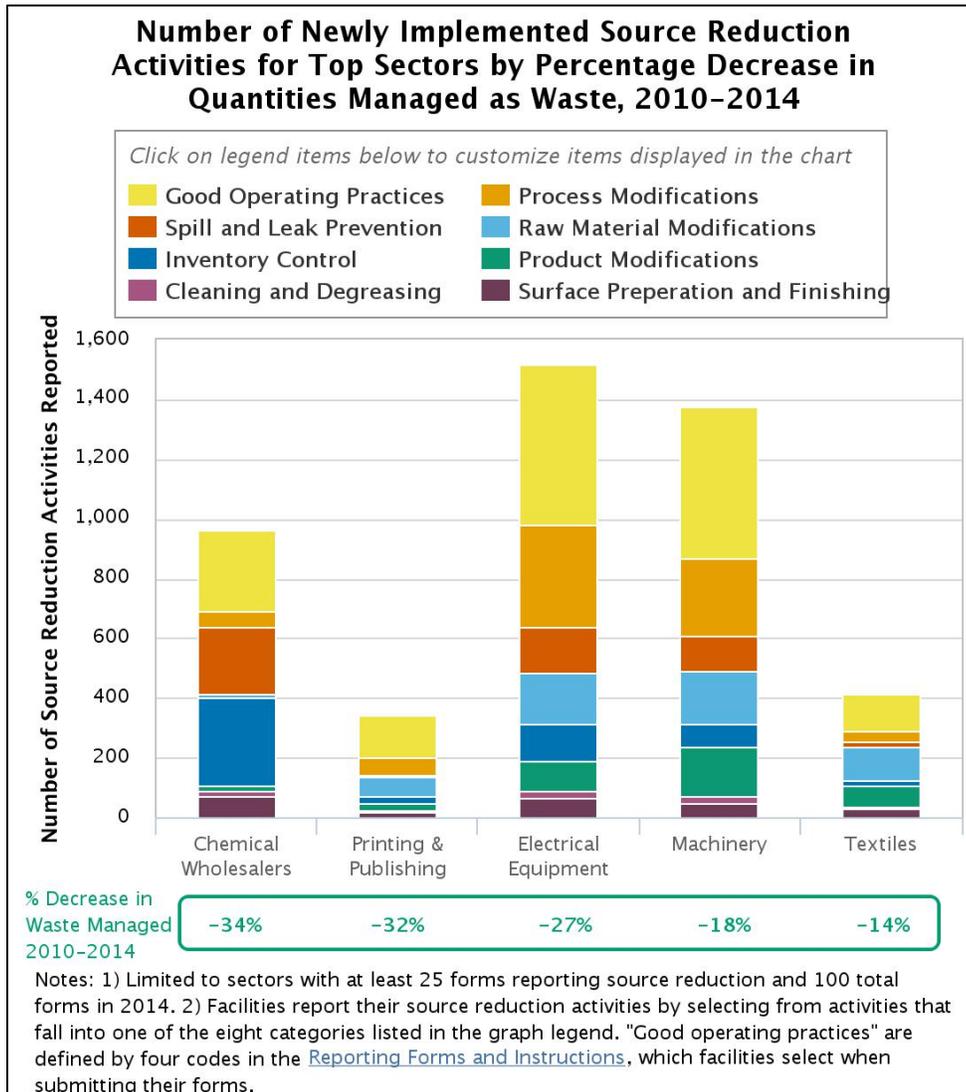


From 2010 to 2014:

- The sectors with the greatest percentage decrease in overall waste managed are chemical wholesalers, printing and publishing, electrical equipment, machinery, and textiles.
- With the exception of the machinery sector, releases and other production-related waste managed decreased in the other four sectors, whereas the machinery sector had an increase in releases.
 - Releases for the machinery sector make up a small portion (less than 5%) of production-related waste. The increase in releases was driven primarily by a 241,000 pound increase of disposal to landfills, but during the same time period, the sector decreased total production-related waste by 32 million pounds.

For many sectors, source reduction activities, which reduce or eliminate waste generation at its source, have contributed to substantial decreases in both the amount of waste generated and releases. Source reduction activities reported by these five industries are discussed further in the next figure.

Source Reduction Activities by Sector



From 2010 to 2014:

- The five sectors with the greatest percentage decrease in overall waste managed are chemical wholesalers, printing and publishing, electrical equipment, machinery, and textiles.
- The types of source reduction activities vary significantly by industry, as shown. For example, many chemical wholesalers reported inventory control (e.g., instituting clearinghouses to exchange materials that otherwise would be discarded), while electrical equipment and machinery manufacturers frequently reported modifications to their raw materials and processes, often associated with the elimination of lead solder.

Facilities may also report additional details to the TRI Program about their source reduction, recycling, or pollution control activities.

Examples of additional pollution prevention-related information for 2014:

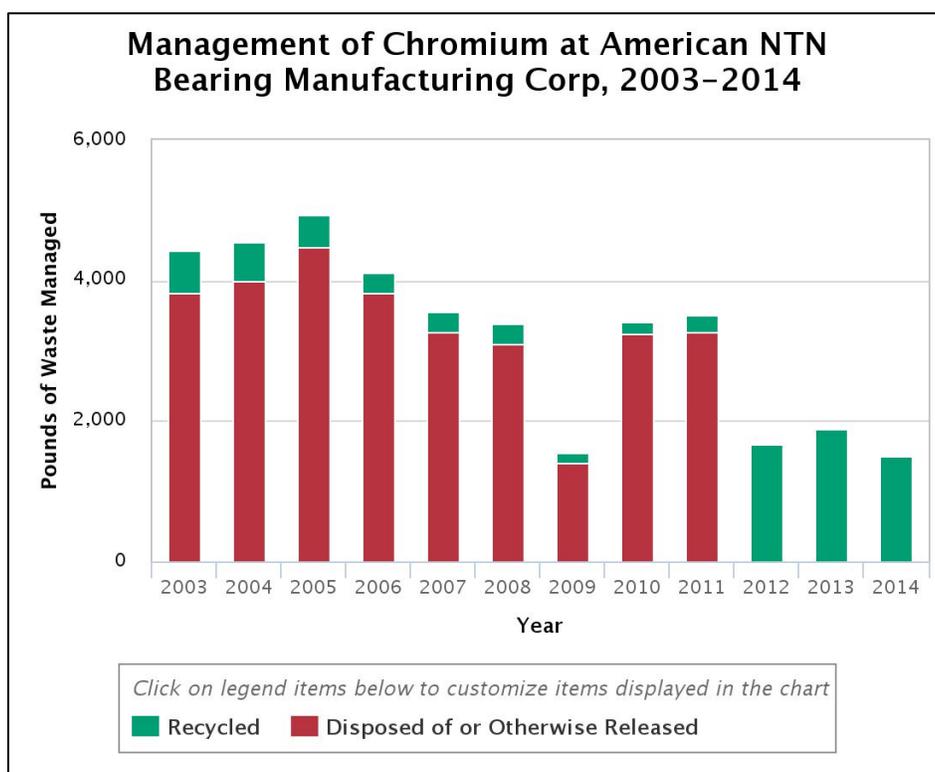


- **Chemical Wholesalers:** A facility changed composition of products in order to reduce or eliminate multiple hazardous chemicals, including methanol. [[Facility Details](#)]
- **Printing & Publishing:** A gravure printing facility reduced certain glycol ethers releases by replacing solvent-based digital inks with UV ink technology. [[Facility Details](#)]
- **Electrical Equipment:** A facility converted its manufacturing process to use lead-free solders starting in 2013, resulting in an 87% decrease in lead releases in 2014 [[Facility Details](#)]
- **Machinery:** An HVAC equipment manufacturer reduced copper scrap releases and overall use by purchasing new tooling for copper bending equipment to improve part quality. [[Facility Details](#)]
- **Textiles:** Through an employee recommendation, one facility installed a spill tank to capture zinc liquid material from overflows which decreased releases by 28%. [[Facility Details](#)]

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](#).

Example of a “Zero Releaser”

The waste management hierarchy emphasizes the preferred waste management techniques that facilities can utilize to reduce the quantities of toxic chemicals they release or otherwise manage as waste. For example, some facilities may be able to completely eliminate all releases of TRI reportable chemicals while still managing other production-related waste. These “zero releasers” are able to do so by implementing a variety of alternative waste management techniques. An example of a facility that followed the waste management hierarchy and no longer releases certain chemicals is shown below. This example illustrates one of the many ways that facilities can improve current pollution prevention and waste management practices. Find additional examples pertaining to TRI reportable chemicals or sectors by using the [TRI P2 Search Tool](#).

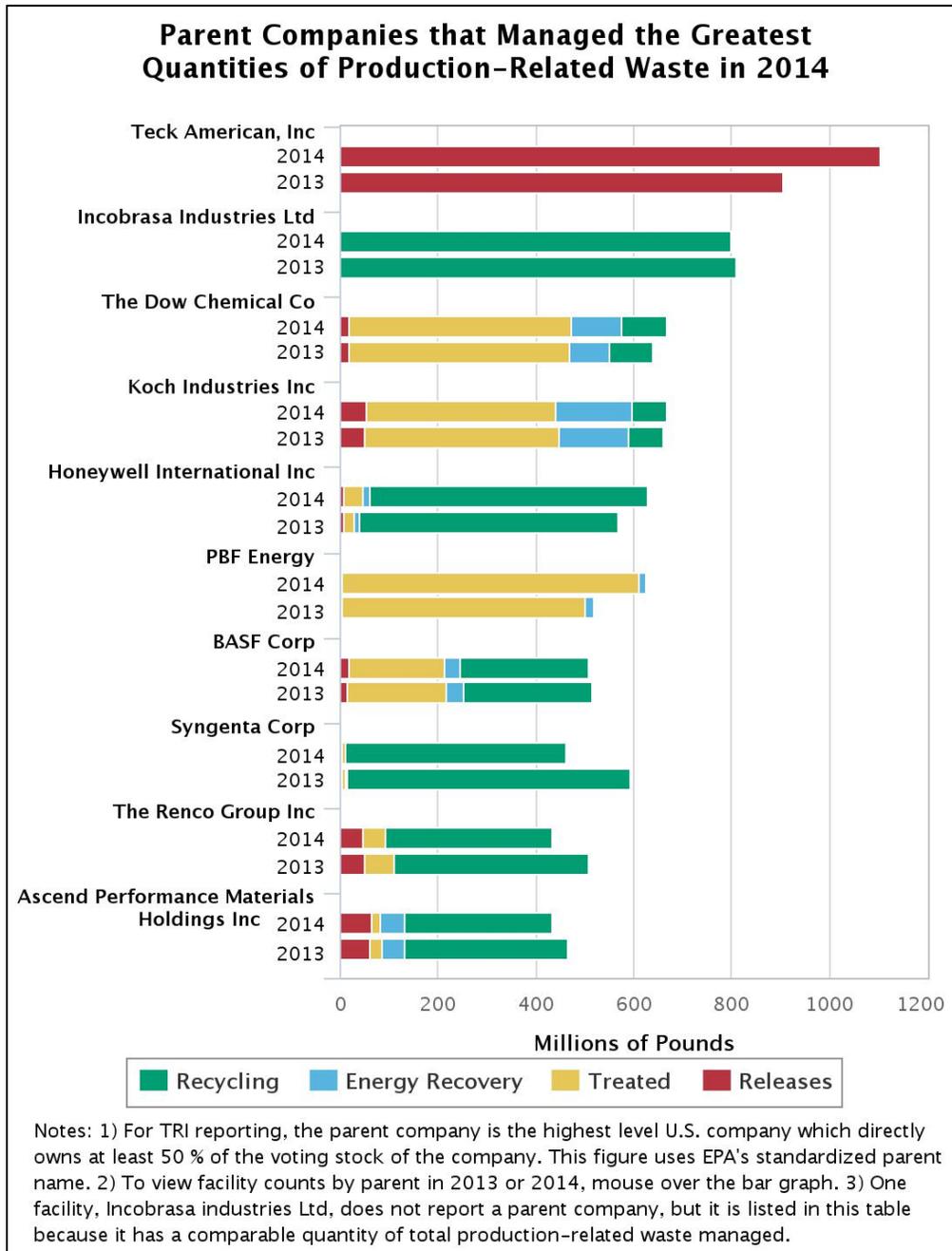


[American NTN Bearing Manufacturing Corp.](#) (owned by NTN USA Corp.) manufactures ball and roller bearings. In 2012, they implemented a recycling process for the chips and debris generated as part of the metal grinding process. By 2012, releases of chromium had been reduced to zero and all other chromium waste was recycled.



Waste Management by Parent Company

Parent companies with the most production-related waste managed



Many of the facilities that report to the TRI Program are owned by parent companies that also own other facilities that report to TRI. Facilities that report are asked to provide information on their parent company, if they have one. For TRI reporting purposes the parent companies must be located in the United States.

This figure shows the parent companies whose facilities reported the greatest quantities of production-related waste for 2014. These parent companies vary in size and in the sectors in which



they operate. The number of facilities owned by these companies that reported to the TRI Program for 2014 ranges from 1 to 130.

The parent companies' TRI-reporting facilities operate in the following sectors:

- Metal mining: Teck American
- Soybean processing: Incobrasa
- Multiple sectors, e.g. pulp and paper, petroleum refining, and chemicals: Koch Industries
- Chemical manufacturing: Dow Chemical, Syngenta, Honeywell International, BASF, and Ascend Performance Materials
- Petroleum refining: PBF Energy
- Metal smelting: The Renco Group

Most of these top parent companies reported implementing one or more new source reduction activities in 2014. Some of these companies also reported additional (optional) information to TRI about their pollution prevention or waste management activities.

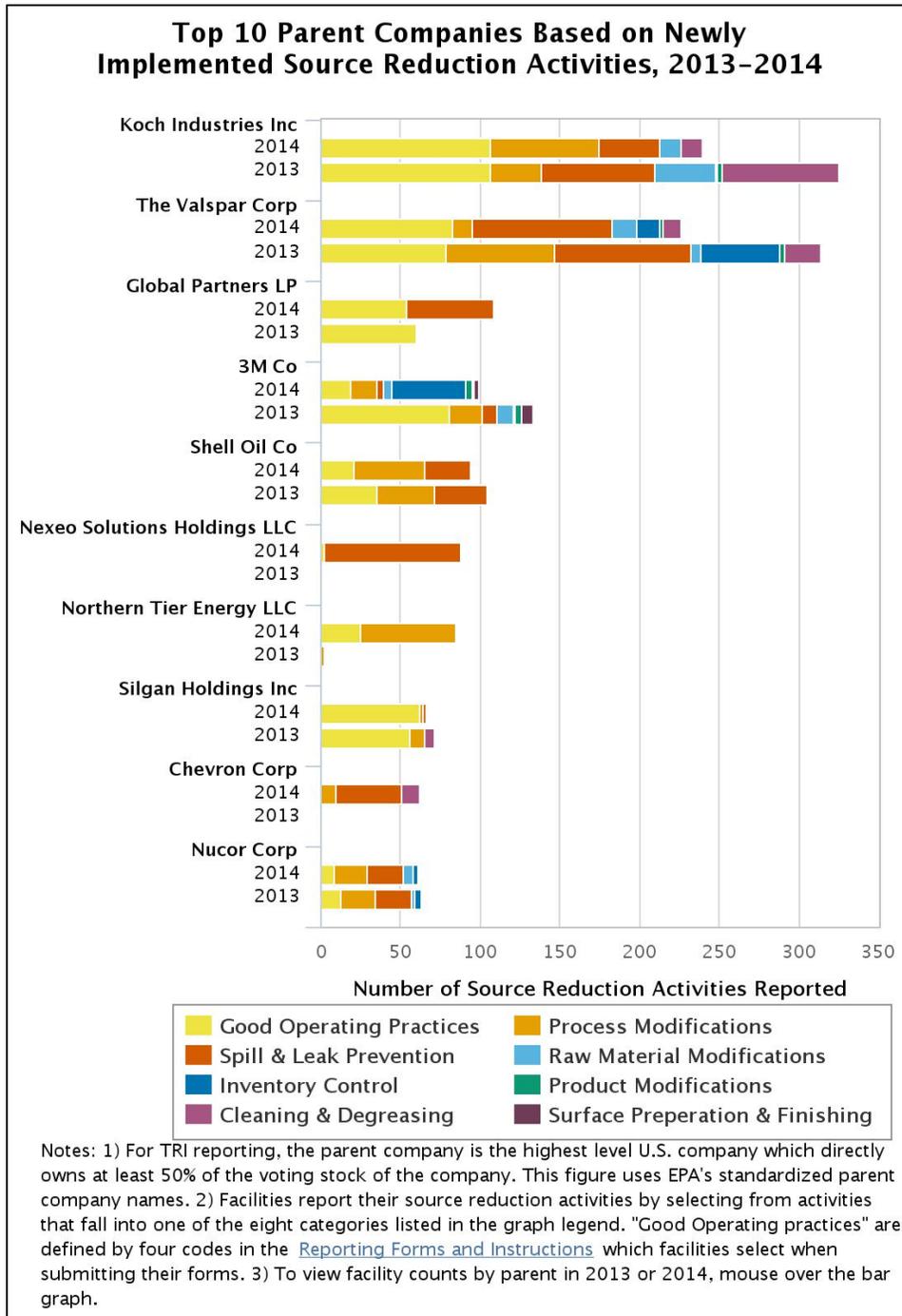
Examples of additional pollution prevention-related information for 2014:

- A Syngenta facility that manufactures pesticides eliminated use of more than 200,000 pounds/year of naphthalene by purchasing a solvent that does not contain the chemical. (Raw Material Modification) [[Facility Details](#)]
- A BASF organic chemical manufacturing plant changed a manufacturing process from high temperature, high pressure to an ambient temperature reaction, which reduced VOC emissions that included acrylonitrile by over 99%. (Process Modification) [[Facility Details](#)]

To conduct a similar type of parent company comparison for a given sector, chemical, or geographic location, use the [TRI P2 Search Tool](#).



Source Reduction Activities by Parent Company



The parent companies that implemented the most source reduction activities in 2014 are shown in the graph.

The parent companies' facilities that reported to the TRI Program primarily operate in the following industries:

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



- Chemical manufacturing sector: Valspar and 3M
- Petroleum refining: Northern Tier Energy
- Bulk petroleum industry (store and distribute crude petroleum and petroleum products): Global Partners
- Multiple petroleum-related sectors, e.g. petroleum refining, bulk petroleum, chemicals: Shell Oil and Chevron
- Chemical wholesaler: Nexeo Solutions
- Metal containers: Silgan Holdings
- Steel manufacturing: Nucor

Good operating practices, such as improving maintenance scheduling and installation of quality monitoring systems, are the most commonly reported source reduction activities for these top parent companies. Spill and leak prevention and process modifications are also commonly reported.

Some of these parent companies submitted additional text to EPA with their TRI reports describing their pollution prevention or waste management activities.

Examples of additional pollution prevention-related information for 2014:

- A Nucor facility worked with a vendor to purchase higher purity steel in response to customer demand for steel with lower residual copper. (Raw Material Modification) [[Facility Details](#)]
- By implementing new adiponitrile (ADN) process technology, a Koch Industries chemical manufacturing facility improved yield and reduced the amount of hydrogen cyanide required for processing. (Process Modification) [[Facility Details](#)]
- Through an employee recommendation, a 3M plastics manufacturer decreased its use of several solvents, including certain glycol ethers, by sequencing changeovers to reduce the amount of cleanings needed. (Good Operating Practices) [[Facility Details](#)]

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](#).