

# The Toxics Release Inventory (TRI) and Emissions Reduction Measures

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## Abstract

EPA's Toxics Release Inventory (TRI) Program collects a wealth of standardized multimedia environmental information from more than 20,000 industrial facilities each year. The TRI's unique combination of quantitative and qualitative information makes it a valuable resource for tracking environmental progress and identifying sustainable practices that have led to measureable improvements.

With respect to air toxics, TRI collects information on both emission quantities and the source reduction and pollution control measures that facilities have undertaken to reduce them. Since 2012, EPA has taken steps to enhance TRI data on emission reduction measures and to make these data more accessible, meaningful, and intelligible. To this end, TRI's new Pollution Prevention (P2) Search Tool (available at [www.epa.gov/tri/p2](http://www.epa.gov/tri/p2)) allows users to identify practices that have contributed to the largest decreases in emissions and to graphically compare facilities and companies using a variety of environmental metrics from both TRI and the Greenhouse Gas Reporting Program (GHGRP). This paper describes the information and insights offered by the TRI P2 Tool with respect to air toxics. It also examines the cumulative impacts that different P2 techniques have had on emissions using a statistical technique known as a differences-in-differences approach.

## **Overview of the Toxics Release Inventory (TRI) Program**

The TRI program tracks the management of over 650 toxic chemicals that may pose a threat to human health and the environment. U.S. facilities in different industry sectors must report annually how much of each chemical is released to the environment and managed through recycling, energy recovery and treatment. The information submitted by facilities is compiled in the Toxics Release Inventory. TRI's unique combination of quantitative and qualitative information make it a valuable resource for tracking environmental progress at facilities and identifying sustainable practices that have led to measurable improvements.

The TRI Program was created in response to several events that raised public concern about local preparedness for chemical emergencies and the availability of information on hazardous substances. On December 4, 1984 a cloud of toxic methyl isocyanate gas escaped from a Union Carbide Chemical plant in Bhopal, India and killed thousands of people, in one of the worst industrial disasters in history. Then in 1985 a serious chemical release occurred at a similar plant in West Virginia. These disasters prompted Congress to pass the Emergency Planning and Community Right-to-Know Act (EPCRA) in 1986, to support and promote emergency planning and to provide the public with information about releases of toxic chemicals in their community. TRI reporting was subsequently expanded by the Pollution Prevention Act of 1990, which created a framework for tracking industrial facilities' progress towards nationwide pollution prevention goals.

Facilities that report to TRI:

- are in a covered industry sector (including manufacturing, metal mining, electric power generation, and hazardous waste treatment);
- have at least 10 full-time equivalent employees; and
- manufacture, process, or otherwise use a threshold amount of a TRI chemical.

Users of TRI data should be aware that TRI captures a significant portion of toxic chemicals in wastes that are managed by industrial facilities, but it does not cover all toxic chemicals or all industry sectors of the U.S. economy. Furthermore, the quantities of chemicals reported to TRI are self-reported by facilities using readily-available data.

### **Air Emissions Information in TRI**

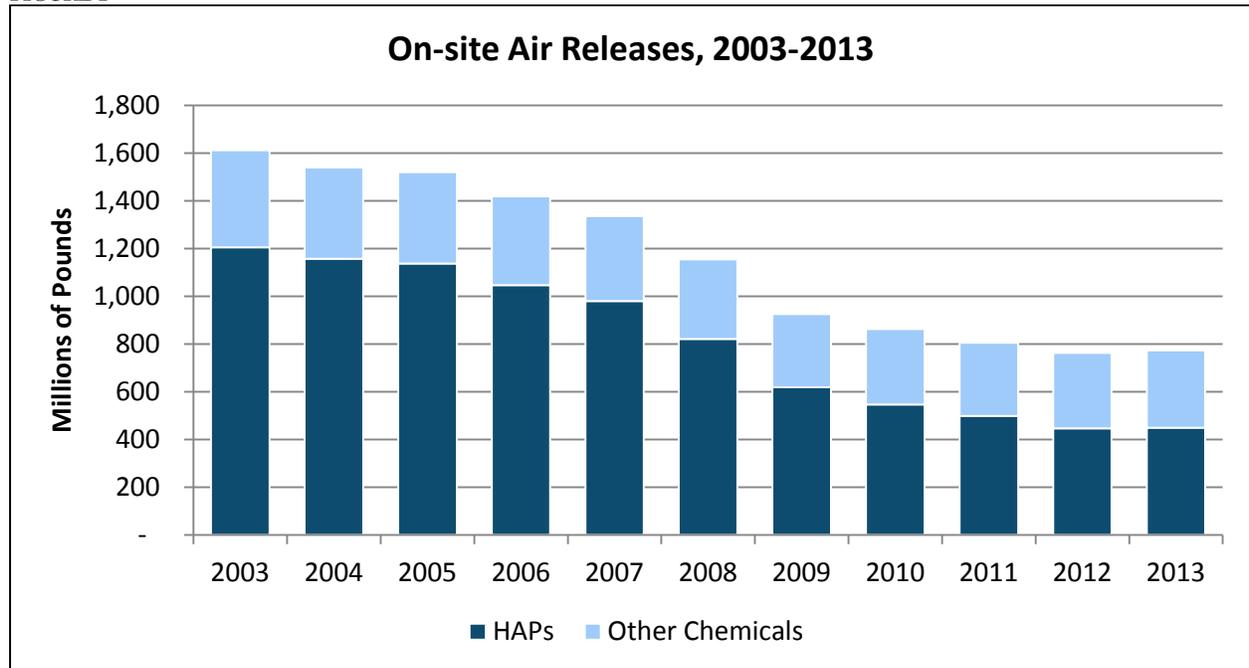
TRI collects data specifically related to facility air emissions, including:

- On-site fugitive air emissions
- On-site stack air emissions
- The basis of estimate for emission quantities
- On-site treatment methods for gaseous wastestreams and associated destruction or removal efficiency

This information can be used to analyze trends in air emissions over time or to look at a facility's specific waste management practices. The following sections take a closer look at national trends in air emissions.

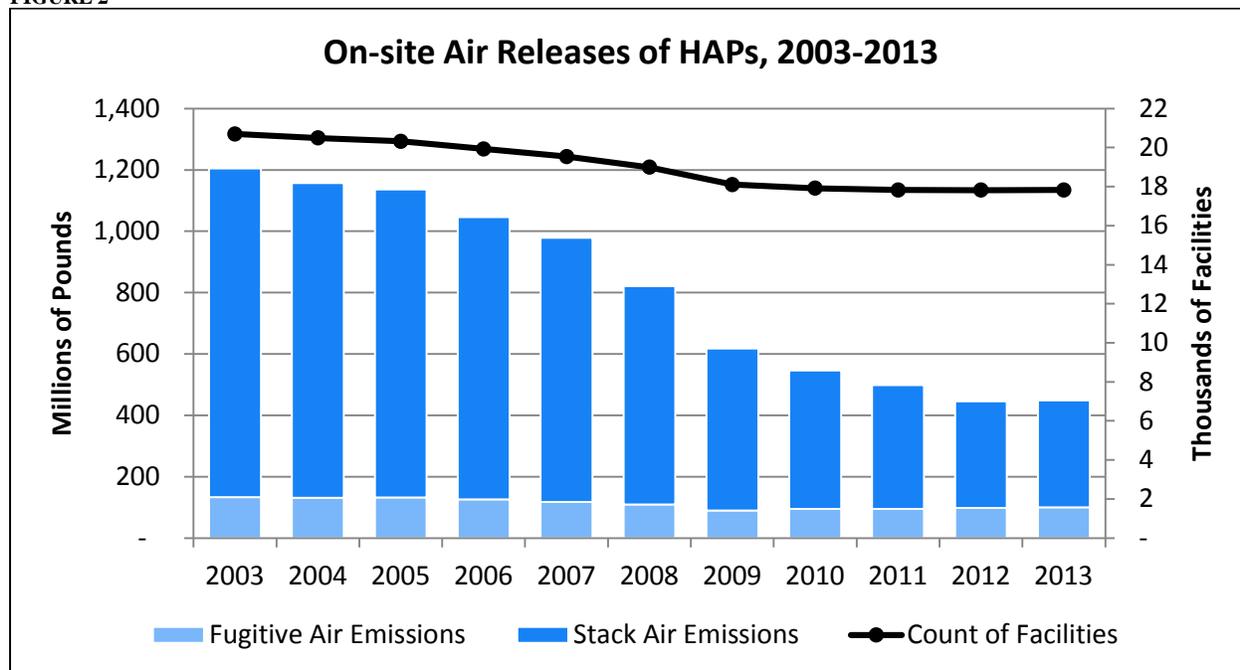
## On-Site Fugitive and Stack Air Emissions

FIGURE 1



On-site air releases of TRI-reportable chemicals have decreased by 52%, or 838 million pounds, from 2003 to 2013. As illustrated in Figure 1, this change has primarily been driven by a decrease in hazardous air pollutants (HAPs), which account for 90% of the decrease in TRI air emissions. One of the drivers of decreasing HAP emissions is electric utilities' shift away from coal to other fuel sources, and the installation of new control technologies at coal-fired power plants. As shown in Figure 2, this shift has resulted in a significant national decrease in stack air emissions. Stack air emissions of HAPs reported to TRI decreased by 68% from 2003 to 2013, and account for over 95% of the overall decrease in HAP air emissions.

FIGURE 2



**Greatest Decreases in Air Emissions**

Figure 3 and Figure 4 present the top five industries and chemicals with the greatest decrease in HAP air emissions from 2003 to 2013. As indicated in these figures, the decrease in emissions of hydrochloric acid (HCl) at electric utilities is a driver of the overall decrease in air emissions reported to TRI. In fact, reported air releases of HCl at electric utilities has decreased by 468 million pounds (85%) from 2003 to 2013, and accounts for 56% of the national decrease in total air emissions (all chemicals and sectors). This decrease is partially due to increased treatment and the installation of new pollution control measures. The next sections of this paper look more closely at air emission control reported to TRI.

FIGURE 3

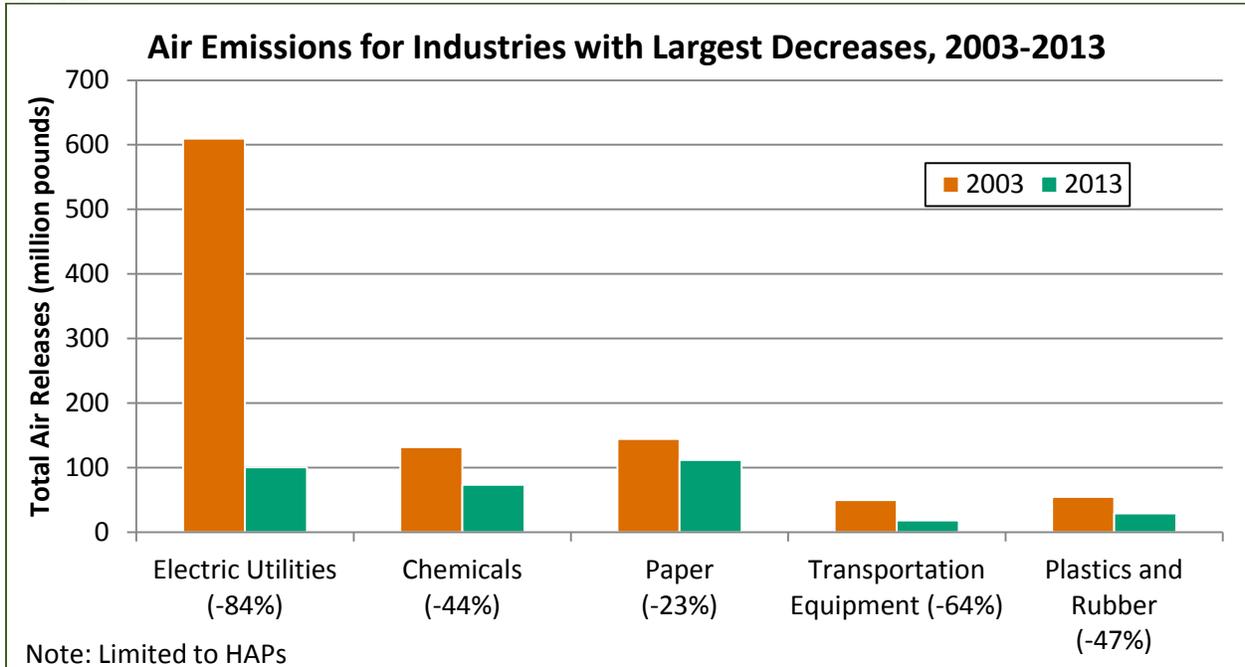
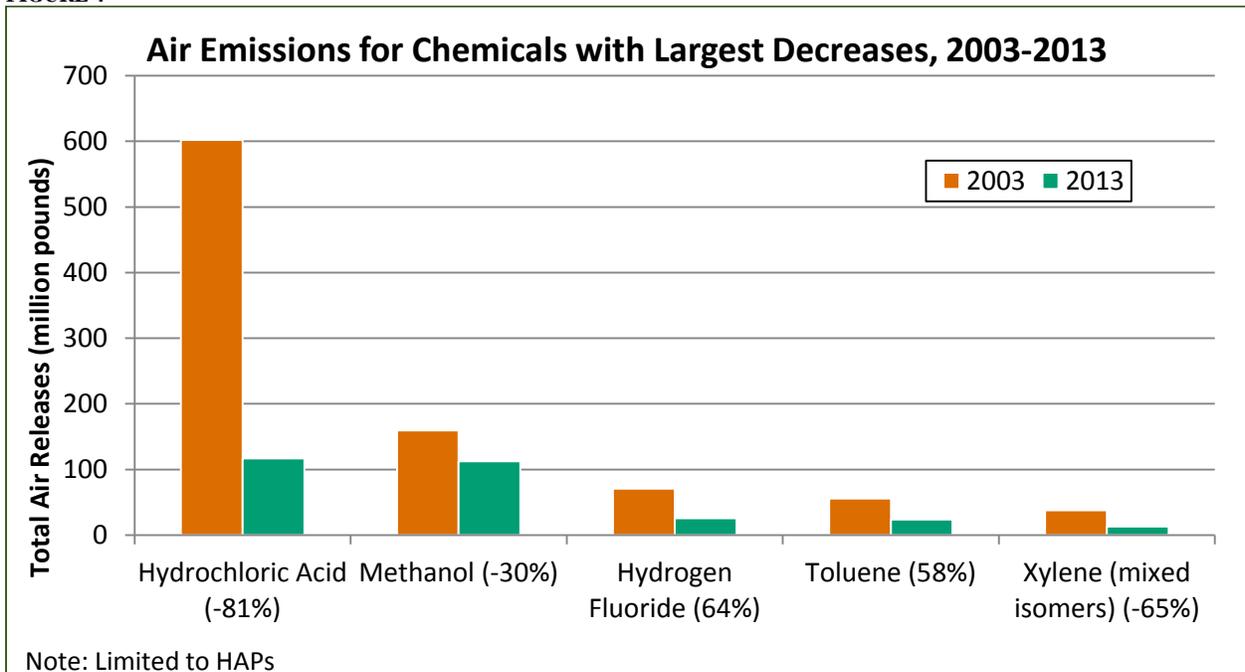


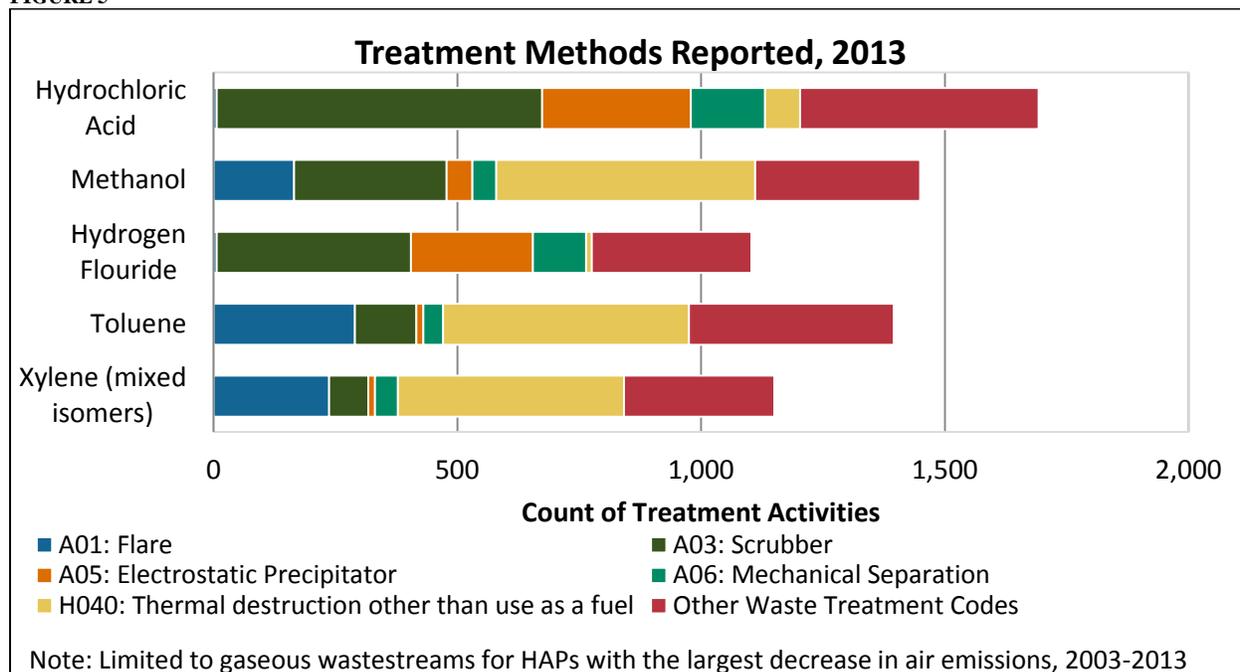
FIGURE 4



## Treatment and Treatment Efficiency in TRI

TRI facilities report the type and efficiency of waste treatment methods applied on-site to each waste stream containing TRI chemicals. Facilities report the type of waste stream, choosing from: gaseous, wastewater (aqueous waste), liquid waste streams (non-aqueous waste), or solid waste streams. They also report the treatment method or methods using 25 codes that correspond to different treatment methods. If the waste stream undergoes multiple treatment steps, they select all applicable codes in the treatment sequence. Figure 5 shows the most common treatment methods reported for the five HAPs with the greatest decrease in air releases from 2003 to 2013, and is limited to gaseous waste streams. The figure illustrates how different chemicals tend to undergo different on-site treatment methods. For example, hydrochloric acid is most commonly treated by scrubbers, while methanol, toluene and xylene are more commonly treated by flares or thermal destruction. Note that facilities must report all treatment methods that a chemical goes through, even if a method has no impact on removing or destroying the chemical.

FIGURE 5

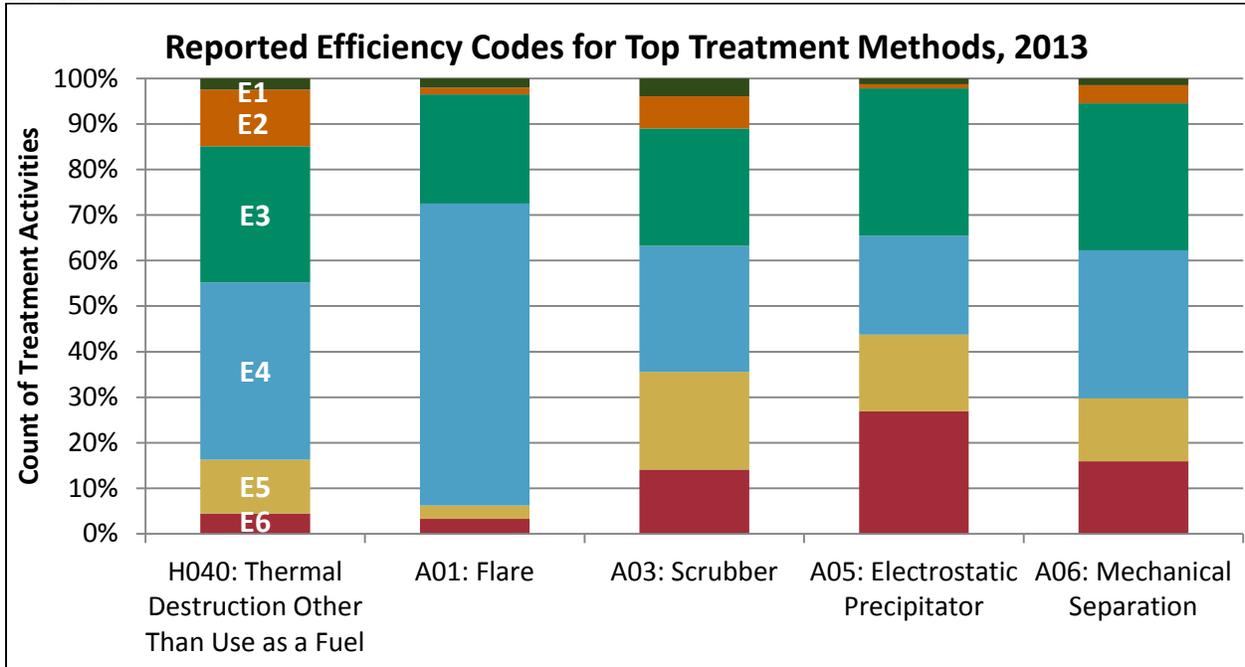


For each waste stream, facilities also report the efficiency of the treatment process or processes. The efficiency indicates the percentage of the chemical destroyed or removed from the waste stream by the treatment sequence. Treatment efficiencies are reported using six codes that correspond to six efficiency ranges, as see in Table 1. Treatment efficiencies for the most common treatment methods applied to gaseous wastestreams of HAPs are shown in Figure 6. While most methods have a similar distribution of efficiency, some, like scrubbers and thermal destruction, are more commonly reported with the highest efficiency codes. If a chemical in a wastestream goes through several treatment steps (e.g., an electrostatic precipitator and then neutralization), the efficiency code applies to the overall treatment sequence, not to the individual treatment method.

TABLE 1: EFFICIENCY CODES AND RANGES

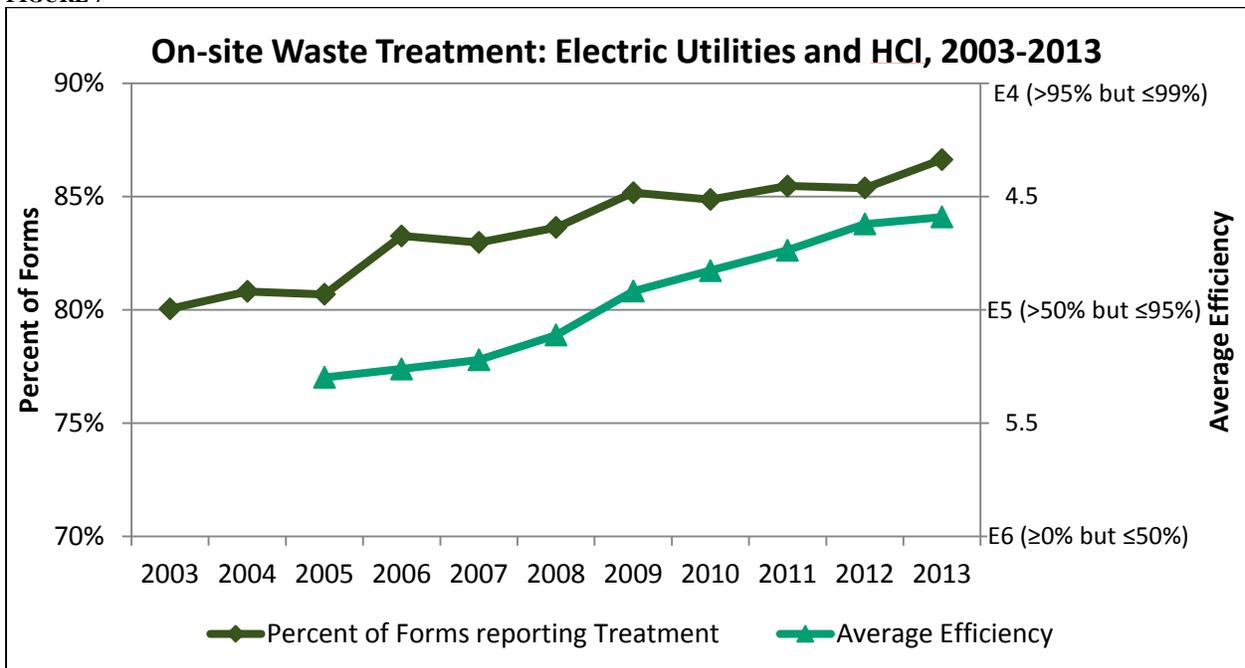
Code	Range
E1	>99.9999%
E2	>99.99%, but ≤ 99.9999%
E3	>99%, but ≤ 99.99%
E4	>95%, but ≤ 99%
E5	>50%, but ≤ 95%
E6	≥0%, but ≤ 50%

FIGURE 6



As discussed earlier, air emissions of hydrochloric acid at electric utilities have been decreasing, partially due to increased and more efficient treatment. From 2003 to 2013 the percentage of electric utilities reporting on-site treatment of hydrochloric acid increased from 80% to 87% of facilities reporting hydrochloric acid air emissions. In addition, the average efficiency of treatment has increased – from 5.3 in 2005 (closer to E5: >50% but ≤ 95%) to 4.6 in 2013 (closer to E4: >95% but ≤ 99%). Note that efficiency reporting by range codes began in 2005. These two trends are shown in Figure 7. Taken together, these trends confirm that treatment of hydrochloric acid air emissions at electric utilities has improved and become more widespread.

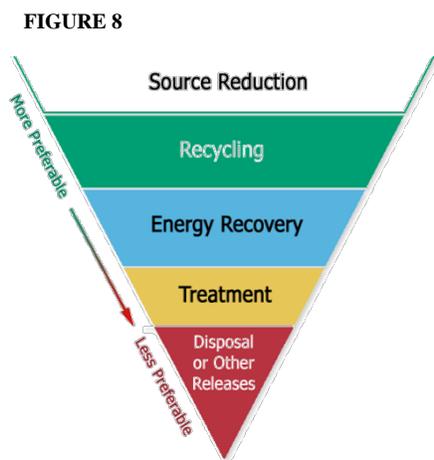
FIGURE 7



## Pollution Prevention (P2) Information in TRI

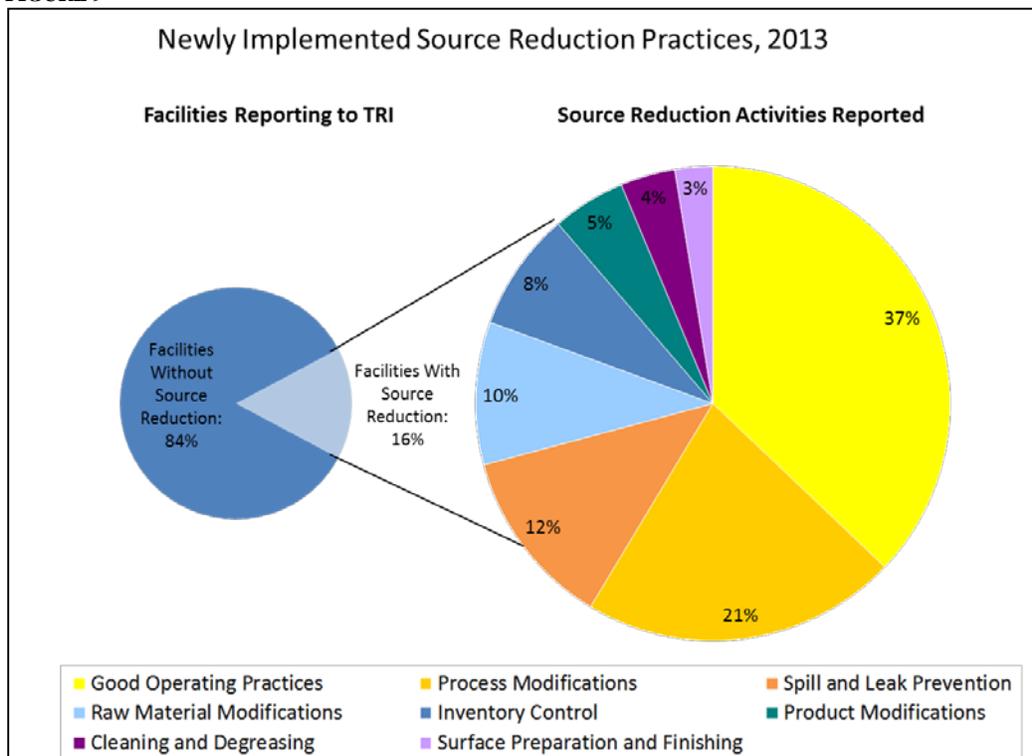
Under the Pollution Prevention Act of 1990, TRI collects information to track progress in reducing waste generation and moving towards safer waste management alternatives. The Waste Management Hierarchy (Figure 8) shows how avoiding the creation of waste through source reduction is preferable to managing waste after its created, and disposal or releasing pollution to the environment is the least preferred waste management method.

Several types of information related to this hierarchy are collected by TRI. Waste management quantities, broken down into the quantity released, treated, used for energy recovery, and recycled are collected for the prior year, current year, and future years. Facilities also report a production ratio or activity ratio, which compares production in the reporting year to production in the prior year and allows data users to account for year-to-year changes in production when comparing annual waste quantities.



TRI also collects information on source reduction and pollution prevention. Source reduction is any practice that reduces the amount of chemical entering any waste stream or released directly to the environment prior to recycling, treatment, or disposal. Facilities must report newly-implemented source reduction activities by selecting from a list of source reduction codes that fall into the eight categories, shown in Figure 9. In 2013, 16% of facilities reporting to TRI also reported source reduction activities.

**FIGURE 9**



Facilities reporting to TRI also have the option to include additional details about their P2, recycling or pollution control efforts as a free-text submission. Over the past few years, EPA has increased publicity

and outreach around this additional data. As a result, the number of forms with P2-related free-text entries has increased, from only 2% in 2010 to 11% in 2013. Several examples of P2 text are included in Table 2. These text entries can help TRI data users learn more about waste management activities at a specific facility or for an industry of interest.

To learn more about P2 reporting in TRI, visit the TRI P2 page at [www.epa.gov/tri/p2](http://www.epa.gov/tri/p2).

TABLE 2

Source Reduction Category	Example Pollution Prevention Text
Process Modifications	“In September of 2013, Veyance Technologies, Inc. in St. Marys, Ohio installed 3 Natural Gas Fired Boilers and decommissioned 2 #6 Fuel Oil Boilers in an effort to reduce emissions. This short 2.5 month window reduced the Benzo(g,h,i)perylene emissions by 36% from the Fuel Oil Boilers. There will be 0 lbs. Benzo(g,h,i)perylene Boiler Emissions in 2014.”
Surface Preparation and Finishing	“Skyworks is in the process of changing the product that we make. The new product does not use spray acid equipment but an immersion acid process so aerosol hydrochloric emissions will decrease as we ramp up our new product and ramp down on our old product.”
Waste Treatment and Leak Detection	“The facility completed the installation of a new emissions scrubber system for capturing methanol emissions for re-use in the process. Emissions control system includes venturi eductors and a packed column in series. A certified compliance test was performed in late spring of 2013 showing the scrubber with an emission control efficiency of greater than 95%.The facility also continues to monitor all regulated equipment for VOC leaks on a regular schedule according to the facility LDAR program schedule.”

### Accessing P2 Information using the P2 Search Tool

EPA has developed a P2 Search Tool, accessed at <http://www.epa.gov/enviro/facts/tri/p2>. It can be used to identify successfully implemented P2 activities and visually compare P2 performance at both the facility and parent company level. Data users can search for specific parent companies, industries, and chemicals and then display related P2 information in charts, maps and useful tables.

The “Facility Comparison” search option in the P2 Search Tool compares waste management practices over time for a specific chemical and/or industry. This search is a useful way to quickly examine P2 trends across an industry or for a specific chemical. The default chart displays the top 10 to 50 facilities managing the most production-related waste, and can also be customized to show waste quantities as percentage of total waste, GHG emissions as reported to GHGRP, or a metric indicating the trend in waste management quantities over the past five years. This information can also be displayed in a map or downloaded as a table. In addition, the search outputs a second chart of production-related waste for the chemical/industry selected by year. Users can click on a specific facility to see its “P2 Details” report, which displays information on the facility’s production-related waste managed by year and its reported source reduction and P2 information. A detailed example of this search option, including screenshots, is included in Appendix A.

The P2 Search Tool can also be used to identify specific P2 activities that have been successful at reducing waste and releases. Users can search for P2 information by industry, year, and/or chemical. The search will display a table of TRI entries, which can be sorted by percent decrease in total releases, air

releases, water releases, or land releases. Users can also navigate to a specific facility's P2 details page. A detailed example of this search option, including screenshots, is included in Appendix B.

## **Quantifying Impacts of P2 Activities**

Between 1991 and 2012, TRI facilities conducted over 370,000 source reduction projects. The EPA has used this data to conduct a retrospective evaluation of how implementing a source reduction project affects the quantity of toxic chemicals released to the environment by an average industrial facility. A differences-in-differences methodology was used to compare the change in TRI releases from facilities that implemented source reduction projects in a particular year against the change in releases from similar facilities that did not implement projects that year. This comparison controls for many unobservable factors that affect toxic releases, such as industry trends and pollution regulations. The results show that the average source reduction project results in a 9% to 16% decrease in facility-level releases of targeted chemicals in the year the project is implemented. Source reduction techniques vary in effectiveness: e.g., raw material modification causes a large decrease in releases, while inventory control has no detectable effect. The analysis also suggests that in aggregate, the source reduction projects carried out in the U.S. since 1991 have prevented between 5 and 14 billion pounds of toxic releases.

This research is currently being prepared for publication.

## **Conclusion**

Emissions of TRI-listed toxic chemicals at large industrial facilities have fallen considerably over the past decade. The decreases have been especially large for hydrochloric acid and other HAP emissions, with the sharpest declines reported by electric utilities. In addition to offering emissions data, the TRI can be used to identify and assess treatment methods and pollution prevention activities that have contributed to emission reductions. For narrative descriptions of the environmental practices that have yielded the largest reductions for a chemical, industry sector, geographic area, or parent company of interest, data users can access the TRI Pollution Prevention Tool through the TRI website.

## Appendix A: Facility Comparisons in the P2 Search Tool

The “Facility Comparison” search option in the P2 Search Tool compares waste management practices over time for a specific chemical and/or industry. This example looks at electric utilities (NAICS 2211) reporting hydrochloric acid, 2005-2013.

Start at the main search page (<http://www.epa.gov/enviro/facts/tri/p2.html>), enter the search criteria, and click “Display Facility Comparison” as shown in Figure 10. The search results page, shown in Figure 11, has two bar charts. The first displays the top 30 facilities in this sector by the total quantity of production-related waste. Users can change the “Chart Options” dropdown to also show waste quantities as percentage of total waste, greenhouse gas emissions for facilities that also reported to the Greenhouse Gas Reporting Program (GHGRP), a 5-year waste trend metric (shown in Figure 11), and 5-year waste trend metric normalized by production ratio. Users can go to a facility-specific P2 Details page (described in detail in Appendix B) by clicking on a facility name along the x-axis. The second chart shows management of the selected chemical (hydrochloric acid) by the selected industry sector (electric utilities) and the number of facilities reporting this sector-chemical combination. To download either chart, click the arrow button in the top right corner. To display the information in the first chart as a table, click the “Table” radio button above the Chart Options dropdown. The table is capable of showing as many facilities as fit the search criteria and can be downloaded as a .csv, .pdf, or .xls file. Finally, the top facilities can be displayed as a map of the United States. Click on the orange facility marker to see more information on the facility’s waste, releases, and P2 activities.

FIGURE 10

**Search Criteria**

Show P2 info for facilities     Show P2 info for parent companies **New!**

Select one or more Industry Sector(s): [i](#)

Electric Utilities ( 2211 ) x

Select one or more Chemical(s) or Chemical Group(s): [i](#)

Hydrochloric Acid (1995 And After "Acid Aerosols" Only) x

Select one or more Year(s): [i](#)

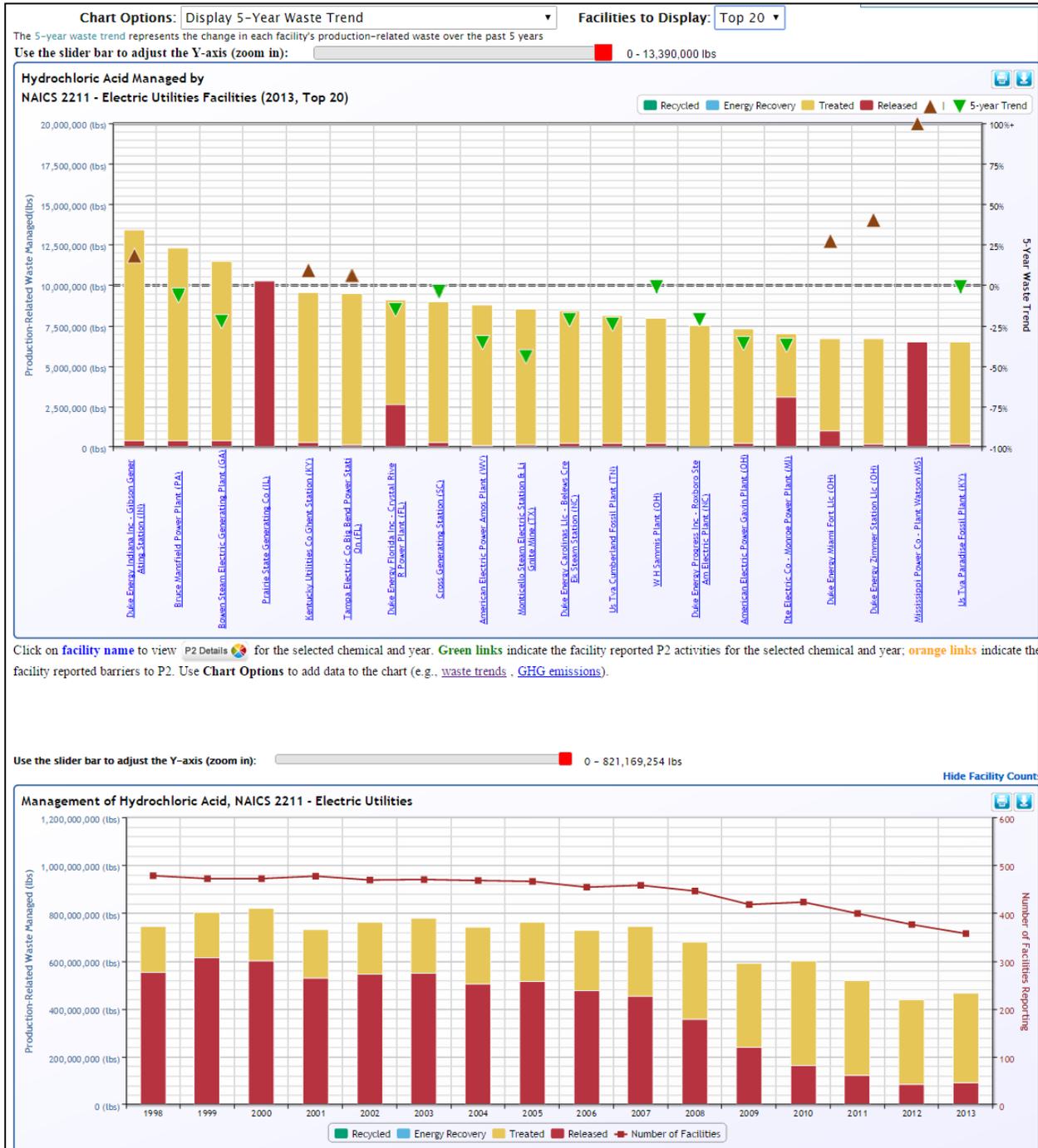
2005-2013

Select one or more State(s): [i](#)

All States

[Show P2 Activities](#)    [Display Facility Comparison](#)    [Clear](#)

FIGURE 11



## Appendix B: P2 Examples in the P2 Search Tool

The P2 Search Tool can also be used to find previously-implemented P2 activities for a specific industry and chemical. This example searches for P2 activities related to reducing air emissions of methanol at chemical manufacturing plants (NAICS 325). Starting at the main search page, enter the search criteria and click “Show P2 Activities,” as shown in Figure 12. The search results page lists facilities that have reported P2 in this sector sorted by the greatest change of total methanol releases. The percent change can also be shown as a percent decrease in air, land, or water releases only, or total waste using the “Value for Year-to-Year comparison” dropdown. Figure 13 shows results sorted by the greatest decreases in air emissions. You can also limit the type of P2 entries displayed using the “Additional Filters” dropdown.

To learn more about a facility’s P2 activities, click on the “P2 Details” button, found underneath each facility name. This example looks at the P2 Report for methanol managed at Montgomery Chemicals in Conshohocken, PA. The P2 Details page for this facility is shown in Figure 14. The top part of the report displays facility information, including TRIFID, location and parent company information. There are three charts displayed in this report – total production-related waste for the facility by year (this chart can be changed to show production ratio, waste quantities normalized based on production, and waste quantities as a percentage of total waste), a pie chart representing waste by type of management, and a pie chart showing how that chemical was managed by the industry as a whole. If the facility has reported to GHGRP, the bar chart can also display reported GHG emissions. The bottom of the page lists all of the P2 source reduction activities the facility has reported for this chemical by year, as well as any optional P2 information. Use the search bar to search for specific activities or keywords. To change to another chemical that the facility has reported to TRI, scroll to the top of the page and use the dropdown “Show P2 data for other chemicals at this facility.”

FIGURE 12

**Search Criteria**

Show P2 info for facilities     Show P2 info for parent companies **New!**

Select one or more Industry Sector(s): [i](#)

Chemicals ( 325 )

Select one or more Chemical(s) or Chemical Group(s): [i](#)

Methanol

Select one or more Year(s): [i](#)

2013

Select one or more State(s): [i](#)

All States

FIGURE 13

List of Facilities in TRI submitting Pollution Prevention Information for Selected Criteria:

Industry: NAICS 325 - Chemicals  
 Chemical: Methanol  
 Year: 2013

Additional Filters: Exclude facilities that reported activity codes but no text descriptions

Value for Year-to-Year Comparison: Air Release [displayed currently]

Buttons: Copy, CSV, Excel, PDF, Print

Show 10 entries Showing 1 to 10 of 7

FACILITY NAME	ADDRESS	PRIOR YEAR AIR RELEASE *	CURRENT YEAR AIR RELEASE *	PERCENT CHANGE	INFORMATION (ACTIVITY CODES/TEXT)
VANDEMARK CHEMICAL INC P2 Details	1 N TRANSIT RD, LOCKPORT, NY 14094	32.89	0	-100%	<p><i>W58: Other process modifications</i> - Methanol is not used in the manufacture of any products. It is only used to clean/dry vessels during transitions. Methanol can be used multiple times for this purpose.</p> <p>Method(s) to Identify P2 Activities: <i>T11 [Other]</i> - We have become much more efficient in re-using the methanol during transitions which has generated much less waste</p> <p>We have become much more efficient in re-using the methanol during transitions which has generated much less waste</p> <p>Methanol is not used in the manufacture of any products. It is only used to clean/dry vessels during transitions. Methanol can be used multiple times for this purpose.</p>
MONTGOMERY CHEMICALS P2 Details	901 CONSHOHOCKEN RD, CONSHOHOCKEN, PA 19428	97,077.00	10,496.00	-89.19%	<p>The facility completed the installation of a new emissions scrubber system for capturing methanol emissions for re-use in the process. Emissions control system includes venturi ductors and a packed column in series. A certified compliance test was performed in late spring of 2013 showing the scrubber with an emission control efficiency of greater than 95%. The facility also continues to monitor all regulated equipment for VOC leaks on a regular schedule according to the facility LDAR program schedule.</p>
PENRAY COS INC P2 Details	1801 ESTES AVE, ELK GROVE VILLAGE,	500.00	67.70	-86.46%	<p><i>W13: Improved maintenance scheduling, recordkeeping, or procedures</i> - N/A</p>

FIGURE 14

