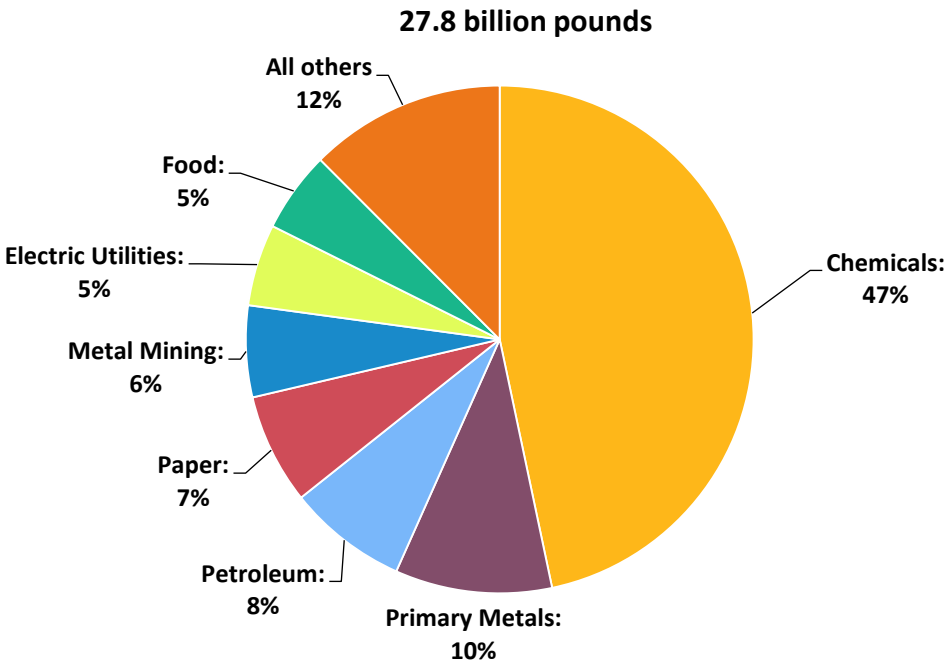
Comparing Industry Sectors

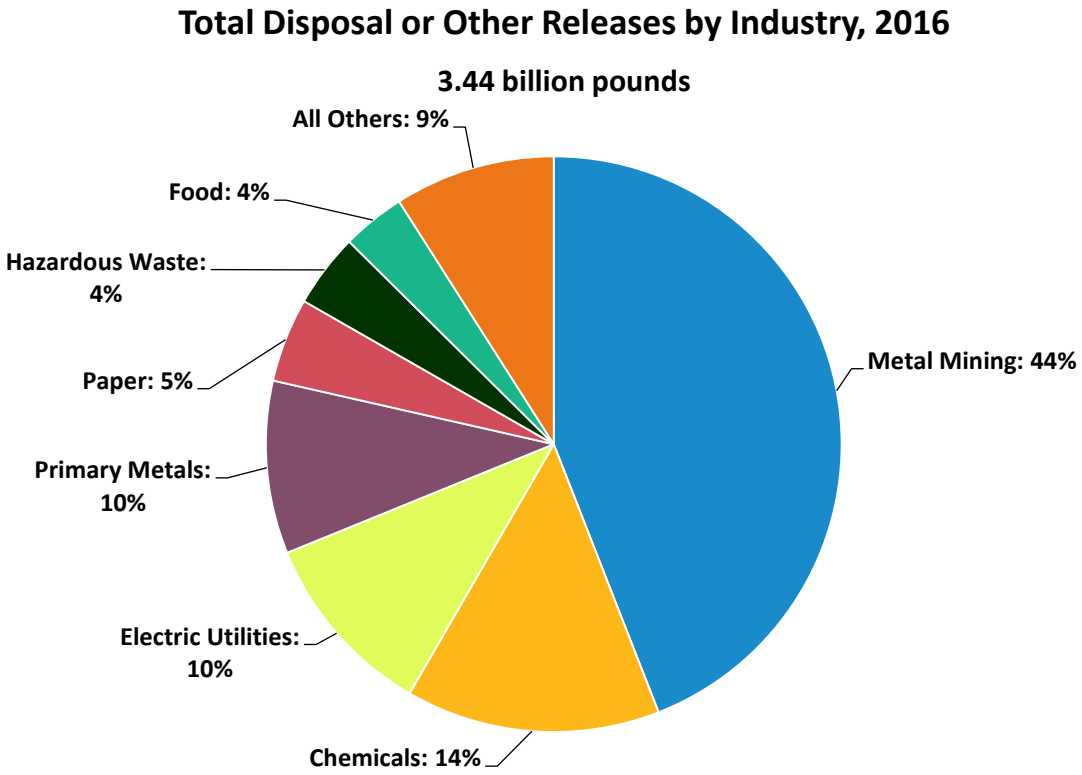
This section examines which sectors contributed the most to production-related waste managed and released in 2016, and highlights several industry sectors to show trends occurring over time. It also discusses the trends among federal facilities, which report to the Toxics Release Inventory (TRI) regardless of sector. For analysis purposes, the TRI Program has aggregated 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 industries that are subject to TRI reporting requirements vary substantially in size, scope, composition, and business type. As a result, the amounts and types of chemicals used, generated, and managed by facilities within a given industry sector often differ greatly from those of facilities in other sectors. For facilities in the same sector, however, the processes, products, and regulatory requirements are often similar, resulting in similar manufacture, processing, or other use of chemicals. Looking at chemical waste management trends within a sector can identify emerging issues, highlight progress made in improving environmental performance, and reveal opportunities for better waste management practices.

Production-Related Waste Managed by Industry, 2016



Seven industry sectors reported 88% of the quantities of TRI chemicals managed as production-related waste in 2016. A majority (65%) of TRI chemical waste managed originated from three sectors: chemical manufacturing (47%), primary metals (10%), and petroleum products manufacturing, primarily from petroleum refineries (8%).



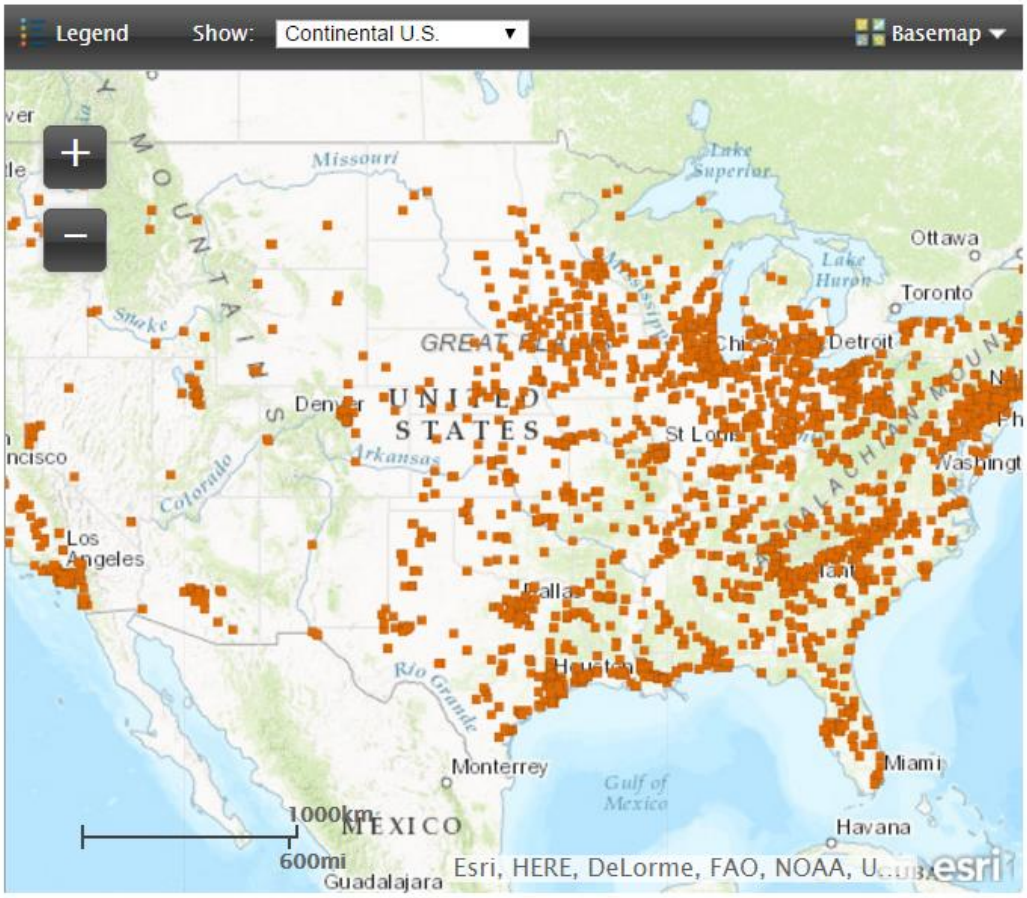
This pie chart shows that 91% of the quantities of TRI chemicals disposed of or otherwise released originated from seven of the 29 industry sectors that are subject to the TRI reporting requirements. More than two-thirds originated from three industry sectors: metal mining (44%), chemical manufacturing (14%), and electric utilities (10%).

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 medium, see land disposal by industry, air releases by industry, and water releases by industry.

Manufacturing Sectors

This map shows the manufacturing facilities that reported to the Toxics Release Inventory (TRI) for 2016. Click on a facility for details on their TRI reporting.



Manufacturing Facilities Reporting to TRI, 2016

View Larger Map

Of the 27.8 billion pounds of production-related waste reported to TRI for 2016, most (86%) was from facilities in a manufacturing sector. Similarly, 89% of the facilities reporting to TRI are in a manufacturing sector. The manufacturing sectors are defined by NAICS codes 31 through 33 and include a variety of industries involved in the production of food, textiles, paper, chemicals, plastics, electronics, transportation equipment, and other products. Two of these manufacturing sectors (pharmaceuticals and chemicals) are highlighted in more detail later in this section.

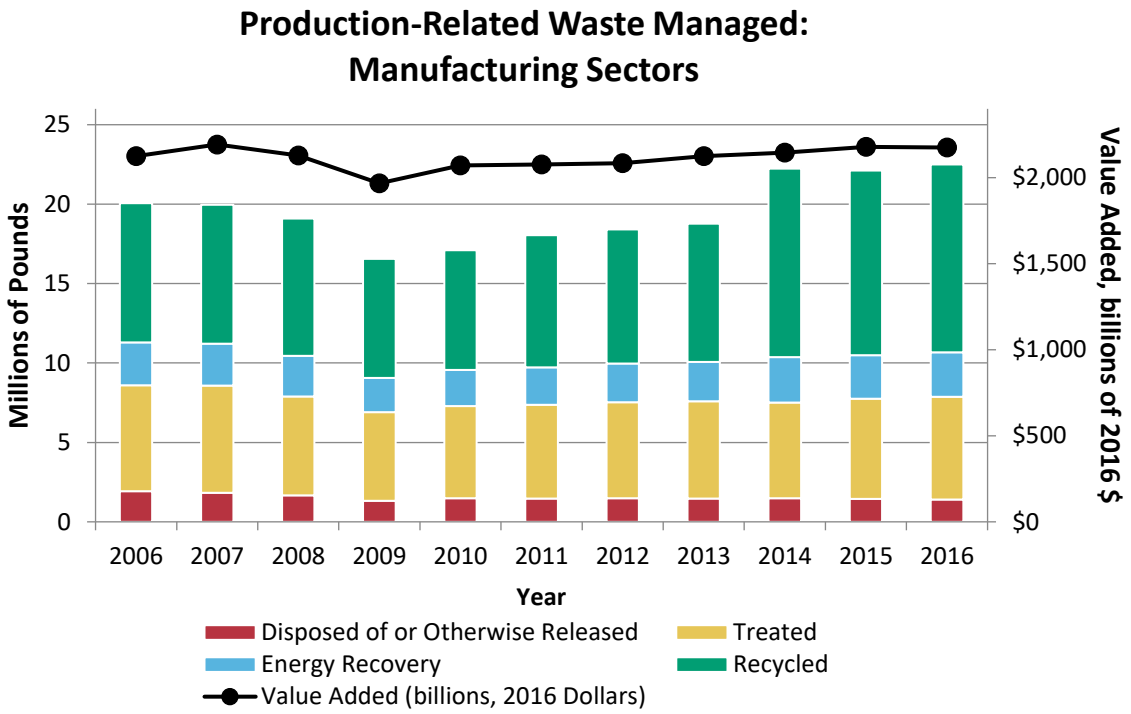
The industry sectors not categorized under manufacturing include metal mining, coal mining, electric utilities, chemical wholesalers, petroleum terminals, hazardous waste management, and others.

Quick Facts for 2016: Manufacturing Sectors (NAICS 31-33)	
Number of Facilities that Reported to TRI	**19,190**
Number of Facilities with New Source Reduction Activities	2,180
Production-Related Waste Managed	**23,802.9 million lb**
Recycled	11,928.7 million lb
Energy Recovery	2,912.6 million lb
Treated	7,539.5 million lb
Disposed or Otherwise Released	1,422.1 million lb
Total Disposal or Other Releases	**1,394.4 million lb**
On-site	**1,105.6 million lb**
Air	514.3 million lb
Water	172.1 million lb
Land	419.3 million lb
Off-site	**288.7 million lb**

Note: Numbers may not sum exactly due to rounding.

Manufacturing Waste Management Trend

The following graph shows the annual quantities of TRI chemicals managed as waste by the manufacturing sectors.



From 2006 to 2016:

- Production-related waste managed by the manufacturing sectors decreased through 2009 following the trend of reduced production resulting from the economic recession. Since 2009, quantities of waste managed have increased.
    - Quantities of waste released and treated decreased, while the quantity of waste used in energy recovery and waste recycled increased.
- It is important to consider the influence the economy has on production and production-related waste generation. This figure also includes the trend in manufacturing sectors' "value added" (represented by the black line as reported by the Bureau of Economic Analysis, Value Added by Industry). Value added is a measure of production that is defined as the contribution of these manufacturing sectors to the national gross domestic product.

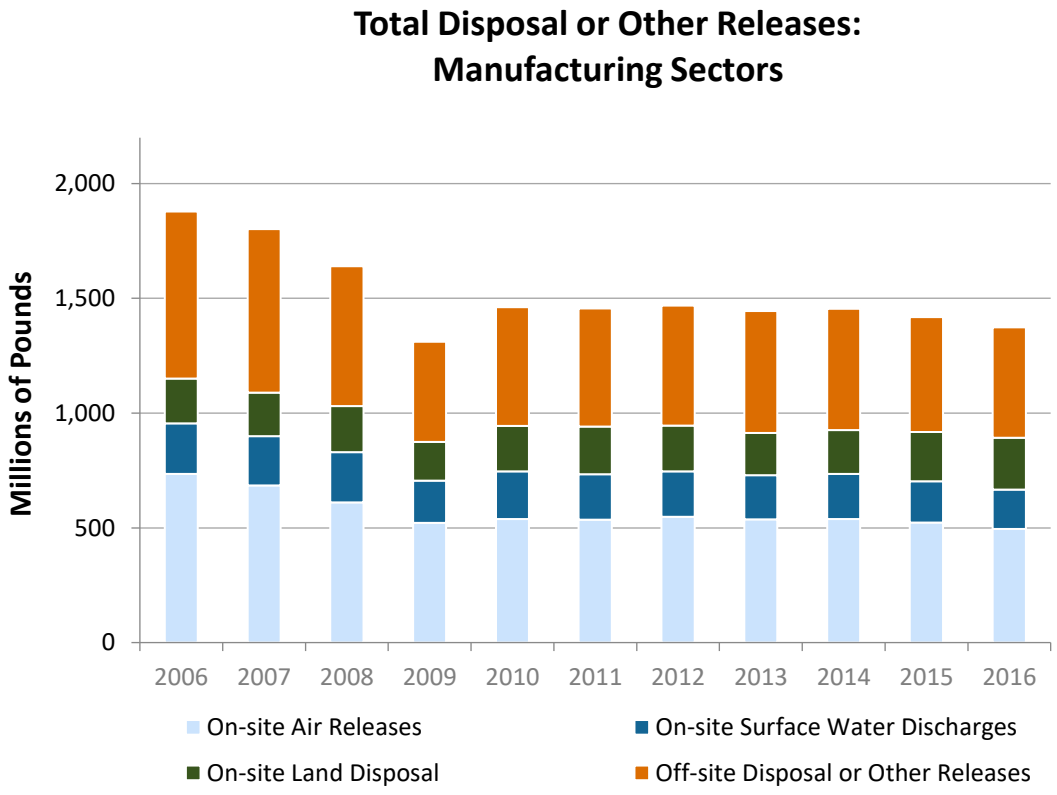
- Production-related waste managed by the manufacturing sectors increased by 12%, while value added by the manufacturing sectors increased by 2%. However, the large increase in recycled waste for 2014 – 2016 is due to the quantity of recycled cumene reported by one facility. Excluding this amount, the total quantities of the manufacturing sectors' production-related waste decreased by 5% since 2006, even as value added increased.

From 2015 to 2016:

- Production-related waste managed increased by 2% (395 million pounds).
- In 2016, only 6% of the manufacturing sectors' waste was released into the environment, while the rest was managed through treatment, energy recovery, and recycling.

Manufacturing Releases Trend

The following graph shows the annual quantities of TRI chemicals released by the manufacturing sectors.



From 2006 to 2016:

- Total releases by the manufacturing sectors decreased by 27%. This is primarily due to a reduction in air emissions and off-site disposal or other releases.
- Releases to water also declined, while on-site land disposal increased by 15%.

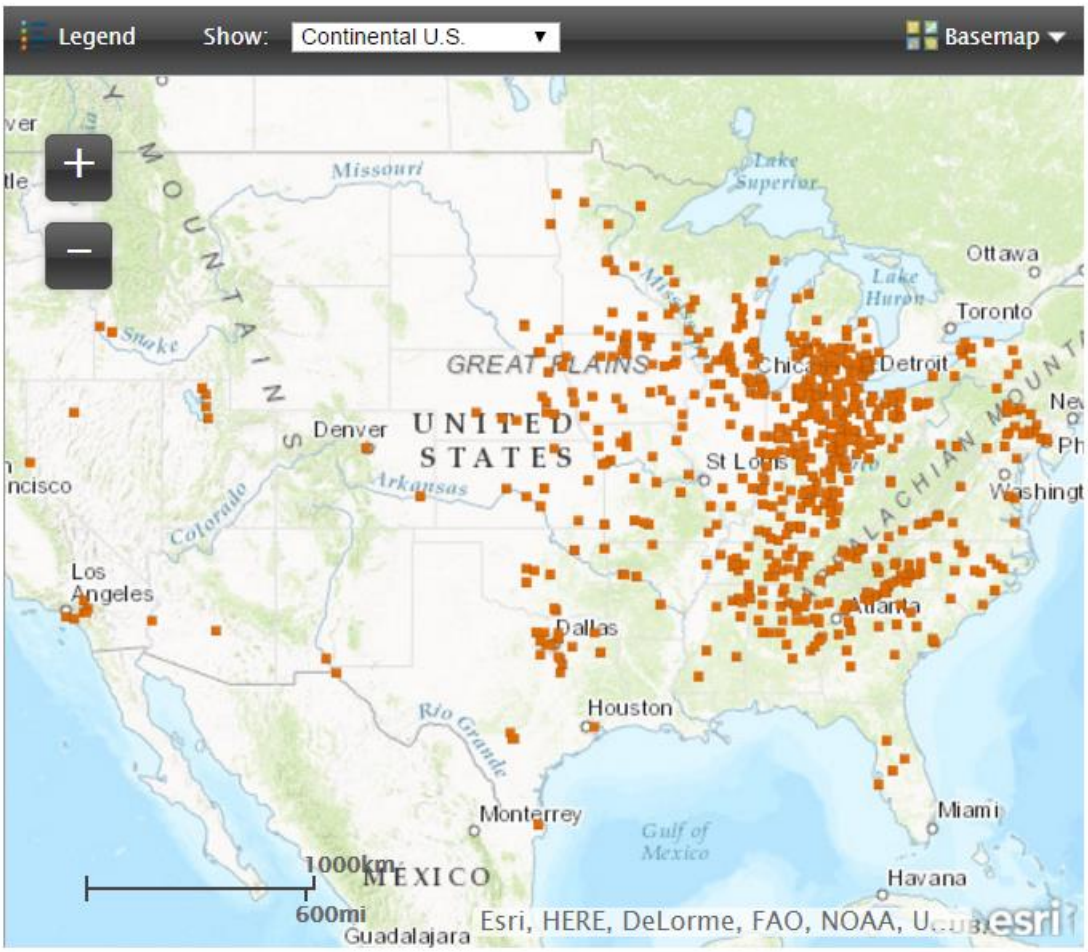
From 2015 to 2016:

- Total releases decreased by 3% (45 million pounds).
- On-site land disposal increased while on-site releases to air and water decreased.

Source Reduction in the Manufacturing Sectors:

Eleven percent of manufacturing facilities initiated source reduction activities to reduce TRI chemical use and waste generation in 2016. The most commonly reported types of source reduction activitites were good operating practices and process modifications. For example, a plastic products manufacturing facility replaced styrene solvent with acetone and water-based cleaners, and expanded their product lines using polyethylene-based productions rather than styrene-based products. TRI's Pollution Prevention Search Tool can help you learn more about pollution prevention opportunities in this sector.

Pharmaceutical Manufacturing



Pharmaceutical Manufacturing Facilities Reporting to TRI, 2016

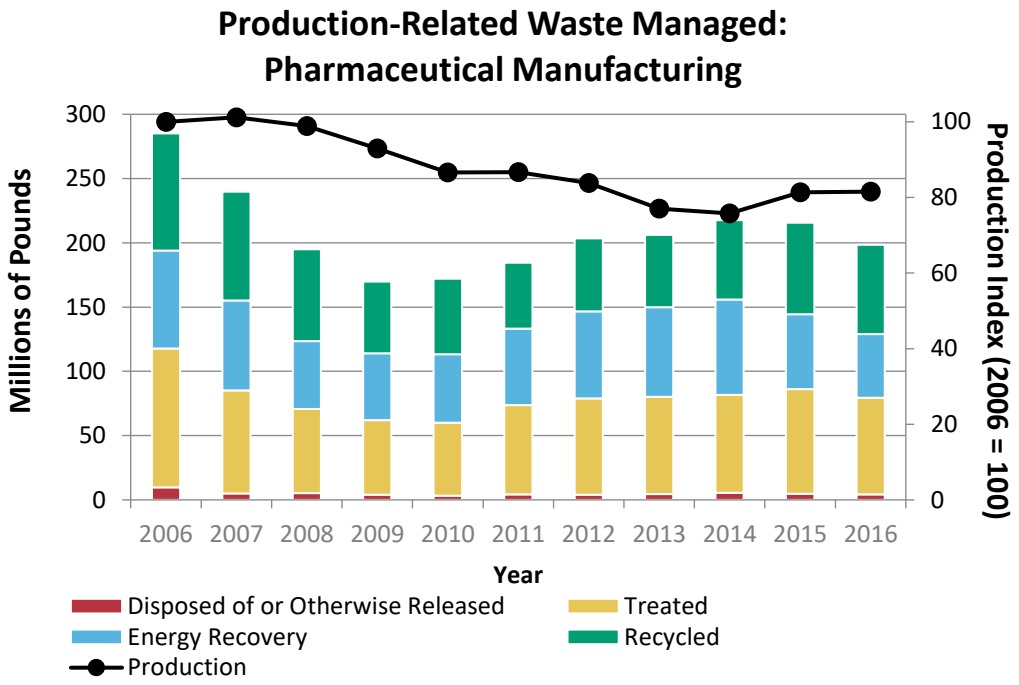
View Larger Map

The pharmaceutical sector includes facilities that manufacture pharmaceutical and medicinal products. It includes sectors under NAICS 3254 engaged in: manufacturing biological and medicinal products; processing botanical drugs and herbs; isolating medicinal principals from botanical drugs and herbs; and manufacturing pharmaceutical products intended for internal and external consumption. This sector is highlighted here because it has one of the highest rates of source reduction reporting and has made significant progress in reducing its Toxics Release Inventory (TRI) release and other production-related waste quantities, especially through reduced use of chlorinated solvents.

Quick Facts for 2016: Pharmaceutical Manufacturing (NAICS 3254)	
Number of Facilities that Reported to TRI	**170**
Number of Facilities with New Source Reduction Activities	34
Production-Related Waste Managed	**198.5 million lb**
Recycled	69.4 million lb
Energy Recovery	49.7 million lb
Treated	75.1 million lb
Disposed or Otherwise Released	4.3 million lb
Total Disposal or Other Releases	**4.0 million lb**
On-site	**3.1 million lb**
Air	2.4 million lb
Water	0.6 million lb
Land	0.1 million lb
Off-site	**0.9 million lb**

Pharmaceutical Manufacturing Waste Management Trend

The following graph shows the annual quantities of TRI chemicals managed as waste by the pharmaceutical industry.



From 2006 to 2016:

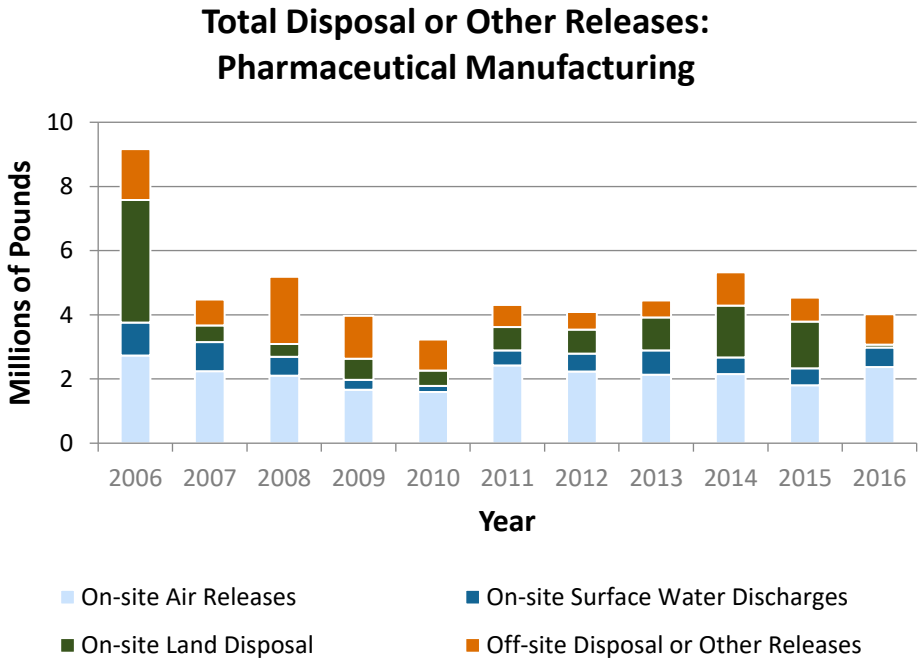
- Production-related waste managed by the pharmaceutical sector decreased through 2009, following the trend of reduced production resulting from the economic recession. Since 2009, quantities of waste managed increased through 2014, at which point production-related waste began to decrease. Overall, waste quantities have decreased by 30%.
- Production (represented by the black line as reported by the Federal Reserve Board, Industrial Production Index) decreased by 18%.

From 2015 to 2016:

- Production-related waste decreased by 8% (17 million pounds).
- In 2016, only 2% of the sector's waste was released into the environment, while the rest was managed through treatment, energy recovery, and recycling.

Pharmaceutical Manufacturing Releases Trend

The following graph shows the annual quantities of TRI chemicals released by the pharmaceutical industry.



From 2006 to 2016:

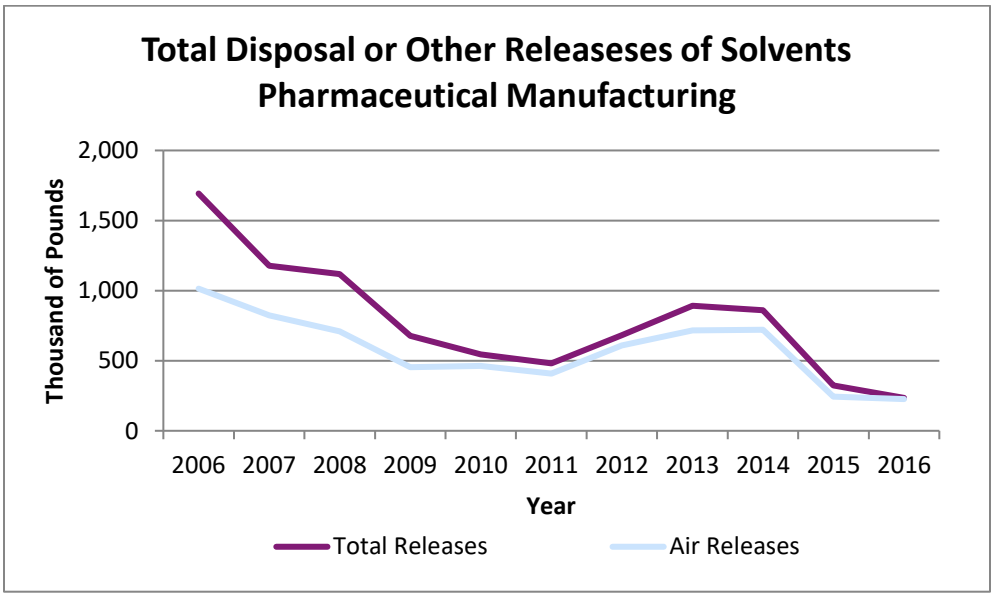
- The sector's total disposal or other releases decreased by 56% since 2006. This is primarily due to reductions in on-site land disposal.

From 2015 to 2016:

- Total releases decreased by 11% (0.5 million pounds).

Solvents in the Pharmaceuticals Sector:

Organic solvents are used in the pharmaceutical sector as reaction media and in separation and purification of synthesis products. In recent years, the sector has implemented efforts to reduce the use and release of solvents. The following graph shows the trend in releases of 20 solvents used by the pharmaceutical industry that are both TRI chemicals and are identified for further assossement under the Toxic Substances Control Act (TSCA). The TRI and Beyond section includes more information on TSCA and TRI.

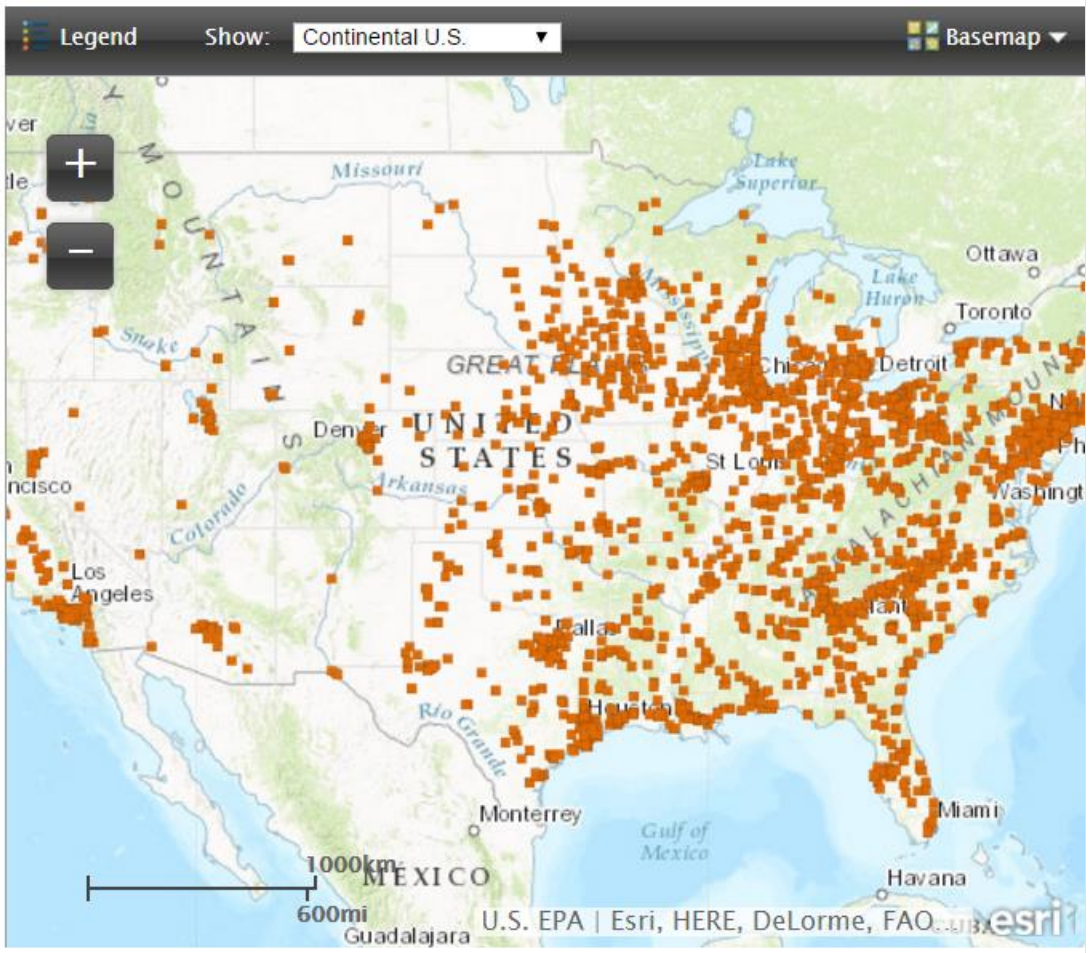


- Total releases of key solvents from the pharmaceutical industry have dropped by 1.5 million pounds (86%) since 2006. This is largely due to a reduction in air releases.

Source Reduction in the Pharmaceuticals Sector:

Twenty percent of pharmaceutical facilities initiated source reduction activities in 2016 that have reduced TRI chemical use and waste generation. The most commonly reported types of source reduction activitites were good operating practices and process modifications. For example, one pharmaceutical facility developed alternative solutions to dichloromethane for use as a solvent which reduced the amount used in chemistry research and process development activities. TRI's Pollution Prevention Search Tool can help you learn more about pollution prevention opportunities in this sector.

Chemical Manufacturing



Chemical Manufacturing Facilities Reporting to TRI, 2016

View Larger Map

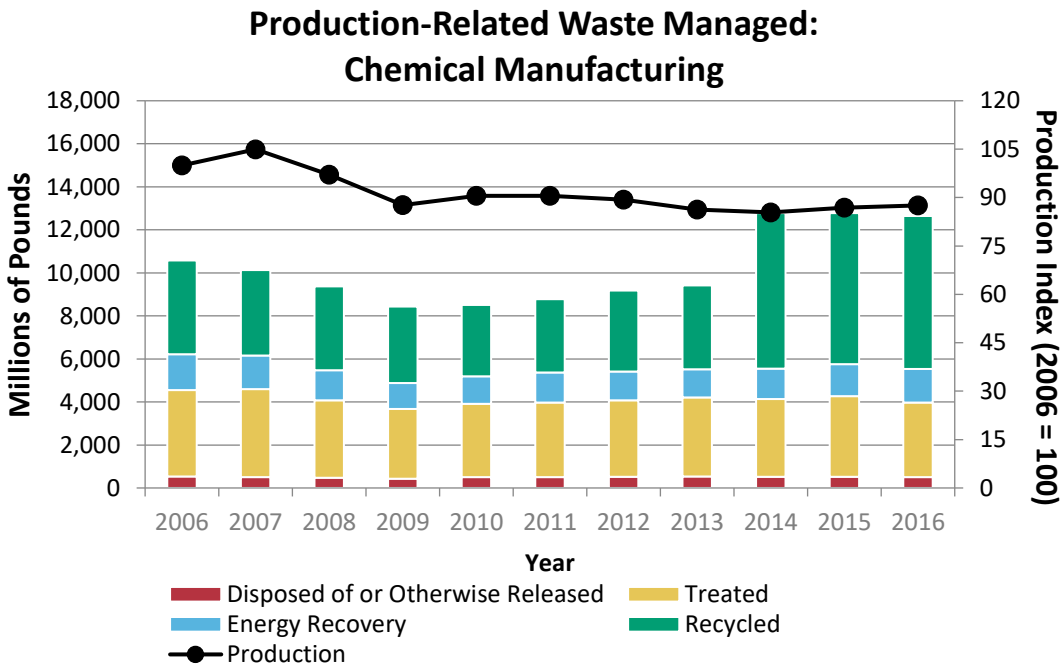
Chemical manufacturers produce a variety of products, including basic chemicals, products used by other manufacturers (such as synthetic fibers, plastics, and pigments), pesticides, paints, and cosmetics, to name a few. For 2016, the chemical manufacturing sector had the most facilities (3,456, 16% of facilities that reported for 2016) report to the Toxics Release Inventory (TRI) and reported 47% of all production-related waste managed; more than any other sector.

Quick Facts for 2016: Chemical Manufacturing (NAICS 325)	
Number of Facilities that Reported to TRI	**3,456**
Number of Facilities with New Source Reduction Activities	482
Production-Related Waste Managed	**12,978.1 million lb**
Recycled	7,186.8 million lb
Energy Recovery	1,658.4 million lb
Treated	3,628.1 million lb
Disposed or Otherwise Released	504.7 million lb
Total Disposal or Other Releases	**499.8 million lb**
On-site	**432.5 million lb**
Air	159.8 million lb
Water	27.3 million lb
Land	245.3 million lb
Off-site	**67.3 million lb**

Note: Numbers may not sum exactly due to rounding.

Chemical Manufacturing Waste Management Trend

The following graph shows the annual quantities of TRI chemicals managed as waste by the chemical manufacturing industry.



From 2006 to 2016:

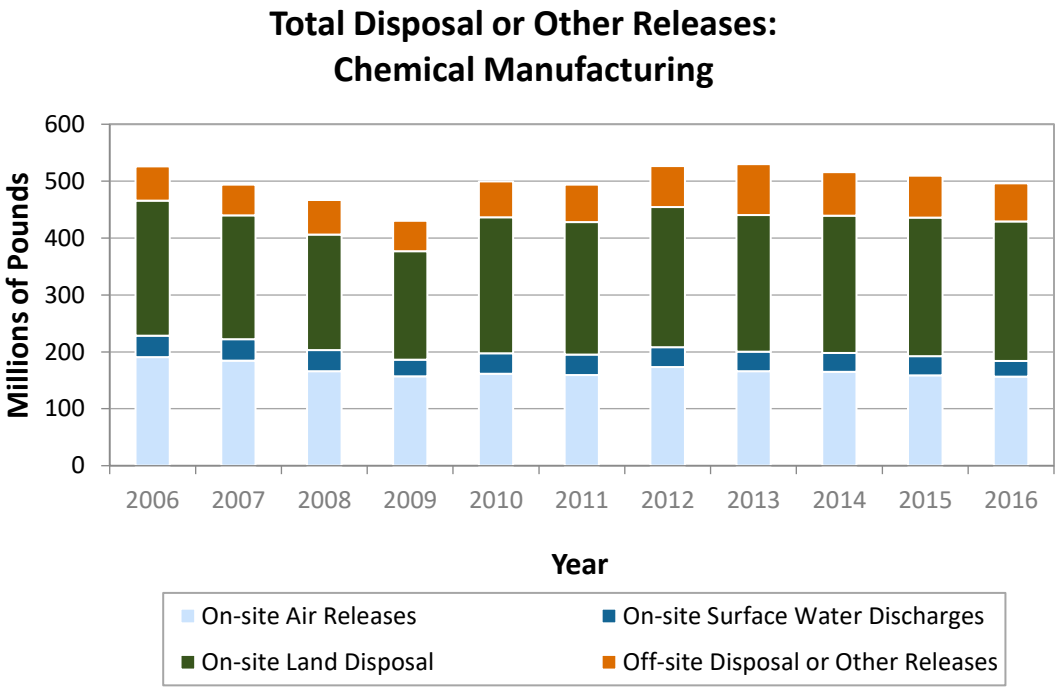
- Production-related waste managed by the chemical manufacturing sector increased by 20%, while production (represented by the black line as reported by the Federal Reserve Board, Industrial Production Index) decreased by 12%.
    - The large increases in recycled waste in 2014, 2015, and 2016 are due to the quantity of recycled cumene reported by one facility. Excluding this amount, the total quantities of waste recycled decreased by 13% and production-related waste managed decreased by 12%.
- Quantities of TRI chemicals released, treated, or used in energy recovery decreased, while the quantities of TRI chemicals recycled increased by 63%.

From 2015 to 2016:

- Production-related waste managed decreased by 129 million pounds (1%).
- In 2016, only 4% of the 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 annual quantities of TRI chemicals released by the chemical manufacturing industry.



From 2006 to 2016:

- Total releases by the chemical manufacturing sector decreased by 6%. This was primarily due to reductions in on-site surface water discharges and air emissions.
- On-site releases to land and off-site disposal increased slightly.

From 2015 to 2016:

- Total releases decreased by 13 million pounds (3%).
- For 2016, the chemical manufacturing sector reported larger quantities of TRI chemicals as released to air than any other sector, accounting for 26% of all reported quantities of TRI chemicals emitted to air.

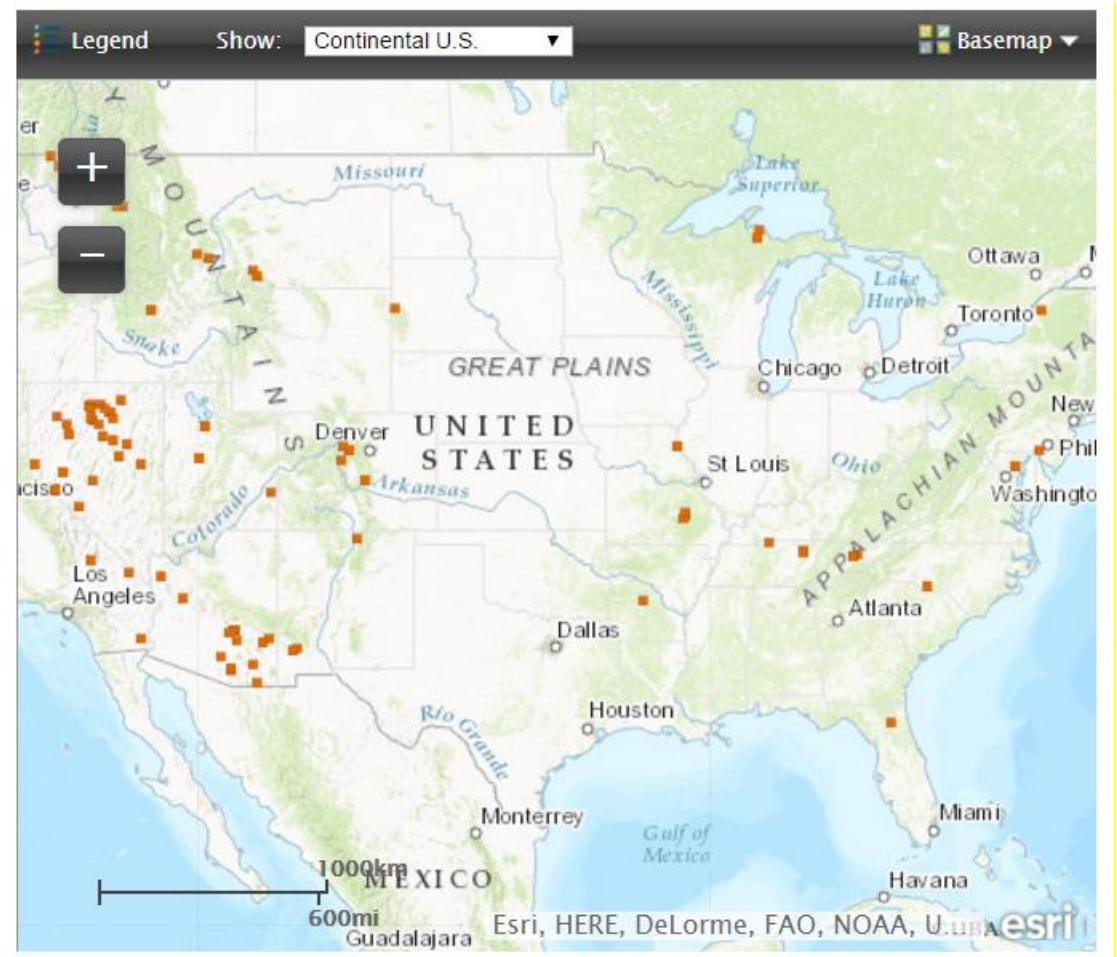
Source Reduction in the Chemical Manufacturing Sector:

Although chemical manufacturing has consistently been the sector with the most production-related waste managed, 14% of facilities (almost 500 facilities) in the sector initiated source

reduction activities 2016 to reduce their TRI chemical use and waste generation. The most commonly reported types of source reduction activities were good operating practices and process modifications. For example, an ethyl alcohol manufacturing facility reduced waste by discontinuing the use of anhydrous ammonia in their ethanol process. TRI's Pollution Prevention Search Tool can help you learn more about pollution prevention opportunities in this sector.

For more information on how this sector and others can choose safer chemicals, visit EPA's Safer Choice Program pages for Alternatives Assessments and the Safer Choice Ingredients List.

Metal Mining



Metal Mines Reporting to TRI, 2016

View Larger Map

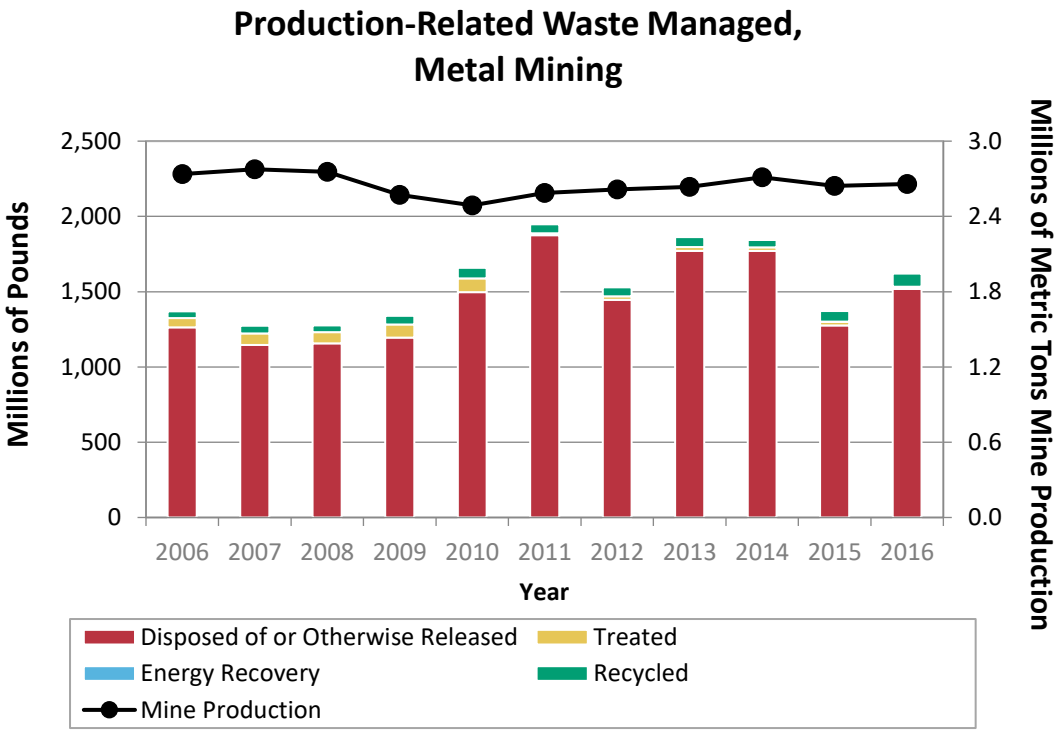
The portion of the metal mining sector covered by Toxics Release Inventory (TRI) reporting requirements includes facilities mining copper, lead, zinc, silver, gold, and several other metals. For 2016, 86 metal mining facilities reported to TRI. They tend to be in Western states where most of the copper, silver, and gold mining occurs; however, zinc and lead mining tend to occur in Missouri, Tennessee, and Alaska. Metals generated from U.S. mining operations are used in a wide range of products, including automobiles and electric and industrial equipment. The extraction and beneficiation or other processing of these minerals generate large amounts of waste.

Quick Facts for 2016: Metal Mining (NAICS 2122)	
Number of Facilities that Reported to TRI	**86**
Number of Facilities with New Source Reduction Activities	2
Production-Related Waste Managed	**1,620.4 million lb**
Recycled	87.6 million lb
Energy Recovery	0.003 million lb
Treated	15.4 million lb
Disposed or Otherwise Released	1,517.4 million lb
Total Disposal or Other Releases	**1,517.8 million lb**
On-site	**1,511.7 million lb**
Air	1.8 million lb
Water	0.5 million lb
Land	1,509.4 million lb
Off-site	**6.1 million lb**

Note: Numbers may not sum exactly due to rounding.

Metal Mining Waste Management Trend

The following graph shows the annual quantities of TRI chemicals managed as waste by the metal mining industry.



From 2006 to 2016:

- While metal mining production (as reported in the United States Geological Survey) remained relatively steady, the quantity of waste managed fluctuated.
- One factor other than production frequently cited by facilities as a contributor to the changes in quantities of waste managed is the composition of the extracted ore and waste rock, which can vary substantially from year to year. In some cases, small changes in the waste's composition can impact whether chemicals in waste rock qualify for a concentration-based exemption from TRI reporting in one year, but not qualify for the exemption the next year or vice versa.

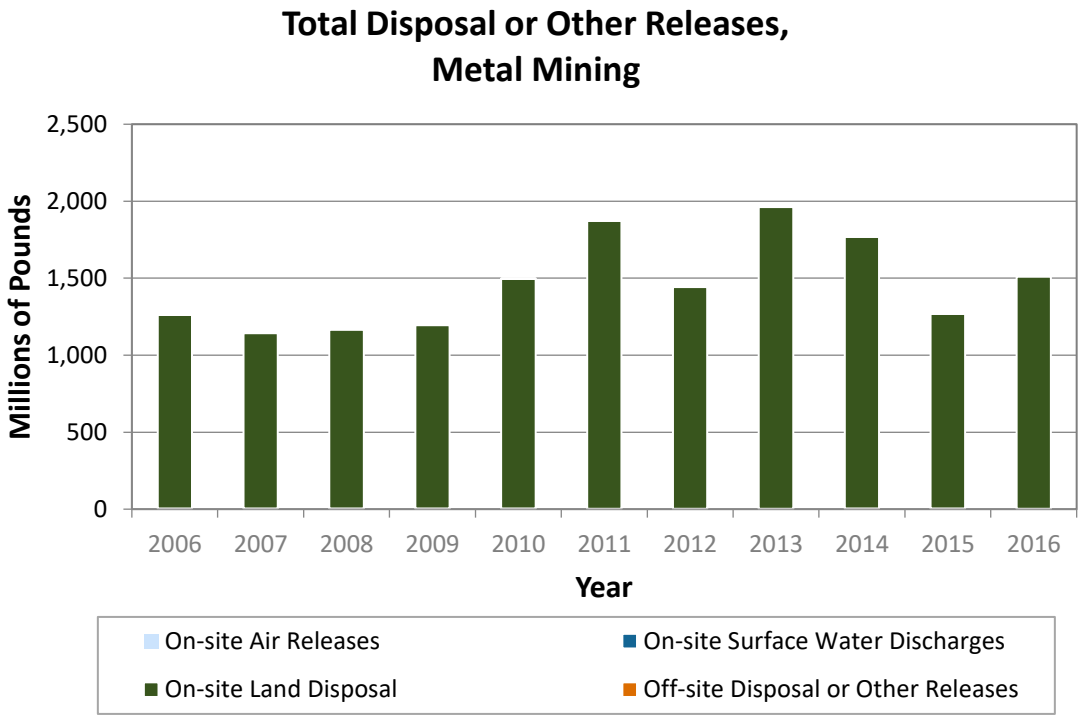
From 2015 to 2016:

- The quantity of waste disposed of or otherwise released by this sector increased 19% between 2015 and 2016.

- One mine where releases of lead compounds increased significantly from 2015 to 2016 commented that lead compounds naturally occur in ore and releases are dependent on ore grade, among other variables. Natural variation accounts for the difference in lead compounds released from year to year.
- For 2016, 94% of the metal mining sector's production-related waste was disposed of or otherwise released. A majority of this waste was for metals, which were primarily released to land on-site.

Metal Mining Releases Trend

The following graph shows the annual quantities of TRI chemicals released by the metal mining industry.



From 2006 to 2016:

- More than 99% of the metal mining sector's releases were in the form of on-site land disposal. On-site land disposal by metal mines has fluctuated in recent years, increasing significantly in 2013, decreasing in 2014 and 2015, and then increasing again in 2016.
- Several mines have reported that changes in production and changes in the chemical composition of the deposit being mined are the primary causes of fluctuations in the amount of chemicals reported.
- Metal mining facilities typically handle large volumes of material, and even a small change in the chemical composition of the deposit being mined can lead to big changes in the amount of TRI chemicals reported nationally.

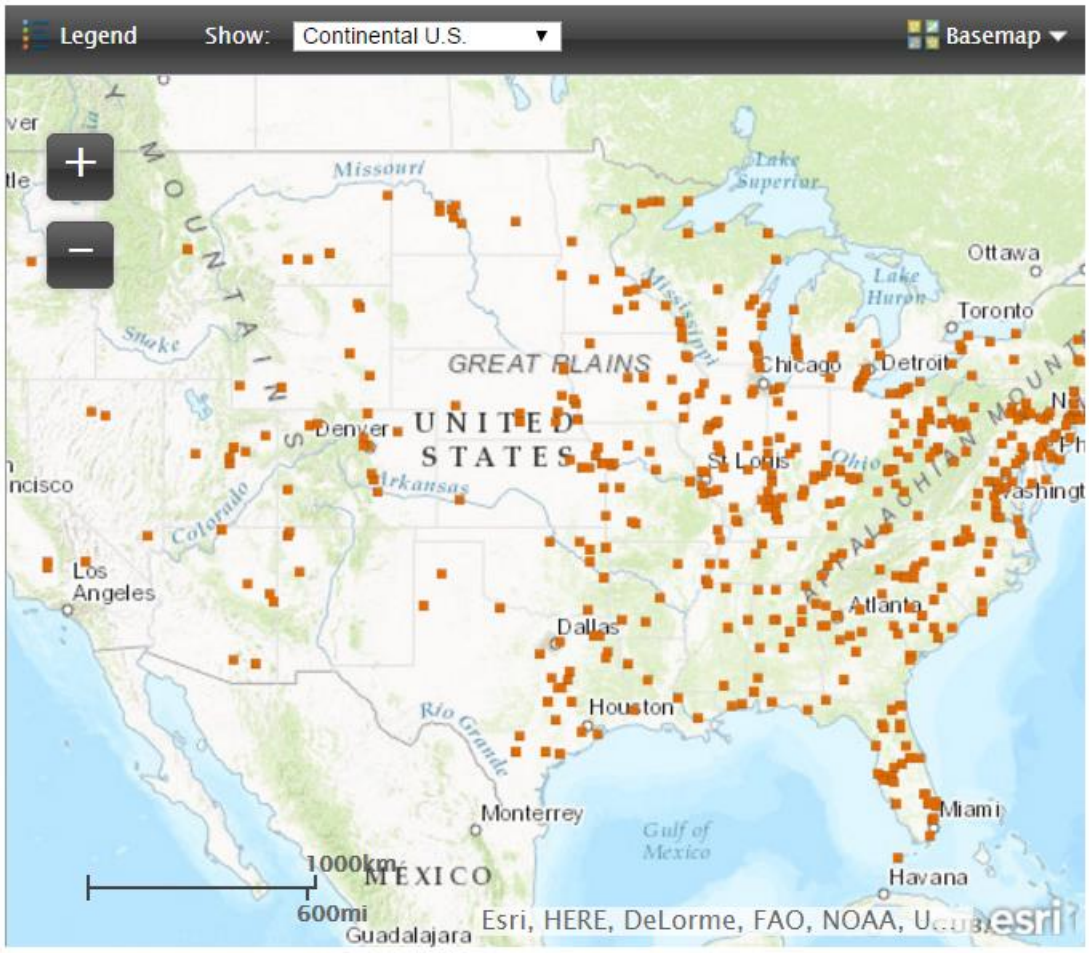
In 2016:

- The metal mining sector reported the largest quantity of total disposal or other releases, accounting for 44% of total releases and 66% of on-site land disposal for all industries.

Source Reduction in the Metal Mining Sector:

Two of the 86 metal mining facilities inititated source reduction activities in 2016 to reduce their use of TRI chemicals, and generation of wastes that contain TRI chemicals. Wastes reported by this sector are not especially amenable to source reduction, because they primarily reflect the natural composition of the ore and waste rock. TRI's Pollution Prevention Search Tool can help you learn more about pollution prevention opportunities in this sector.

Electric Utilities



Electric Utilities Reporting to TRI, 2016

View Larger Map

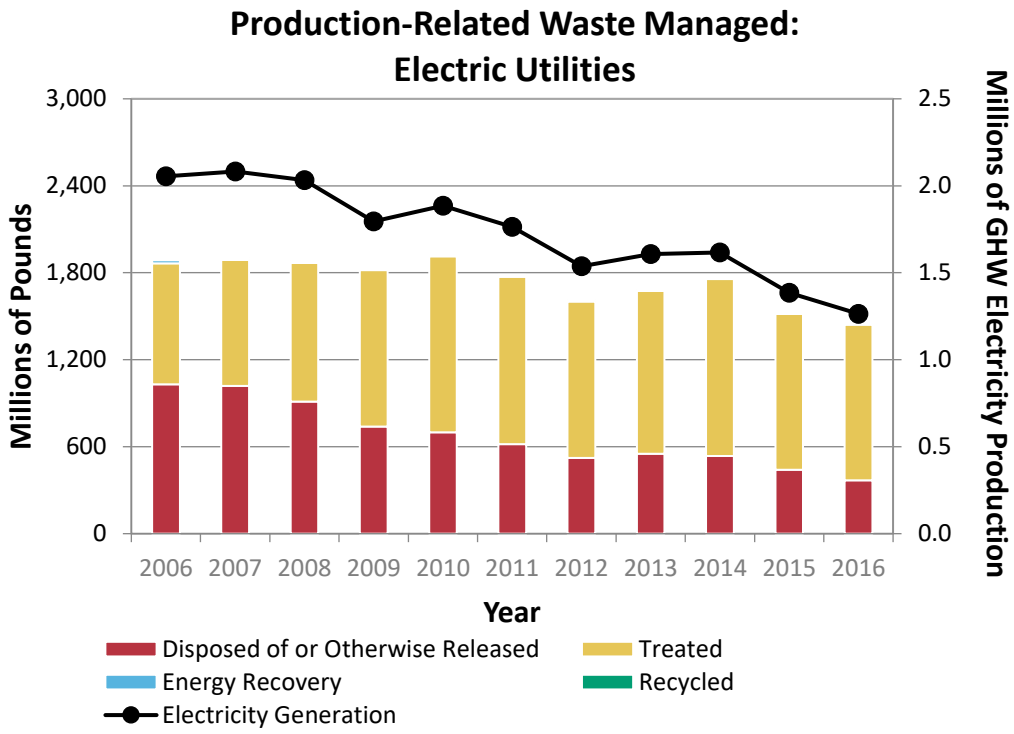
The electric utilities sector consists of establishments primarily engaged in generating, transmitting, and distributing electric power. Electric-generating facilities use a variety of fuels to generate electricity; however, only the combustion of coal or oil to generate power for distribution in commerce is covered under Toxics Release Inventory (TRI) reporting requirements. For 2016, 494 electricity generating facilities reported to the TRI Program.

Quick Facts for 2016: Electric Utilities (NAICS 2211)	
Number of Facilities that Reported to TRI:	**494**
Number of Facilities with New Source Reduction Activities	22
Production-Related Waste Managed	**1,447.1 million lb**
Recycled	4.4 million lb
Energy Recovery	0.2 million lb
Treated	1,074.2 million lb
Disposed or Otherwise Released	368.3 million lb
Total Disposal or Other Releases	**368.3 million lb**
On-site	**304.5 million lb**
Air	86.3 million lb
Water	3.3 million lb
Land	214.9 million lb
Off-site	**63.8 million lb**

Note: Numbers may not sum exactly due to rounding.

Electric Utilities Waste Management Trend

The following graph shows the annual quantities of TRI chemicals electric utility facilities manage as waste.



From 2006 to 2016:

- Production-related waste managed decreased by 453 million pounds (24%) since 2006.
- Net electricity generation decreased by 38% (in terms of electricity generated using coal and oil fuels as reported by the U.S. Department of Energy's Energy Information Administration). The recent production decrease (beginning in 2014) was driven by the industry's transition to natural gas, as only facilities that combust coal or oil to produce power are covered under TRI reporting requirements.
- Per gigawatt-hour (GWH) produced, releases decreased dramatically (42%), while quantities treated increased.

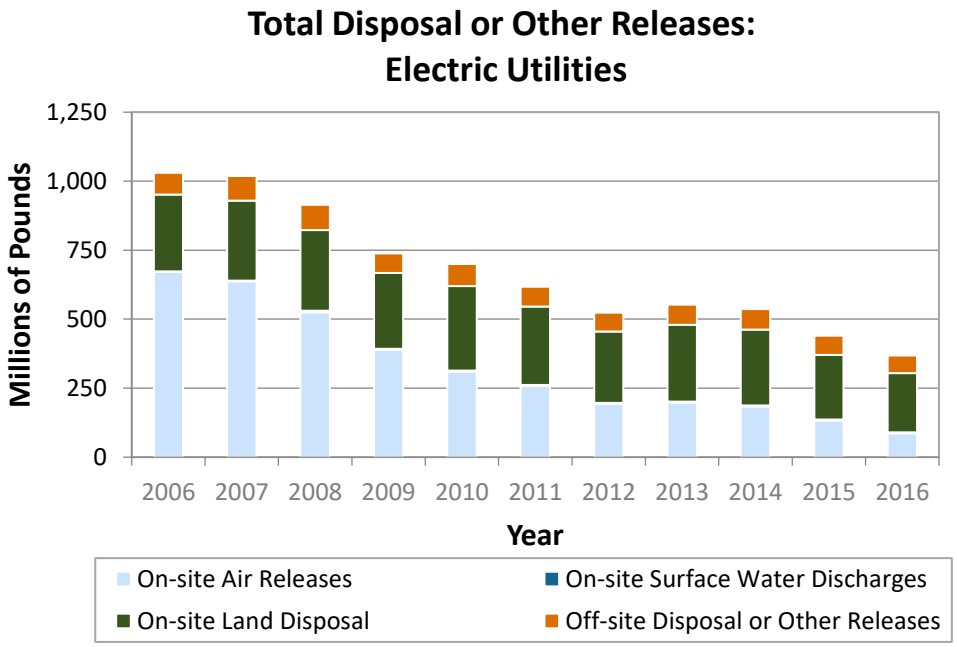
In 2016:

- Approximately three-quarters of the total production-related waste was treated, while one-quarter was released to the environment.

- This is in contrast to 2006, when over half of the waste was released. This trend is largely due to an increase in scrubbers at electric utilities that treat (or destroy) TRI reportable acid gases that would otherwise be released on-site to the air.

Electric Utilities Releases Trend

The following graph shows the annual quantities of TRI chemicals electric utility facilities released or disposed.



From 2006 to 2016:

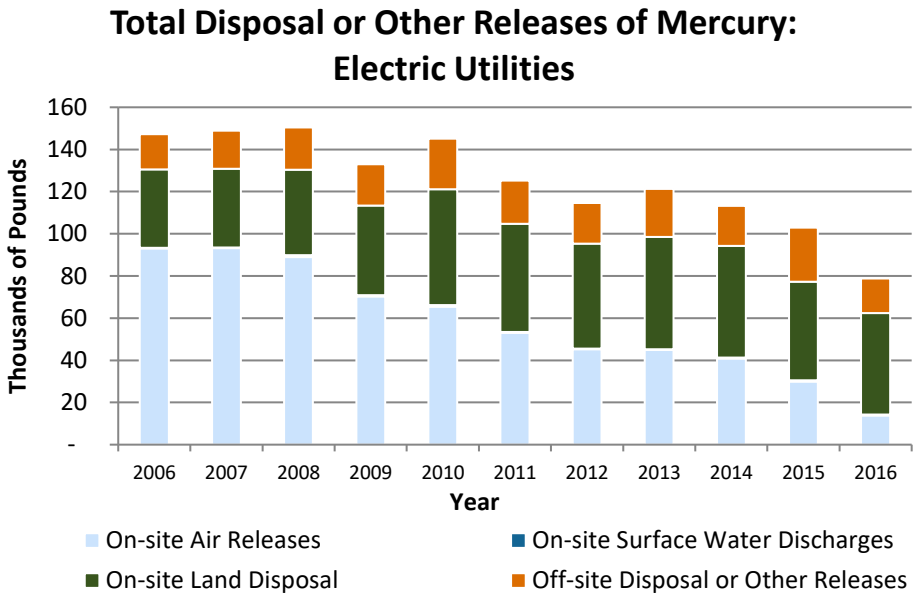
- Releases from the electric utilities sector decreased by 64%. This decrease was driven by an 87% decrease in on-site air releases. On-site land disposal and off-site disposal also decreased, but to a lesser extent.

From 2015 to 2016:

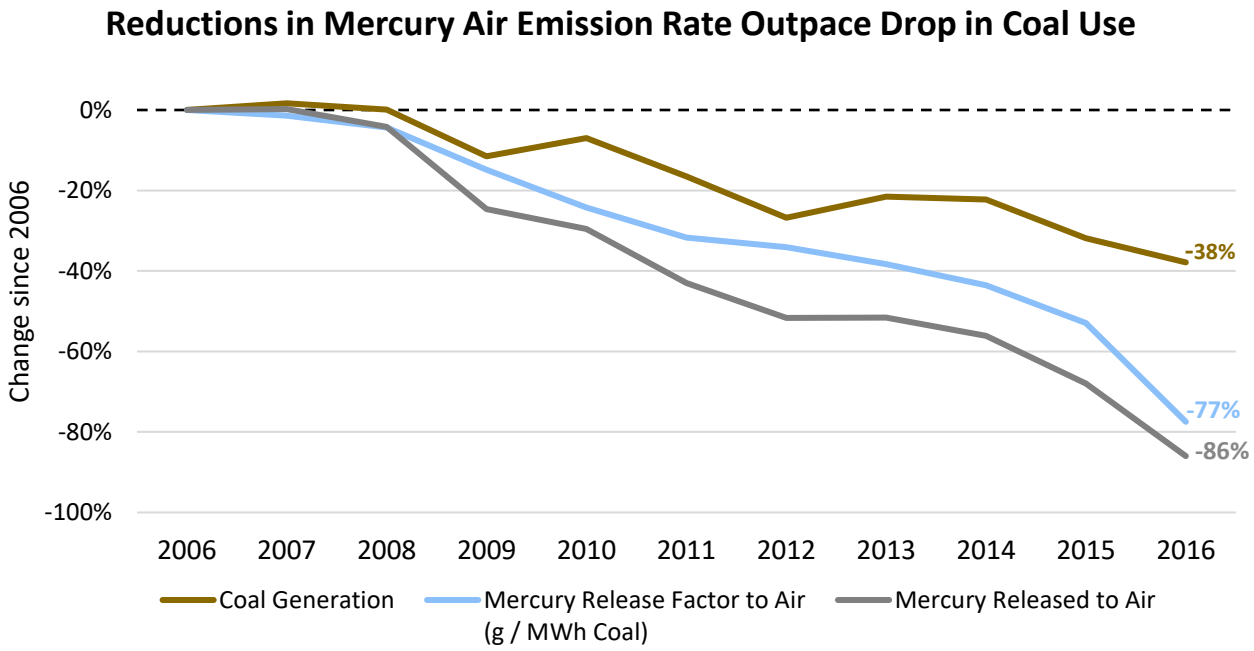
- Releases by electric utilities decreased by 16% (73 million pounds). This decrease was driven by decreases in on-site air releases and off-site land disposal.

Electric Utilities Mercury Releases

Coal and fuel oil contain trace amounts of mercury. When coal or oil is burned by power plants to produce energy, mercury can be emitted to air in the form of stack emissions unless removed by pollution control devices. Examining the trend in mercury emissions shows that the sector's releases dropped by 46% (68 thousand pounds) since 2006:



- The considerable decrease in mercury releases was driven by an 86% (79 thousand pounds) decrease in mercury air emissions. This drop was offset somewhat by increased releases of mercury to land.
- While decreased use of coal to generate electricity does play a role, mercury releases per gigawatt-hour (GWh) of electricity generated dropped even more dramatically.



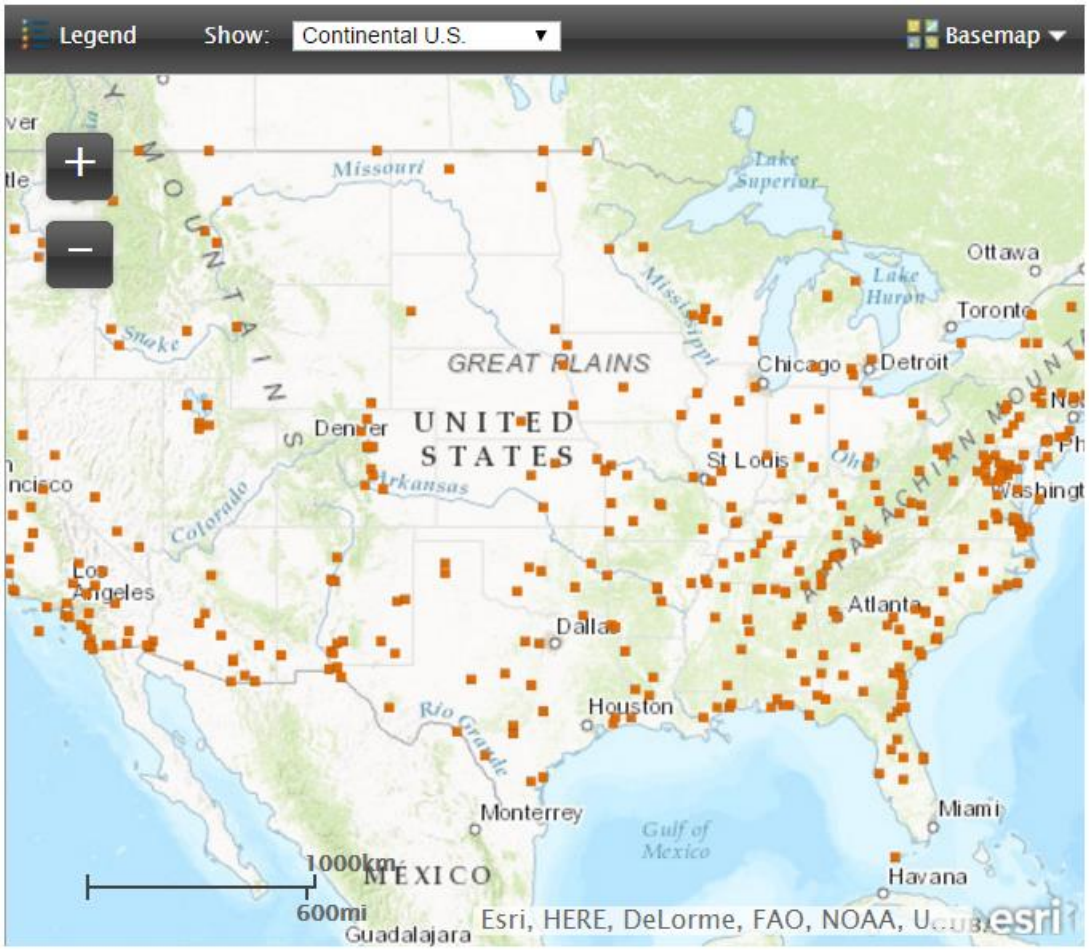
- Since 2006, net electricity generation from coal decreased by 38%, while the rate of release of mercury to air per GWh of electricity generated from coal dropped 77%.
- In 2016, over three times as much mercury (in coal ash) was disposed of on land compared to mercury released to air. In 2006, the amount of mercury disposed on land was less than half that released to air. This shift in the release trend reflects higher rates of mercury capture and disposal due to improved air emissions controls, such as activated carbon injection systems installed at electric utilities.
- The recent rise in installations of equipment to control mercury air emissions at coal-fired power plants to meet regulatory requirements is detailed in a data analysis by the U.S. Energy Information Administration.

Source Reduction in the Electric Utilities Sector:

In the electric utilities sector, 22 (4%) facilities initiated source reduction activities in 2016 to reduce their use of TRI chemicals and generation of wastes that contain TRI chemicals. Note that adding treatment equipment is considered a control technology for TRI chemical waste that is generated, and is not a source reduction activity that prevents waste from being generated. The most commonly reported types of source reduction activities for this sector were good operating practices and process modifications, which include activities such as modifying

equipment, layout, or piping. TRI's Pollution Prevention Search Tool can help you learn more about pollution prevention opportunities in this sector.

Federal Facilities



Federal Facilities Reporting to TRI, 2016

View Larger Map

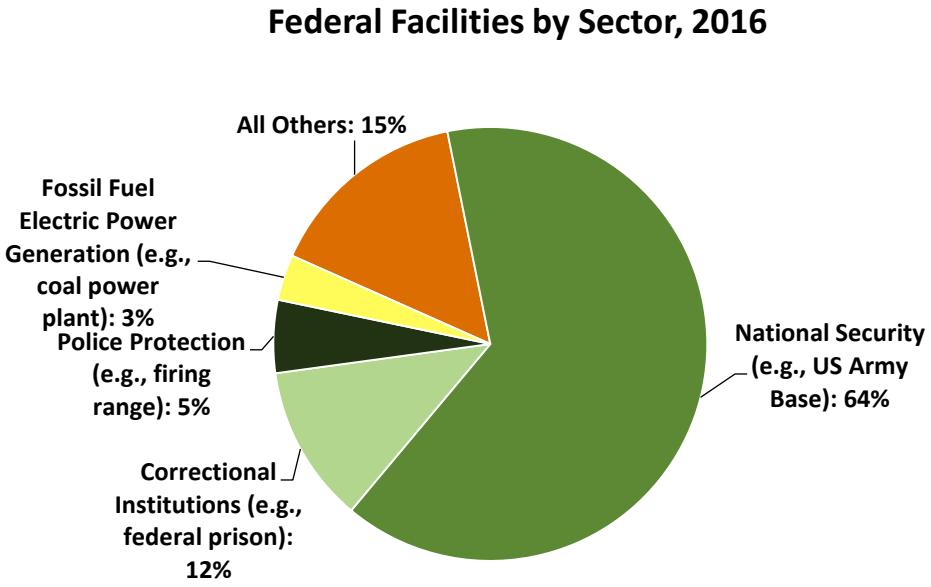
Under the 1993 Executive Order 12856, "Federal Compliance with Right-to-Know Law and Pollution Prevention Requirements," all federal facilities are subject to the Toxics Release Inventory (TRI) reporting requirements, regardless of the type of operations at the facility, as described by their NAICS code. These actions were affirmed in March 2015 through Executive Order 13693, "Planning for Federal Sustainability in the Next Decade." Due to these requirements, federal facilities are subject to the TRI reporting requirements.

Quick Facts for 2016: Federal Facilities (All Sectors)	
Number of Facilities that Reported to TRI:	**442**
Number of Facilities with New Source Reduction Activities	22
Production-Related Waste Managed	**185.0 million lb**
Recycled	42.5 million lb
Energy Recovery	0.2 million lb
Treated	92.1 million lb
Disposed or Otherwise Released	50.3 million lb
Total Disposal or Other Releases	**51.8 million lb**
On-site	**47.6 million lb**
Air	11.4 million lb
Water	14.7 million lb
Land	21.5 million lb
Off-site	**4.2 million lb**

Note: Numbers may not sum exactly due to rounding.

Federal Facilities by Industry

The following pie chart shows the number of federal facilities reporting to the TRI Program by sector for 2016.

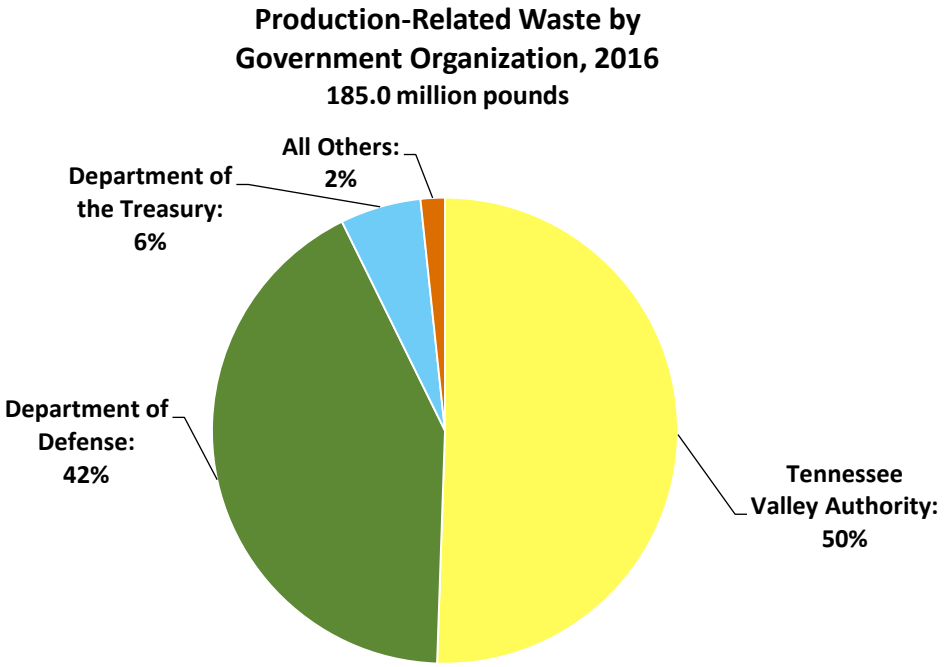


For the year 2016, 442 federal facilities in 34 different types of operations (based on their 6-digit NAICS codes) reported to the TRI Program. Almost two-thirds of these facilities were in the National Security sector, which includes Department of Defense facilities such as Army and Air Force bases. All federal facilities are subject to TRI reporting requirements regardless of their sector. Therefore, for some industry sectors, the TRI database only includes data from federal facilities. More than three-quarters of federal facilities are in such sectors, including Military Bases (64%); Correctional Institutions (12%); and Police Protection, such as training sites for Border Patrol stations (5%).

As with non-federal facilities, activities at federal facilities drive the types and quantities of waste managed that is reported. Some of the activities at federal facilities that are captured by TRI reporting are similar to those at non-federal facilities, such as hazardous waste treatment. In other cases, federal facilities may report waste managed from specialized activities that are not usually performed by non-federal facilities. For example, all of the federal facilities included under Police Protection and Correctional Institutions only reported for lead and lead compounds, likely due to the use of lead ammunition on firing ranges at these facilities.

Waste Management by Federal Facilities

The following pie chart shows the percentages of TRI chemicals managed as waste by federal government organizations in 2016.



- The types of waste reported by federal facilities vary by the type of operation.
    - The Tennessee Valley Authority (TVA) is a government-owned electric utility that provides power to southeastern states. Out of the 18 TVA facilities that reported to TRI for 2016, virtually all of the TRI production-related waste comes from the fossil fuel plants that report in the Fossil Fuel Electric Power Generation sector. More than 80% of their reported waste was hydrochloric and sulfuric acid aerosols which were mostly treated on-site.
    - The Department of the Treasury facilities reporting to TRI are mints for manufacturing currency and, accordingly, they report as metals (e.g., copper and nickel) to TRI. More than 99% of their metal waste is recycled off-site.

Source Reduction at Federal Facilities:

Since federal facilities are subject to TRI reporting regardless of their industry sector classification, their operations are diverse and few focus on manufacturing processes. Due to

their unique functions, some federal facilities may face challenges in implementing source reduction strategies to reduce chemical waste. For the 2016 reporting year, 22 federal facilities (5%) reported implementing source reduction activities.

Facilities that do not implement source reduction activities may elect to indicate the types of barriers to source reduction they encountered. For federal facilities, most of the facilities that indicate barriers to implementing source reduction are national security or correctional institutions that report on lead or copper. For example, several facilities in the National Security sector indicated that they reported on lead because it is contained in the ammunition used on site and they have not been able to identify ammunition that does not contain lead. However, other federal facilities have been able to implement some source reduction activities. To find examples of federal facilities' source reduction activities, visit TRI's Pollution Prevention Search Tool and select industry sectors, such as National Security, Correctional Institutions, or Police Protection.