Tetrabromobisphenol A (TBBPA):
Technical Report on Conditions of Use

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About this Technical Report

On August 23, 2019, the U.S. Environmental Protection Agency (EPA) released what it describes as "reasonably available information" about tetrabromobisphenol A (TBBPA) and requested comments about the chemical's conditions of use. TBBPA is one of twenty proposed high-priority substances for evaluation under the Toxic Substances and Control Act.

In response to EPA's call for further information, this Technical Report provides an overview of the manufacturing, processing, importation, distribution into commerce, and disposal of this chemical. It also provides an accounting of TBBPA waste transfers and releases from these conditions of use.

The majority of the information in the following report is not in EPA's August 2019 informational document.

Specifically, the EPA does not:

- Name the manufacturers, importers, processors, distributors, or disposers of TBBPA. These include:
  - Albemarle, the only remaining manufacturer in the US;
  - ICL and Great Lakes/Chemtura/Lanxess, two leading importers of brominated flame retardants, which they manufacture in Israel and Jordan;
  - Importers of TBBPA that may not have submitted Chemical Data Reporting (CDR) forms as required in the years 2012 and 2016. EPA requires companies to report any manufacturing or importation of 25,000 pounds or more. Aurora Plastics / S&E Specialty Polymers of Lunenburg, Massachusetts, imported 675,262 pounds of TBBPA from China between 2012 and 2018. Pride International of Baltimore imported more than 1.4 million pounds of TBBPA from

China between 2012 and 2019. Neither of these companies appear in EPA CDR records for TBBPA.

- Identify certain industries in which TBBPA is processed, especially recyclers of plastic, e-waste, and automotive scrap. The only discussion of recycling in EPA's Supporting Information document is that a company has claimed such activity to be "confidential business information."
- Identify the presence of TBBPA in products containing recycled plastics, especially toys, jewelry, and other children's products.
- Consider the further distribution of this chemical and byproducts through waste transfer, fuel blending, and disposal practices. The incineration of TBBPA waste creates over 100 semi-volatile compounds, including polybrominated dibenzo-p-dioxins and furans.

In short, the EPA document fails to identify many common conditions of use of TBBPA, even though this information is publicly available from EPA and other government agency data.

The following technical report is based on public information, including company literature and filings, state and federal agency data especially from the EPA, Centers for Disease Control and Prevention, and U.S. Customs and Border Protection Agency, and overseas government reports.

Note: TBBPA can be used to make at least 70 other compounds, mostly other flame retardants. This scope of this report does not include derivatives of TBBPA such as TBBPA-BAE Tetrabromobisphenol A bis(allyl ether) (CAS No. 25327-89-3); TBBPA-BDBPE Tetrabromobisphenol A bis(2,3-dibromopropyl ether) (CAS No. 21850-44-2); TBBPA-BME Tetrabromobisphenol A bismethyl ether (CAS No. 108608-62-4); TBBPA-DHEE Tetrabromobisphenol A dihydroxyethyl ether (CAS No. 4162-45-2); and, TBBPS-DBPE Tetrabromo-bisphenol-S-bis(2,3-dibromopropyl) (CAS No. 42757-55-1).[1]

A. Identifications

CAS RN: 79-94-7
EPA Docket Number: EPA-HQ-OPPT-2018-0462
UN Codes: UN3077
Harmonized Tariff Schedule: 2908.19.25
Synonyms:

- Most commonly: TBBPA; also:
- 2,2-bis-(3,5-dibromo-4-hydroxyphenyl)propane
- 2,2-bis-(4'-hydroxy-3',5'-dibromophenyl)-propane
- 2,2',6,6'-Tetrabromo-4,4'-isopropylidene bisphenol
- 2,2',6,6'-TETRABROMO-4,4'-ISOPROPYLIDENEDIPHENOL
- 2,2',6,6'-TETRABROMOBISPHENOL A
- 2,2'',6,6''-Tetrabromobisphenol A

- 2,5-dibromo-4-hydroxyphenyl)propane
- 2,5-dibromophenyl)propane
- 2,6-dibromo-4-[1-(3,5-dibromo-4-hydroxy-phenyl)-1-methyl-ethyl]phenol
- 2,6-dibromo-4-[2-(3,5-dibromo-4-hydroxyphenyl)propan-2-yl]phenol
- 2,6,6'-Tetrabromobisphenol A
- 3,3',5,5'-Tetrabromo-4,4-dihydroxy-2,2-diphenylpropane
- 3,3',5,5'-Tetrabromobisphenol A
- 3,3',5'-Tetrabromobisphenol A
- 3,5,3',5'-Tetrabromobisphenol A
- 4-[1-(3,5-dibromo-4-hydroxyphenyl)-isopropyl]-2,6-dibromophenol
- 4,4'-(1-Methylethylidene)bis(2,6-dibromophenol)
- 4,4'-(1-Methylethylidene)bis(2,6-dibromophenol)2,2-bis(3,5-dibromo-4-hydroxyphenyl)propane
- 4,4'-(1-methylethylidene)bis[2,6-dibromophenol]
- 4,4'-(2,2-propanediyl) bis[2,6-dibromo]phenol
- 4,4'-(propane-2,2-diyl)bis(2,6-dibromophenol)
- 4,4'-Isopropylidenebis(2,6-dibromophenol)
- 4,4'-Isopropylylidenebis(2,6-dibromophenol)
- 4,4'-propane-2,2-diylbis(2,6-dibromophenol)
- 4,4''-(1-Methylethylidene)bis(2,6-dibromophenol)
- 4,4''-(2,2-propanediyl) bis[2,6-dibromo]phenol
- 4,4''-(propane-2,2-diyl)bis(2,6-dibromophenol)
- 4,4''-Isopropylidenebis(2,6-dibromophenol)
- 4,6-dibromophenol
- Phenol, 4,4'-(1-methylethylidene)bis(2,6-dibromo-
- Phenol, 4,4'-isopropylidenebis (dibromo-)
- Phenol, 4,4'-isopropylidenebis(2,6-dibromo-
- Phenol,4'-(1-methylethylidene)bis[2,6-dibromo-
- Phenol,4'-isopropylidenebis[2,6-dibromo-
- TETRABROMO-4,4'-ISOPROPYLIDENEDIPHENOL
- Tetrabromobisphenol ''A''
- Tetrabromodiphenylopropane

Trade Names:

- BE-59 and BA-59P (Chemtura/Great Lakes Chemical/Lanxess)
- FR-1524 (ICL, formerly Dead Sea Bromine)[2]
- Saytex CP-2000 (Albemarle)
- Firemaster BP4A (formerly made by Michigan Chemical)[3]

B. Manufacturing

Chemical factories produce tetrabromobisphenol-A (TBBPA) by adding bromine to a solution of bisphenol-A, which is usually stirred in methanol, in a reactor. After the reaction, according to *Ullmann's Encyclopedia of Industrial Chemistry*, "methyl bromide and some hydrogen bromide are vented through the overhead condenser system into a series of scrubbers that neutralize and dry methyl bromide, which is produced in about 60% yield based on byproduct HBr. Water is then added to precipitate TBBPA and the resulting slurry is cooled, filtered, washed, and dried." [4]

Two U.S. manufacturers have been leading global producers of TBBPA. Manufacturing peaked from 1994 to 2010. One manufacturer (Great Lakes) appears to have stopped making TBBPA; the other (Albemarle) continues to make it, in Magnolia, Arkansas. Overall, TBBPA manufacturing, processing and distribution in the US are in rapid decline.

EPA reports provide TBBPA production (domestic manufacturing plus imports) figures in ranges. They state that TBBA's production volume in the U.S. was between 10 million and 50 million pounds per year in 1986. This rose to 50 and 100 million pounds per year in 1990, and between 100 and 500 million pounds per year from 1994 to 2010.[5]

In 2011, EPA placed the National Aggregate Production Volume at 119.8 million pounds of TBBPA, according to Chemical Data Reporting (CDR). This is the most precise figure provided by EPA for any year. Thus, the U.S manufactures or imports at least one-third of the world's TBBPA.

TBBPA is the most-produced chemical in the brominated flame retardant (BFR) chemical category. In 2011, the global flame retardant industry made about 800 million pounds of BFRs[6]; so, at least one-third of all BFRs produced are TBBPA. Earlier estimates place TBBPA's share higher: In 2001, the Bromine Science Environmental Forum said 59% of the world's BFRs were TBBPA.[7] In 2013, the European Food Safety Authority estimated this share to be 60%.[8]

In the U.S., TBBPA manufacturing and imports have fallen since 2011. According to EPA's CDR reports, this activity dropped to between 50 and 100 million pounds in 2012, 2013, 2014 and 2015, the lowest levels since 1990.

1. U.S. Manufacturer: Albemarle (Magnolia, Arkansas)

Albemarle (formerly Ethyl Corp.) manufactures TBBPA under the trade name Saytex CP-2000 at its Magnolia, Arkansas South Plant.[9] This plant opened in 1999 with a 50,000-metric ton per year capacity.[10] It appears to be the only remaining TBBPA producer in the United States.

2. Overseas Manufacturers

Outside of the U.S., major manufacturing centers for TBBPA are in Israel, Jordan, and China.[11]

ICL is the leading source of TBBPA shipments to the U.S. It makes TBBPA at a bromine compounds plant near the Dead Sea in Israel.

Albemarle is in a joint venture with **Arab Potash** called **Jordan Bromine**, in Safi, Jordan. Jordan Bromine produces brominated products including TBBPA.[12] It had a TBBPA manufacturing capacity of 82.7 million pounds per year in 2001. Jordan, according to U.S. trade data, is an occasional source of TBBPA.

Shandong Tianyi Chemical produces TBBPA in Weifang, Shandong, China, and has shipped TBBPA to Lintech, a chemical distributor in the U.S. that has provided CDR information to EPA.[13]

According to US Customs shipping records, a Massachusetts company imported 675,262 pounds of TBBPA from China between 2012 and 2018. All of the imports came from **Shandong Brother Sci And Tech Co Ltd**., a flame retardant producer based in Bohai Industrial Park, Shandong, China. Shandong Brother shipped at least 675,262 pounds of TBBPA to a Massachusetts company that is not identified in EPA's CDR database for this chemical (see Aurora Plastics / S&E Specialty Chemicals below).

C. Importation and Processing

Trade records (Automated Manifest System of US Customs and DataWeb of U.S. International Trade Administration) reveal a steep decline in imports since 2012. Imports fell 70%, from over 4 million pounds in 2009 to 1.2 million pounds in 2018.

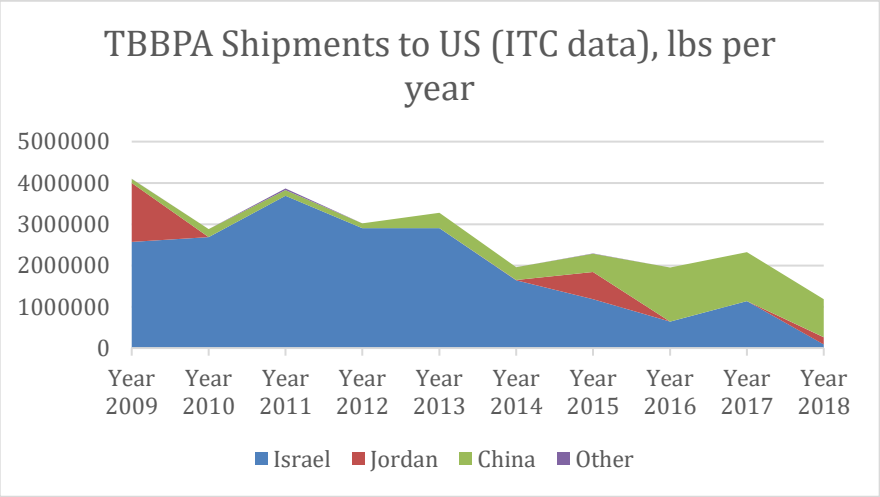


Chart 2. Graph based on United States International Trade Commission DataWeb report for imports for consumption, all countries, Harmonized Tariff Schedule 2908.19.25, Tetrabromobisphenol A.

EPA CDR reports identify – either directly or by inference – several companies as importers of TBBPA.

1. ICL North America, Inc. (St. Louis, Missouri)

Over 70% (9 million pounds) of the TBBPA imported into the U.S., since 2012, came from ICL. It produces TBBPA at a bromine compounds plant near the Dead Sea in Israel.

In its CDR reporting, ICL said it imported TBBPA between 2010 and 2015 for processing as a flame retardant in computers, and electrical and electronic products. Concentrations of TBBPA in these products, it said, can reach 30% by weight.

Dead Sea Bromine, a U.S.-based subsidiary of ICL, sells TBBPA under the trade name FR-1524.[14]

2. Great Lakes / Chemtura / Lanxess (El Dorado, Arkansas)

Great Lakes Chemical sells the flame retardant under the trade name BE-59.[15] The Great Lakes Chemical plant in El Dorado, Arkansas, produced TBBPA since at least 1994.[16] Great Lakes became Chemtura in 2005 and is now a subsidiary of Lanxess.

Lanxess sells TBBPA under the product name, BA-59P.[17] The absence of reported releases of TBBPA from the plant in 2010 indicates that manufacturing of TBBPA in El Dorado stopped nearly a decade ago. (See Releases.)

EPA's CDR information for Chemtura notes that the company imports undisclosed amounts of TBBPA.[18] According to U.S. Customs shipping records, Chemtura imported 49,853 lbs of TBBPA from Inabata & Co. of Japan between 2013 and 2019. Inabata sells plastics compounds "formed by adding flame retardants and other additives to raw plastic."[19]

3. Albemarle (Magnolia, Arkansas)

In addition to manufacturing TBBPA at its plant in Arkansas, Albemarle imports it. According to shipping records, it imported Saytex CP-2000 from Japan in 2012 (96,020 pounds) and Belgium in 2019 (27,591 pounds). A shipping company – Panalpina – imported 1,091,252 pounds of TBBPA, including some listed as Saytex CP-2000, between 2015 and 2019.

4. Huntsman Corporation (McIntosh, Alabama)

Huntsman reported importing an undisclosed amount of TBBPA in its 2016 CDR submission. It said the chemical was used as an intermediate in the manufacturing of transportation equipment. Huntsman's plant in McIntosh, Alabama, produces epoxy resins for the aerospace and oil and gas industries.[20] Huntsman is a leading supplier of brominated epoxy resins to the printed wiring board industry.[21]

5. LG International America Inc. (Bergen, New Jersey)

LG reported importing 485,159 pounds of TBBPA in 2011. LG said it was processed in the manufacturing of flame-retardant plastics. LG is a leading manufacturer of printed wiring boards using epoxy resin laminates.[22]

6. Lintech International, Inc. (Macon, Georgia)

In CDR reporting, Lintech, said it imported undisclosed amounts of TBBPA for use as a processing aid in plastic material and resin manufacturing. According to U.S. Customs records, in 2012, Lintech imported 20,400 pounds of TBBPA from Tianyi International Corp. From 2013 to 2015, Lintech imported 157,410 pounds from Shangdong Tianyi Chemical. All shipments were from Tsingtao (Qingdao), China, to Long Beach, California.

Lintech distributes chemicals to companies in the southern United States.

7. Sabic US (Mount Vernon, Indiana, and Ottawa, Illinois)

Saudi Crown Prince Mohammed bin Salman owns several chemical and plastics plants in the United States though the Saudi government held company, Sabic (or Saudi Basic Industries).[23] In a 2016 CDR filing, Sabic reported that it either imported or manufactured TBBPA, and processed it as a flame retardant in plastic and rubber products at concentrations of up to 30%. Sabic has never been identified as a manufacturer of TBBPA, so it can be inferred that it imports the chemical for processing into its plastic and rubber products.

Sabic reported the importing locations as Pittsfield, Massachusetts, and Washington, West Virginia. However, the Pittsfield location is an office and the Washington plant, which produced ABS plastics, closed in 2015. Sabic shifted ABS manufacturing from West Virginia to Ottawa, Illinois.[24] Toxic Release Inventory data reveals where Sabic releases (and presumably processes) TBBPA: Ottawa, Illinois; Mount Vernon, Indiana; and, Selkirk, New York.

8. Olin Corporation (St. Louis, Missouri)

In 2016, Olin submitted a CDR form for TBBPA but EPA did not publish any related information, including whether Olin imports or manufactures the chemical and how it is used. Olin has never been identified as a manufacturer of TBBPA, so it can be inferred that it imports the chemical, likely for processing in epoxy resins. Olin acquired Dow's epoxy resin business. Dow was a leading supplier of brominated epoxy resins to the printed wiring board industry in 2003.[25]

9. Importers Not Identified in CDR Reporting

Two companies not named in EPA CDR reporting appear to be importing or processing substantial quantities of TBBPA.

a. Aurora Plastics / S&E Specialty Polymers (Lunenburg, Massachusetts)

According to US Customs shipping records, S&E Specialty Polymers imported 675,262 pounds of TBBPA from China between 2012 and 2018. All of the imports came from Shandong Brother Sci And Tech Co Ltd., a flame retardant producer based in Bohai Industrial Park, Shandong, China.[26] Aurora Plastics acquired S&E Specialty Polymers of Lunenburg, Massachusetts in 2017.[27]

Aurora Plastics produces concentrate masterbatches (these are systems for adding pigments and additives to polymers). It sells flame retardant masterbatches for polyolefin plastics.[28] Neither S&E Specialty Polymers nor Aurora Plastics are identified in CDR or other EPA reports on TBBPA.

b. Pride International (Baltimore, Maryland)

Pride International, a shipping company, imported 1,468,630 pounds of TBBPA from unnamed suppliers in China between 2012 and 2019. It has not been named in CDR or other reports from EPA.

D. Distribution

Most TBBPA enters commerce in the laminate – comprising flame resistant epoxy resins – of electronic circuit boards. It is also used in electronic enclosures that are composed of polycarbonate and acrylonitrile-butadiene-styrene (ABS) resins.

Much of the electronics industry has committed to end the use of BFRs, including TBBPA, in plastics. According to Greenpeace, "The International Electronics Manufacturing Initiative [iNEMI] comprising 100 members (among these major electronic companies such as Dell, IBM, HP, Intel, Hitachi and Samsung), supports removal of halogenated flame retardants and has conducted a number of projects under the iNEMI HFR- Free Programs."[29]

Dell claims to have phased-out the use of TBBPA in plastics since June 2006.[30]

In 2006, HP announced that the company would eliminate the use of TBBPA from external case parts of all new HP brand products introduced after Dec. 31, 2006.[31]

Apple also has a phase-out policy for brominated flame retardants for all products manufactured since 2009. There is a threshold of 900 ppm of bromine; products with less of that chemical are considered bromine free.[32]

According to Greenpeace research published in 2017, "only Apple and Google have eliminated BFRs and PVC from all product lines and parts. Acer, Dell, HP, LG, Lenovo, Microsoft, Samsung and Sony have all failed to fully follow through on commitments made circa 2009, with exemptions made for ongoing use of BFRs and PVC in certain parts or accessories."[33]

The proportion of TBBPA in products depends upon the application.

Products containing TBBPA may also carry polybrominated dibenzo-p-dioxins (PBDDs) and furans (PBDFs). According to a National Toxicology Program report, "When used as a flame retardant, TBBPA contains <0.01 to 0.05 µg/kg [microgram per kilogram] PBDDs and <0.01 to 0.02 µg/kg PBDFs.[lxxi] (One µg/kg equals one part per billion.)

1. Printed Circuit Boards

FR-4 is the most common type of laminate for printed circuit boards. It is typically produced by reacting between 5% and 15% of TBBPA in the epoxy resin. In 2000, it was estimated that epoxy resins used in printed circuit boards (FR2 and FR4 laminates) consumed 70% of TBBPA produced worldwide.[34] In 2014, over 90% of FR-4 printed circuit board laminates were produced using TBBPA.[35] These boards are used in computers, communications systems, cars, consumer electronics, aircraft electronics, military electronics and other applications.[36]

Solepoxy of Olean, New York is a large producer of epoxy powder coatings for the electronics industry.[37] SolEpoxy™ DK18-05 BLUE contains 5-10% TBBPA by weight.[38]

Most TBBPA enters into commerce in Asia, because this is where most of the world's electronics are manufactured. Imported electrical and electronic products are thus likely to contain this flame retardant.

2. Plastic Electronics Enclosures

Enclosures for electronic equipment are frequently loaded with brominated flame retardants, especially TBBPA. Types of products with these enclosures include computers, televisions, and cameras.

The primary plastics used in enclosures are acrylonitrile butadiene styrene (ABS) and high impact polystyrene (HIPS). [39] In 2000, it was estimated that high impact polystryrene (HIPS) casings consumed 15% of TBBPA produced worldwide.[40] Studies have found "additive TBBPA" concentrations of up to 2.3% in personal computer housings.[41]

In 2013, the state of Washington measured TBBPA in six samples of plastic electronics enclosures. Four of these six contained over 1% TBBPA by weight:

- a car charger (9.43%),
- heated mattress foot warming pad (6.51%),
- paper shredder (3.52%), and
- battery charger (1.24%).[42]

3. Products Containing Recycled Plastics

In the period studied for this technical report (2012 to present), the fourth largest material flow of TBBPA waste was from LMR Plastics (Greeneville, Tennessee) to Mir Plastics, a recycling company in Knoxville, Tenn. LMR, an injection molding company, produces ABS, polycarbonate, and other plastics used in high temperature applications like lawnmowers, telecommunications towers, and industrial controls.[43]

Source: Screenshot from Mir Plastics website,
http://www.mirplastics.com/applications/#prettyPhoto.

From 2015 to 2017, LMR transferred 82,262 pounds of TBBPA waste to Mir Plastics. In turn, Mir Plastics sells scrap for use in other products, including "household goods" (see screenshot). It ships scrap destinations in the U.S., Latin America, and China.[44] In 2017, for instance, Mir Plastics sent 44,092 pounds of "plastic scrap regrind" to a scrap trader in Venezuela, J & J Desechos y Reciclajes (Carabobo, Bolívar, Venezuela).

On a smaller scale, in 2013, Polyone Corp (Warsaw, Indiana) transferred 835 pounds of TBBPA waste to Intergroup International, a plastic scrap dealer. Both Intergroup and Polyone's plastic sheet plant in Warsaw, Indiana, have since closed.[45]

Many plastic enclosures are loaded with BFRs including TBBPA. A 2005 study at an e-waste recycling plant in Switzerland found a mean value of 1,420 ppm TBBPA in the waste, higher than any other BFR.[46] Automotive shredder residue (ASR) contains TBBPA "in the range of sub-ppm levels to several ppm. The amount of "TBBPA in ASR was found to be higher than in municipal solid waste and lower than that in waste television sets."[47]

Plastic, e-waste, and ASR scrap trade redistributes recycled feedstocks contaminated with TBBPA flame retardants into worldwide commerce, unregulated and without notice to consumers about its origins and the presence of toxic TBBPA waste.

Photo by Flickr user Samuel Mann

EPA noted in 2015 that "TBBPA has also been reported as a contaminant with no function in children's footwear, clothing, personal accessories, arts and crafts, baby feeding products (i.e., baby bibs, according to a single report) and bedding."
It added that "TBBPA has also been found in a variety of other products such as small plastic toys, jewelry and other children's products." [48]

In 2014, the Ecology Center tested 13 Mardis Gras plastic necklaces, and found TBBPA in all. They found the flame retardant at an average concentration of 2,146 ppm , and a high of 6,664 ppm.[49]

Ecology Center photo.

A 2013 study in the Czech Republic found TBBPA in 13 out of 30 samples of thermos lids and kitchen utensils, which the authors assumed to be unintended contamination from the supply chain.[50]

In 2016, Washington State, through a new section in its Child Safe Products Act, limited the amount of TBBPA (and four other flame retardants) in certain children's products and residential upholstered furniture. These products were no longer allowed to be sold in the state if they contained over 1,000 ppm (0.1%).

The state of Washington's Child Safe Products testing program has identified TBBPA as a contaminant in at least 48 products, ranging from jewelry to children's clothing. Recent tests measured TBBPA contamination at levels above the state regulatory limit of 0.1%

in three products: two musical toys sold by Jazwares and a play structure sold by Home Depot.[51]

4. Adhesives

3M uses TBBPA in its adhesives factory in Springfield, Missouri.[52] This plant manufactures specialty adhesives, such as foam tapes and sealants, for use in transportation, electronics, furniture, appliances, sporting goods and other industries.[53] 3M's Scotchcast 521+ Epoxy Resin (Blue) contains up to 5% TBBPA. It is a flame retardant epoxy powder applied to infrastructure.[54]

In 2011, 3M said it intended to import "less than 100 kilograms" of TBBPA, "as part of an experimental product formulation for R&D purposes."[55]

5. Textiles

The flame retardant has been found to be applied to camping tents. In a study published in 2014, fabric from a two-person tent made in South Korea and sold in the United States was found to have 25,700 parts per million TBBPA, or 2.57% of the product by weight.[56]

The state of Washington prohibits the presence of TBBPA in children's clothing beyond 0.1% of the product by weight. In 2014, testing by the state found TBBPA in headwear, sold by Dollar Tree (Greenbriar International), at levels higher than 5%. Since 2014, Washington has measured TBBPA in over 96 articles of children's clothing, usually at levels under 500 ppm. It also has measured TBBPA at levels higher than 1% in a baby carrier, booster seat, play pen, and baby swing, sold by Graco Children's Products Inc, and a booster seat sold by Harmony Juvenile Products.

The Oeko-Tex certification prohibits the use of TBBPA in textiles.[57]

6. Other Possible Uses

Federal reports identify many potential uses for TBBPA. These include applications in paper coatings, rubber products, and interior finishes such as carpet backing and simulated marble floors. No examples of such products on the market were identified in research for this technical paper.

E. Waste Transfers and Disposal

At least 925,000 pounds of TBBPA waste were disposed in landfills and incinerators between 2012 and 2018. EPA's Toxic Release Inventory and Chemical Data Exchange systems recorded the transfer of 669,375 pounds of TBBPA for disposal. Most of the waste (412,489 pounds) was dumped in landfills. The balance (at least 256,411 pounds), except for a small fraction going to underground injection wells[58], was burned in incinerators and cement kilns. There were also 161,190 pounds of TBBPA waste reported as going to waste brokers and fuel blenders. Some – but not all – of the waste was forwarded to incinerators, kilns and landfills, identified in EPA records.

1. Landfills

From 2012 to 2018, according to EPA records, 412,489 pounds of TBBPA waste were dumped in landfills around the country. Most of the waste dumped in landfills (78%) comes from two TBBPA manufacturing locations.

The Albemarle TBBPA manufacturing plant in Magnolia, Arkansas, sent 145,194 pounds to the US Ecology landfill in Robstown, Texas, and 48,817 pounds to a landfill within its Magnolia complex. In 2012, EPA and US Ecology reached a settlement in which the company admitted to illegally storing hazardous waste at the Robstown landfill, and paid EPA a fine of $788,120.[59]

In 2015, the Great Lakes Chemical manufacturing plant reported sending 120,000 pounds of TBBPA waste to a Chemical Waste Management (ChemWaste) landfill in Sulphur, Louisiana. The ChemWaste landfill reported disposing of 134,000 pounds of TBBPA waste on land in 2015 and 2016.

Table 1: TBBPA Toxic Waste Sent to Landfills, 2012 to 2018

Company	Location	Pounds	Waste Origins	% of Landfill
US Ecology Texas Inc	Robstown, TX	145,194	Albemarle (Magnolia AR)	30.2%
Chemical Waste Management	Sulphur, LA	134,000	Great Lakes Chemical (El Dorado AR)	27.8%
Dow Chemical	Freeport, TX	68,894	TBBPA processing on-site	14.3%
Albemarle	Magnolia AR	48,817	TBBPA manufacturing on-site	10.1%
Waste Management Of New York, LLC	Chaffee, NY	12,018	Solepoxy (Olean NY)	2.5%
Advanced Disposal (Veolia) Arbor Hills Landfill Inc	Northville, MI	10,315	EQ Detroit (Detroit MI)	2.1%

Clean Harbors Lone Mountain LLC	Waynoka, OK	9,558	Unknown	2.0%
US Ecology Idaho Inc	Grand View, ID	9,546	Unknown	2.0%
US Ecology Nevada Inc	Beatty, NV	8,123	Mitsubishi Carbon (Irvine CA)	1.7%
Wayne Disposal	Belleville, MI	5,926	EQ Detroit (Detroit MI)	1.2%
North Shelby Landfill	Millington, TN	4,996	Unknown -> Tradebe (Millington, TN)	1.0%
Cherokee Run Landfill	Bellefontaine, OH	4,500	Spartech (Greenville OH)	0.9%
Rhea County Landfill	Dayton, TN	4,011	Ravago Manufacturing (Manchester TN)	0.8%
Regional Disposal Co Roosevelt Landfill	Roosevelt, WA	2,254	Boeing (Everett WA)	0.5%
Butterfield Station Landfill	Mobile, AZ	1,625	Cytec Aerospace (Costa Mesa CA) and Solepoxy (Olean NY)	0.3%
Town of Colonie Sanitary Landfill	Cohoes, NY	1,157	Sabic (Selkirk NY)	0.2%
Washington County Solid Waste Department	Abingdon, VA	1,144	General Dynamics (Marion VA)	0.2%
Heritage Environmental Services LLC	Indianapolis, IN	990		
Pine Tree Acres Inc	Lenox, MI	974		
Chemical Waste Management	Arlington, OR	959		
Williams County Landfill	Bryan, OH	882		
Newton County Landfill	Brook, IN	803		
Clean Harbors Laporte	La Porte, TX	722		
Covanta Warren Energy Resource	Oxford, NJ	490		
AASydcol LLC	Yuma, AZ	488		
Courtney Ridge Landfill	Sugar Creek, MO	401		
Land Comp Corporation	Ottawa, IL	388		
Millbury Resource Recovery Facility	Millbury, MA	357		
LarawayRDF	Joliet, IL	256		
Clean Harbors Grassy Mountain LLC	Grantsville, UT	254		
Town of Manchester Landfill	Manchester, CT	251		
WasteMgmtArk-2900 West 68th	Little Rock, AR	247		
Brent Run Landfill	Montrose, MI	245		
Countryside Landfill (Waste Management)	Grayslake, IL	193		
River Bend Prairie Landfill	Dolton, IL	104		
SKB Landfill	Austin, MN	82		
Veolia Environmental Services, Claypool Landfill	Claypool, IN	69		
East Central Solid Waste Commission	Mora, MN	50		
Waste Connections Transfer Station	Wichita, KS	25.4		

Hyland Landfill	Angelica, NY	23		
W M W I - Metro Recycling & Disposal	Franklin, WI	16		
Veolia Es Emerald Park Landfill	Muskego, WI	14		
VexorTechnology Inc	Medina, OH	10		
21st Century Environmental Management of Nevada LLC	Fernley, NV	6		
Allied Waste of NA LLC	Kenmore, NY	3.27		
Waste Management	Rochester, NH	1.3		
Clean Harbors Chattanooga LLC	Chattanooga, TN	1		
All landfills (44 landfills, 2012-2018 combined)	**USA**	**481,383**		

Blank = No information reported in TRI or Chemical Data Exchange.

2. Incinerators and Kilns

From 2012 to 2018, the manufacturing and processing of TBBPA transferred 247,610 pounds of waste that were burned in at least 15 incinerators and cement kilns around the country. Most (94%) of the waste was shipped to fuel blending facilities.

More than half (50.5%) of the TBBPA destined for burning went from Albemarle's TBBPA manufacturing plant in Magnolia, Arkansas, to Clean Earth's hazardous waste fuel blending facility in Glencoe, Alabama.

Many of the kilns and incinerators that burn this waste cannot be determined. Federal regulations do not require fuel blending and transfer facilities to report destinations of waste they have prepared to burn.[60]

Table 2: TBBPA Toxic Waste Transfers to Fuel Blending Operations, Incinerators and Kilns, 2012 to 2018

Incinerator / Waste Fuel Distributor	Type	Location	Waste Received (pounds)	Waste Origins	% of waste burned
Clean Earth (formerly EWS Alabama / Fisher Industrial)	Fuel Blending	Glencoe, AL (to unknown facilities)	125,118	Albemarle (Magnolia, AR)	50.5%
Systech Environmental Corp	Fuel Blending	Fredonia, KS (to Lafarge cement kilns)	35,990	Isola USA (Chandler AZ)	14.5%

Rineco Chemical Industries (Heritage)	Fuel Blending	Benton/Haskell, AR (to unknown facilities)	32,009	Hexcel (Kent WA), Huntsman (McIntosh AL), Cytec (five CA locations)	12.9%
Tradebe Treatment & Recycling LLC	Fuel Blending	East Chicago IN (to Covanta incinerator in Indianapolis IN; other destinations unknown)	28,767	Park Aerospace (Newton KS), Cytec (Winona KS), Isola (Chandler AZ)	11.6%
Clean Harbors Environmental Services	Incinerator	Kimball, NE	4,955	Hexcel (Casa Grande AZ, West Valley City UT)	2.0%
Veolia Es Technical Solutions	Fuel Blending	Azusa, CA (to unknown facilities)	4,782	Ashland (Commerce CA), Cytec (Orange CA)	1.9%
Clean Harbors El Dorado	Incinerator	El Dorado, AR	4,417	Hexcel (Casa Grande AZ), Lamart (Clifton NJ)	1.8%
Philip Services Solvent Recovery Corporation	Fuel Blending	Kansas City, MO (to unknown facilities)	3,456	Park Aerospace (Newton KS)	1.4%
3M Cottage Grove	Incinerator	Cottage Grove, MN	3,441	3M (Springfield MO)	1.4%
Emerald Services Inc	Fuel Blending	Tacoma, WA (to unknown facilities)	1,215	Boeing (Everett WA)	0.5%
Temarry Recycling	Incinerator	Tecate, Baja California, Mexico	1,116	Cytec (3 CA locations)	0.5%
VLS Armor	Incinerator	Mt. Pleasant, TN	513	Toray Advanced Composites (Fairfield CA)	
Clean Harbors	Incinerator	El Dorado, AR	480	Waste Management (Kettleman City CA)	
Safety-Kleen Systems Inc (Clean Harbors)	Fuel Blending	Smithfield, KY (to unknown facilities)	453	Parker Hannefin (Hudson NH), I3 Electronics (Endicott NY)	
Covanta Energy	Incinerator	Indianapolis, IN	329*	Tradebe (East Chicago IL)	
Covanta Lancaster Inc	Incinerator	Marietta, PA	228	Boeing (Ridley Park PA)	
American Environmental Services (Clean Earth)	Fuel Blending	Calvert City, KY (to unknown facilities)	191	Park Aerospace (Newton KS)	
Clean Harbors Deer Park	Incinerator	La Porte, TX	125	Hexcel (Casa Grande AZ), Lamart (Clifton NJ)	
Veolia Es Technical Solutions	Fuel Blending	Henderson, CO (to unknown facilities)	112	Hexcel (West Valley City UT)	
Advanced Waste Services of Indiana (Covanta)	Fuel Blending	Portage, IN	103*	Tradebe (East Chicago IL)	
Covanta Delaware Valley LP	Incinerator	Chester, PA	82.3	Boeing (Ridley Park PA)	
Ross Incineration Services Inc	Incinerator	Grafton, OH	79	Bostik (Middleton MA)	

VLS Piedmont LLC IRF	Fuel Blending	Gray Court, SC	44	Boeing (Ladson, SC)	
Buzzi Unicem USA	Cement Kiln	Greencastle, IN	10.6	Parker Hannefin (Hudson NH)	
Essroc Cement	Cement Kiln	Logansport, IN	9.1	Parker Hannefin (Hudson NH)	
Clean Harbors Aragonite LLC	Incinerator	Grantsville, UT	9	Hexcel (West Valley City UT)	
Kiln Direct Inc.	Fuel Blending	Sumter, SC	4	Boeing (Ladson, SC)	
Clean Harbors	Fuel Blending	Hebron, OH	2.5	Lamart (Clifton NJ)	
Lone Star Industries, Inc	Cement Kiln	Cape Girardeau, MO	1.7	Parker Hannefin (Hudson NH)	
Total Waste Received (pounds)			**247,610**		

Blank = No information reported in TRI or Chemical Data Exchange.

(*) Weights included in fuel blending operations, noted above, are not included in total.

F. Releases

According to the National Institute of Environmental Health Sciences, "TBBPA is currently the world's most highly produced brominated flame retardant, making human exposure to it widespread. It has been found in human tissue, and household dust, as well as other places in the environment, including soil, water, and fish."[61]

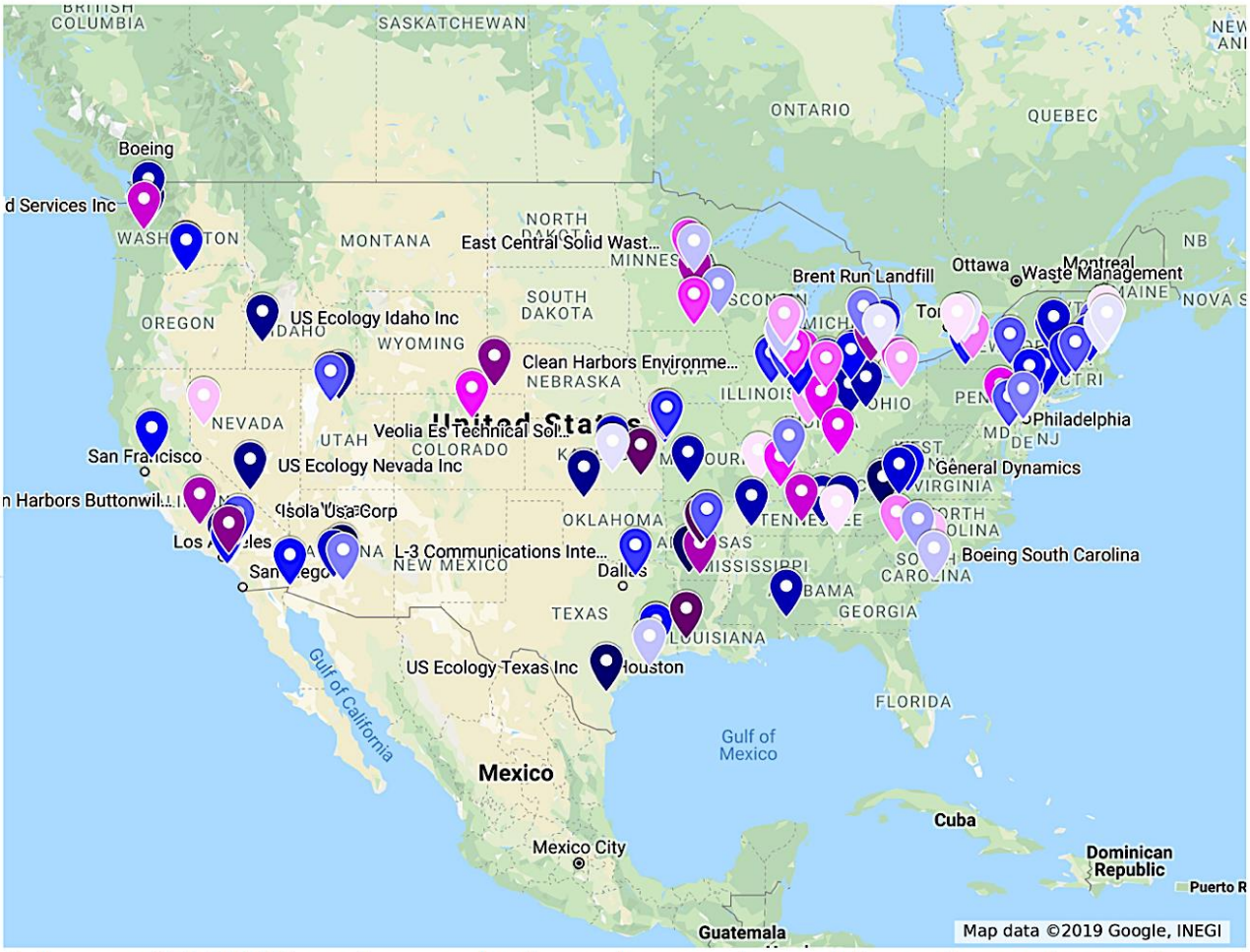
There are many ways in which this chemical is released. TBBPA is released when it is produced. Manufacturers send TBBPA waste to landfills and incinerators offsite. The chemical migrates from products during use. Some of these releases reach water treatment plants and contaminate sewage. The flame-retardant spreads further through recycling, into dust around processing plants, and into new products using recycled plastics.

A complete list of waste transfers and releases reported to EPA is provided below.

1. Releases from Manufacturing

Albemarle's TBBPA manufacturing plant releases far more TBBPA into the air than any other in location in the United States. It was the source of 76% of reported air emissions, nationwide, from 2012 to 2018. From 2012 to 2018, this plant released 21,850 pounds into the air, 48,817 pounds into an onsite landfill, and 475 pounds into an underground injection well. It also shipped 145,194 pounds of TBBPA waste to the US Ecology Texas landfill in Robstown, Nueces County, Texas.

Great Lakes reported releasing about 50,000 pounds of TBBPA per year from its El Dorado flame retardants factory into the air until it appears to have stopped producing this chemical in 2010. From 2011 to 2014, it reported no releases at all. In 2015, Great Lakes reported transferring 120,000 pounds of TBBPA waste from El Dorado to a Chemical Waste Management incinerator in Lake Charles, Louisiana. Great Lakes has not reported any TBBPA releases or waste transfers from its El Dorado plant since 2015.[62]



Releases of TBBPA Waste from production and processing and disposal operations in the United States, 2012-2018, per EPA data.

Screenshot: https://drive.google.com/openid=1drYHyOjjxZYd0hLwJ7IZ63m91D17BQ1R&usp=sharing

2. Releases from Processing

Some of the leading sources of TBBPA releases are companies that process it in the manufacturing of other products.

3M, which manufacturers epoxy construction adhesives, reported releasing 378 pounds of TBBPA from its Springfield, Missouri, plant into the air between 2012 and 2014, none since.

A Huntsman plant in McIntosh, Alabama, which produces epoxy resins for the aerospace and oil and gas industries, reported releasing 722 pounds of TBBPA into the air between 2012 and 2018.

Cytec, another company that processes TBBPA in adhesives manufacturing, reported releasing 1,779 pounds of TBBPA into the air from five manufacturing plants in the US since 2012 (see E. Releases, below).

In 2012, Dow, which had been a leading supplier of brominated epoxy resins to the printed wiring/circuitry board industry before transferring this business to Olin in 2015, reported disposing of 68,894 pounds of TBBPA waste in a landfill at its Freeport, Texas, complex.

In Toxics Release Inventory forms, Sabic reported TBBPA releases at three different plants: Mount Vernon, Indiana, Ottawa, Illinois (where Sabic shifted ABS Manufacturing from Washington, West Virginia), and Selkirk, New York. Sabic's Mount Vernon plant was the country's leading source of water releases of TBBPA from 2012 to 2018, when it discharged 184 pounds of the flame retardant into the Ohio River. Sabic also sent 1,157 pounds of TBBPA from its Selkirk plant to the town of Colonie's dump in Cohoes, NY.

A Saudi-owned petrochemicals and plastics factory in Mount Vernon, Indiana, is the country's leading source of

TBBPA water pollution. Photo by James Vallette, Material Research, 2019.

3. Releases from Products

Manufacturers have emphasized that most TBBPA used in electronics and plastics is reactive and not additive. In theory, additive TBBPA ,"finds its way into the environment and the food chain," while reactive TBBPA poses, "little danger of this substance being released."[63]

For example, in 2015, Chemtura/Lanxess (owner of Great Lakes Chemical's BFR plant in El Dorado, Texas) asserted that its TBBPA (BA-59P) product, "has been embedded into a polymer matrix is not readily released into the environment. BA-59P that has been reacted and transformed into a resin for circuit board manufacture cannot be released into the environment as BA-59P, because it no longer exists as the same substance and has combined with other materials to make a new plastic."[64]

Similarly, Hexion stated in 2008 that, "TBBPA is used as a reactive component in the manufacturing of printed circuit boards (mainly of FR4 laminates) and, being integrated into the polymer of the board, it does no longer exist as such."[65]

However, some TBBPA in computer housing is additive and is released during use. One study found emissions, decreasing over time, of 1 nanogram per cubic meter from computer housing containing additive TBBPA.[66]

A recent study detected TBBPA on the surface of 97% of the mobile phones and 91% of the personal computer surfaces that it tested.[67] The TBBPA is either coming from additive use or from unreacted residuals of reactive processes that are not ,"bound in a matrix."

A 2013 study of flame retardants in sewage sludge found that, "As expected, high concentration levels of TBBPA were observed due to the fact that TBBPA is the most applied flame retardant in the world. TBBPA was detected in quantifiable levels in 15 of the 17 [wastewater treatment plants] analyzed..," wrote the authors. The scientists found far higher levels of MonoBBPA and TriBBPA than TBBPA, which they said, "could be explained by a possible TBBPA debromination to their related compounds." They also detected bisphenol-A, in every sample. "(T)he presence of this contaminant could be due to the TBBPA degradation as well as to their industrial manufacturing and use."[68]

Another research team noted the degradation of TBBPA during wastewater treatment could lead to bisphenol-A being formed and, "applied to agricultural land with the digested sludge."[69]

4. Releases from E-Waste Recycling

In 2005, tests of the air inside an e-waste recycling plant in Sweden revealed higher levels of TBBPA than any other workplace known at the time.[70]

5. Releases from Waste Incineration

Researchers in Spain recently identified over one hundred, semi-volatile compounds formed from combustion or pyrolysis of TBBPA. “High levels of 2,4-, 2-6- and 2,4,6-bromophenols were found. The levels of polybrominated dibenzo-p-dioxins and furans have been detected in the ppm range. Most abundant isomers are 2,4,6,8-TeBDF in pyrolysis and 1,2,3,7,8-PeBDF in combustion,” they wrote. “These results should be considered in the assessment of thermal treatment of materials containing brominated flame retardants, as TBBPA, since the emissions could pose a health and environmental risk.” [71]

A US Ecology waste fuel blending facility in Detroit, Michigan, receives TBBPA waste. Coalition to Oppose the Expansion of US Ecology photo, 2019.

Table 3: TBBPA Waste Transfer and Disposal, 2012 to 2018

Facility	Type	Pounds				
		Incoming Waste	Air	Land	Off-site (Transfers and Recycling)	Releases and Off-site Transfers (total)
US Ecology Texas Inc (Robstown, TX)	Landfill	145,194		*145,194*		*145,194*
Chemical Waste Management (Sulphur, LA)	Incinerator	120,000	2	134,000		134,002
Fisher Industrial Service Inc / EWS Alabama (Glencoe, AL)	Fuel Blending	125,118			*125,118*	*125,118*

Mir Plastics (Knoxville, TN)	Plastics Recycling	82,262			*82,262*	*82,262*
Tradebe Treatment & Recycling LLC (East Chicago, IN)	Fuel Blending	30,092			*30,092*	*30,092*
EQ Detroit Inc (US Ecology) (Detroit, MI)	Waste Treatment and Solidification	176.7	35.3		17,214	17,249
Southern Waste (Whitesburg, TN)	Waste Broker	16,399			*16,399*	*16,399*
Waste Management Of New York, LLC (Chaffee, NY)	Landfill	12,018		*12,018*		*12,018*
Veolia Es Arbor Hills Landfill Inc (Northville, MI)	Landfill	10,231		*10,231*		*10,231*
Clean Harbors Lone Mountain LLC (Waynoka, OK)	Landfill	n.d.		9,558		9,558
US Ecology Idaho Inc (Grand View, ID)	Landfill	n.d.	3	9,546		9,549
US Ecology Nevada Inc (Beatty, NV)	Landfill	2,160	0.45	8,123		8,123
Wayne Disposal (Sub C Landfill) (Belleville, MI)	Landfill	1942	0.07	5,926		5,926
Tradebe Treatment & Recycling (Millington, TN)	Fuel Blending	n.d.			5,273	5,273
North Shelby Landfill (Millington, TN)	Landfill	4,996		*4,996*		*4,996*
Cherokee Run Landfill (Bellefontaine, OH)	Landfill	4,500		*4,500*		*4,500*
Rhea County Landfill (Dayton, TN)	Landfill	4,011		*4,011*		*4,011*
Regional Disposal Co Roosevelt Landfill (Roosevelt, WA)	Landfill	2,254		*2,254*		*2,254*
Solvent Recovery Corp (Kansas City, MO)	Fuel Blending	2,113			*2,113*	*2,113*
Butterfield Station Landfill (Mobile, AZ)	Landfill	1,625		*1,625*		1,625
Washington County Solid Waste Department (Abingdon, VA)	Landfill	1,144		*1,144*		*1,144*
Temarry Recycling (Tecate, Baja California, Mexico)	Incinerator	1,116				
Town of Colonie Sanitary Landfill (Cohoes, NY)	Landfill	1,077		*1,077*		*1,077*
Veolia Es Environmental Services, LLC (Richmond, CA)	Logistics	1,041			*1,041*	*1,041*
Heritage Environmental Services LLC (Indianapolis, IN)	Landfill	990		*990*		990
Pine Tree Acres Inc (Lenox, MI)	Landfill	974		*974*		*974*
Chemical Waste Management of the Northwest (Arlington, OR)	Landfill	100.08		959		959
Williams County Landfill (Bryan, OH)	Landfill	882.2		*882*		*882*
Berg Lacquer Co (Ellis Paint) (Los Angeles, CA)	Logistics	863			*863*	*863*

Intergroup International (Warren, OH)	Recycled Materials Processor	835			*835*	*835*
Marisol Incorporated (Middlesex, NJ)	Logistics	817			*817*	*817*
Newton County Landfill (Brook, IN)	Landfill	803		*803*		*803*
Clean Harbors Laporte (La Porte, TX)	Landfill	722		*722*		*722*
Gaeta Recycling Inc (Paterson NJ)	Logistics	605			*605*	*605*
Covanta Warren Energy Resource (Oxford, NJ)	Landfill	490		*490*		*490*
AA Sydcol LLC (Yuma, AZ)	Landfill	488		*488*		*488*
Chemical Waste Management (Kettleman City, CA)	Fuel Blending	n.d.			480	480
Courtney Ridge Landfill (Sugar Creek, MO)	Landfill	401		*401*		*401*
Land Comp Corporation (Ottawa, IL)	Landfill	388		*388*		*388*
Veolia Es Technical Solutions LLC (Irwindale, CA)	Recycled Materials Processor	361			*361*	*361*
Millbury Resource Recovery Facility (Millbury, MA)	Landfill	357		*357*		*357*
Nexeo Solutions LLC (Binghamton, NY)	Logistics	297			*297*	*297*
Laraway RDF (Joliet, IL)	Landfill	256		*256*		*256*
Clean Harbors Grassy Mountain LLC (Grantsville, UT)	Landfill	n.d.	0.01	254		254
Town Of Manchester Landfill (Manchester, CT)	Landfill	251		*251*		*251*
WasteMgmt Ark-2900 West 68th (Little Rock, AR)	Landfill	247		*247*		*247*
Brent RunOrFintHills (Sub D Landfill) (Montrose, MI)	Landfill	245		*245*		*245*
Northland Environmental (Stericycle) (Providence, RI)	Logistics	232			*232*	*232*
Ross Incineration Services Inc (Grafton, OH)	Incinerator	79			177	177
Countryside Landfill (Grayslake, IL)	Landfill	153		*153*		*153*
Veolia Es Technical Solutions (Middlesex, NJ)	Fuel Blending	111			*111*	*111*
River Bend Prairie Landfill (Dolton, IL)	Landfill	104		*104*		*104*
Clean Harbors Arizona (Phoenix, AZ)	Logistics	100			*100*	*100*
Advanced Disposal Services Arbor Hills Landfill Inc (Northville, MI)	Landfill	84		*84*		*84*
SKB Landfill (Austin, MN)	Landfill	82		*82*		*82*
Colonie Landfill (Cohoes, NY)	Landfill	80		*80*		*80*
Veolia Environmental Services, Claypool Landfill (Claypool, IN)	Landfill	69		*69*		*69*

Spring Grove Resource Recovery (Clean Harbors) (Cincinnati, OH)	Fuel Blending	64.8			*64.8*	*64.8*
East Central Solid Waste Commission (Mora, MN)	Landfill	50		*50*		*50*
Waste Management (Grayslake, IL)	Landfill	40		*40*		*40*
Clean Earth Of Calvert City (Calvert City, KY)	Fuel Blending	28			*28*	*28*
Waste Connections Transfer Station (Wichita, KS)	Landfill	25.4		*25.4*		*25.4*
Hyland Landfill (Angelica, NY)	Landfill	23		*23*		*23*
W M W I - Metro Recycling & Disposal (Franklin, WI)	Landfill	16		*16*		*16*
Veolia Es Emerald Park Landfill (Muskego, WI)	Landfill	14		*14*		*14*
AES Environmental, LLC (Calvert City, KY)	Fuel Blending	13.2			*13.2*	*13.2*
Buzzi Unicem USA (Greencastle, IN)	Cement Kiln	10.6			*10.6*	*10.6*
Vexor Technology Inc (Medina, OH)	Landfill	10		*10*		*10*
Ashland Chemical Co (Binghamton, NY)	Fuel Blending	9			*9*	*9*
21st Century Environmental Management of Nevada LLC (Fernley, NV)	Landfill	6		*6*		*6*
Allied Waste of NA LLC (Kenmore, NY)	Landfill	3.27		*3.27*		*3.27*
Clean Harbors Recycling Services (Hebron, OH)	Fuel Blending	2.5			*2.5*	*2.5*
Lone Star Industries, Inc (Cape Girardeau, MO)	Cement Kiln	1.7	n.d.			*0*
Clean Harbors Canada, Inc. (Corunna, Ontario, Canada)	Fuel Blending	1.3			*1.3*	*1.3*
Waste Management (Rochester, NH)	Landfill	1.3		*1.3*		*1.3*
Clean Harbors Chattanooga LLC (Chattanooga, TN)	Landfill	1		*1*		*1*
Systech Environmental Corp (Fredonia, KS)	Incinerator	35,990	n.d.			
Rineco Chemical Industries, LLC (Benton, AR)	Incinerator	24,540	n.d.			
Heritage (Rineco) (Haskell, AR)	Incinerator	7,469	n.d.			
Clean Harbors Environmental Services Inc (Kimball, NE)	Incinerator	4,955	n.d.			
Veolia Es Technical Solutions LLC (Azusa, CA)	Incinerator	4,421	n.d.			
Clean Harbors El Dorado, LLC (El Dorado, AR)	Incinerator	4,417	n.d.			
Michigan Disposal (Belleville, MI)	Incinerator	3,738	n.d.			

3M Cottage Grove Utilities/SupportSvcs(Cottage Grove, MN)	Incinerator	3,441	n.d.			
Clean Harbors Buttonwillow LLC (Buttonwillow, CA)	Incinerator	1,337	n.d.			
Philip Services Solvent Recovery Corporation (Kansas City, MO)	Incinerator	1,323	n.d.			
Emerald Services Inc (Tacoma, WA)	Incinerator	1,215	n.d.			
Temarry Recycling (Tecate, Baja California, Mexico)	Incinerator	1,116	n.d.			
VLS Armor (Mt. Pleasant, TN)	Incinerator	513	n.d.			
Safety-Kleen Systems Inc (Smithfield, KY)	Incinerator	453	n.d.			
Covanta Energy (Indianapolis, IN)	Incinerator	329	n.d.			
Covanta Lancaster Inc (Marietta, PA)	Incinerator	228	n.d.			
American Environmental Svcs (Calvert City, KY)	Incinerator	191	n.d.			
Clean Harbors Deer Park, (La Porte, TX)	Incinerator	125	n.d.			
Veolia Es Technical Solutions LLC (Henderson, CO)	Incinerator	112	n.d.			
Advanced Waste Services of Indiana LLC (Portage, IN)	Incinerator	103	n.d.			
Covanta Delaware Valley LP (Chester, PA)	Incinerator	82.3	n.d.			
Clean Harbors - El Dorado AR (El Dorado, AR)	Incinerator	80	n.d.			
VLS Piedmont LLC IRF (Gray Court, SC)	Incinerator	44	n.d.			
Essroc Cement Corp (Logansport, IN)	Cement kiln	9.1	n.d.			
Clean Harbors Aragonite LLC (Grantsville, UT)	Incinerator	9	n.d.			
Beaver Oil Treatment And Recycling (Hodgkins, IL)	Wastewater Treatment	7				
Kiln Direct Inc (Sumter, SC)	Incinerator	4	n.d.			
Lone Star Industries, Inc (Cape Girardeau, MO)	Cement Kiln	1.7	n.d.			
TOTAL		**677,395**	**40.8**	**363,672**	**285,637**	**649,350**

n.d. = no data where some might be expected.

Blank = No information reported in TRI or Chemical Data Exchange.

Derived from a Toxic Waste Transfer and Release analytic tool, developed by Material Research, which harmonizes data from EPA's Toxic Release Inventory (TRI) and Chemical Data Exchange (CDX).

Figures in italics are assumptions based upon type of operation. In these cases, EPA's TRI and CDX data systems have recorded transfers to this facility but not disposal or transfer of waste from this facility. Shipments to landfills, for example, are presumed to have been disposed of on land. Shipments to recyclers, fuel blending, and repackaging operations are assumed to be transferred to other destinations, although some waste is released through these processes.

ENDNOTES

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