Chapter 3
2000 Toxics Release Inventory Data for PBT Chemicals

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Introduction

For the reporting year 2000, TRI was expanded to include certain new persistent bioaccumulative toxic (PBT) chemicals. In addition, reporting thresholds were lowered for both the newly-added PBT chemicals and certain PBT chemicals already on the TRI list. In a rule (64 FR 58666) finalized on October 29, 1999, EPA added six PBT chemicals and one PBT chemical compound category. Two of the chemicals were added to the Polycyclic Aromatic Compounds (PACs) category. The rule also lowered reporting thresholds for 15 PBT chemicals and three PBT chemical categories (see Box 3-1). This chapter of the 2000 Toxics Release Inventory Public Data Release presents detailed information on and TRI data for the PBT chemicals.

In a separate action, as part of this same rulemaking, EPA added vanadium compounds to the list of TRI chemicals and changed the reporting qualifier for vanadium (already on the list of TRI chemicals) from “fume or dust” to “except when contained in an alloy.” Vanadium and vanadium compounds have not been classified as PBT chemicals.

Prior to the changes for the PBT chemicals, the reporting threshold for all chemicals had been 25,000 pounds for manufacturing or processing the chemical and 10,000 pounds if otherwise used. Because PBT chemicals persist and bioaccumulate in the environment, they have the potential to cause greater exposure to humans and the environment over a longer period of time, making even small quantities of these chemicals a concern. Therefore, EPA established lower thresholds for these chemicals. For those chemicals that are persistent and bioaccumulative, a threshold of 100 pounds manufactured, processed or otherwise used was established. For the subset of PBT chemicals that are *highly* persistent and *highly* bioaccumulative, a threshold of 10 pounds was established. In addition, because dioxins are highly persistent and highly bioaccumulative, but are generally produced in extremely small amounts, the threshold for dioxin and dioxin-like compounds was set at 0.1 grams, so that reporting would result.

This chapter provides an overview of 2000 TRI data for each group of PBT chemicals (see Box 3-1). Data analyses in this chapter begin with summary tables that present 2000 release and other waste management data for PBT chemicals. The chapter then presents separate sections on each PBT chemical group and its TRI data. In addition, to help put the TRI data in context, each section describes the chemical, its sources and uses, where and how the chemical ends up in the environment, general environmental and health issues, and efforts to reduce pollution from the chemical.

While the expansion of information on PBT chemical releases and other waste management through the TRI provides an invaluable source of environmental data, it is limited. TRI does not include all industrial sources or other sources of releases, for example agricultural applications of pesticides. Although, these chemicals are known to exist in the environment for long periods of time, TRI data do not supply information on exposure and risk, but rather on releases and other waste management that take place in a given calendar year. Chapter 1 explains the types of releases and other waste management activities, and it provides important information on factors and limitations to consider when using TRI data.

Box 3-1: PBT Chemicals on TRI list

CAS Number	PBT Chemicals	New for 2000	Reporting Threshold
—	**Dioxin and dioxin-like compounds category**	X	0.1 grams
	(including the following chemicals)		
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran		
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran		
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran		
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran		
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran		
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran		
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin		
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin		
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin		
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin		
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran		
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin		
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran		
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran		
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin		
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran		
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin		
			(pounds)
	Mercury and mercury compounds		
7439-97-6	Mercury		10
—	Mercury compounds category		10
	Polycyclic aromatic compounds (PACs)		
191-24-2	Benzo(g,h,i)perylene	X	10
—	Polycyclic aromatic compounds category		
	(including the following chemicals)		100
56-55-3	Benzo(a)anthracene		
205-99-2	Benzo(b)fluoranthene		
205-82-3	Benzo(j)fluoranthene		
207-08-9	Benzo(k)fluoranthene		
206-44-0	Benzo(j,k)fluorene	X	
189-55-9	Benzo(r,s,t)pentaphene		

Box 3-1: PBT Chemicals on TRI list (continued)

CAS Number	PBT Chemicals	New for 2000	Reporting Threshold
218-01-9	Benzo(a)phenanthrene		
50-32-8	Benzo(a)pyrene		
226-36-8	Dibenzo(a,h)acridine		
224-42-0	Dibenzo(a,j)acridine		
53-70-3	Dibenzo(a,h)anthracene		
194-59-2	7H-Dibenzo(c,g)carbazole		
5385-75-1	Dibenzo(a,e)fluoranthene		
192-65-4	Dibenzo(a,e)pyrene		
189-64-0	Dibenzo(a,h)pyrene		
191-30-0	Dibenzo(a,l)pyrene		
57-97-6	7,12-Dimethylbenz(a)anthracene		
193-39-5	Indeno[1,2,3-cd]pyrene		
56-49-5	3-Methylcholanthrene	X	
3697-24-3	5-Methylchrysene		
5522-43-0	1-Nitropyrene		
1336-36-3	**Polychlorinated biphenyls (PCBs)**		10
	Pesticides		
309-00-2	Aldrin		100
57-74-9	Chlordane		10
76-44-8	Heptachlor		10
465-73-6	Isodrin		10
72-43-5	Methoxychlor		100
40487-42-1	Pendimethalin		100
8001-35-2	Toxaphene		10
1582-09-8	Trifluralin		100
	Other PBT chemicals		
118-74-1	Hexachlorobenzene		10
29082-74-4	Octachlorostyrene	X	10
608-93-5	Pentachlorobenzene	X	10
79-94-7	Tetrabromobisphenol A	X	100

Chemical Characteristics

Persistence

A chemical's persistence refers to the length of time the chemical can exist in the environment before being destroyed (i.e., transformed into another chemical species) by natural processes. The environmental media for which persistence is measured or estimated include air, water, soil, and sediment.

A distinction is made between persistence in a single medium (air, water, soil, sediment) and overall environmental persistence. Persistence in an individual medium is controlled by transport of the chemical to other media, as well as transformation to other chemical species. Persistence in the environment as a whole is a distinct concept based on the observations that the environment behaves as a set of interconnected media, and that a chemical substance released to the environment will become distributed in these media in accordance with the chemical's intrinsic (physical/chemical) properties and reactivity.

A common measure of persistence in an environmental medium is a chemical's half-life, or the amount of time necessary for half of the chemical present to be eliminated from the medium. If a toxic chemical meets any one of the media-specific criteria, it is considered to be persistent. However, in the PBT chemicals rulemaking, EPA did not classify chemicals as PBT chemicals based solely on the in air criterion.

Bioaccumulation

Bioaccumulation is a general term that is used to describe the process by which organisms may accumulate chemical substances in their bodies. Bioaccumulation can occur in plants, and animals, including humans.

EPA has defined bioaccumulation as the net accumulation of a substance by an organism as a result of uptake from all environmental sources. The nondietary accumulation of chemicals in aquatic organisms is referred to as bioconcentration. EPA has defined bioconcentration as the net accumulation of a substance by an aquatic organism as a result of uptake directly from the ambient water through gill membranes or other external body surfaces.

A chemical's potential to bioaccumulate can be quantified by measuring or predicting the chemical's bioaccumulation factor (BAF). The BAF is the ratio of a substance's concentration in tissue of an aquatic organism to its concentration in the ambient water, in situations where both the organism and its food are exposed and the ratio does not change substantially over time. A chemical's potential to bioaccumulate can also be quantified by measuring or predicting the chemical's bioconcentration factor (BCF). The BCF is the ratio of a substance's concentration in tissue of an aquatic organism to its concentration in the ambient water, in situations where the organism is exposed through water only and the ratio does not change substantially over time. Because BAFs consider the uptake of chemicals from all routes of exposure they are considered better predictors of the accumulation of chemicals within fish than BCFs which only consider uptake of chemicals directly from water.

Toxicity

EPCRA Section 313 provides toxicity criteria at Section 313(d)(2) to be used to determine whether a chemical should be added or deleted from the EPCRA Section 313 list of toxic chemicals. All of the chemicals listed as PBT chemicals, including dioxin and dioxin-like compounds, were either added based on these criteria or were on the initial EPCRA Section 313 list provided to EPA by Congress.

2000 TRI DATA FOR PBT CHEMICALS

As shown in Table 3-1, 6,901 forms were submitted for PBT chemicals. Over half of these forms were for polycyclic aromatic compounds.

On- and Off-site Releases

In 2000, TRI releases for all PBT chemicals totaled 12.1 million pounds, of which polycyclic aromatic compounds accounted for 5.4 million pounds, or

44.6 percent of total releases for all PBT chemicals (see Table 3-1). Almost 44.0 percent of the releases of PBT chemicals were released on-site to land, 38.9 percent were off-site releases (off-site transfers to disposal), and 17.8 percent were released to air. Polychlorinated biphenyls accounted for 1.4 million pounds of the 1.7 million pounds of on-site land releases to RCRA subtitle C landfills (79.9 percent). Mercury and mercury compounds accounted for 3.2 million pounds of the 3.6 million pounds of on-site releases to land that were not to RCRA subtitle C landfills (88.7 percent). Polycyclic aromatic compounds accounted for 3.1 million pounds of the 4.6 million pounds of off-site releases (68.6 percent). Polycyclic aromatic compounds also accounted for most of the air emissions and surface water discharges. Air emissions of polycyclic aromatic compounds were 1.9 million pounds or 88.8 percent of the total of 2.2 million pounds for all PBT chemicals. Surface water discharges of polycyclic aromatic compounds were 18,137 pounds or 85.1 percent of the total of 21,319 pounds for all PBT chemicals.

Thus, the various PBT chemicals were generally released in different ways. Over half of dioxin and dioxin-like compounds were off-site releases (off-site transfers to disposal). One-third of dioxin and dioxin-like compounds and 74.1 percent of mercury and mercury compounds were released on-site to land in sites other than RCRA subtitle C landfills. Polycyclic aromatic compounds were either transferred off-site to disposal (58.1 percent) or released to air (35.5 percent). Practically all of the polychlorinated biphenyls (93.9 percent) were released to on-site RCRA subtitle C landfills. For the group of pesticides, 40.9 percent of their total releases was as releases to on-site RCRA subtitle C landfills, 34.6 percent was as other types of on-site land releases and 16.5 percent was transferred off-site to disposal. For the four other PBT chemicals, 65.7 percent of total releases of this group were transferred off-site to disposal.

Table 3-1: TRI On-site and Off-site Releases, PBT Chemicals, 2000

			On-site Releases							Off-site Releases	
					Underground Injection		On-site Land Releases				
CAS Number	Chemical	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
--	**Dioxin and Dioxin-like compounds***	**1,274**	**11.51**	**4.58**	**0.63**	**0.27**	**10.81**	**73.46**	**101.24**	**118.85**	**220.09**
--	*Dioxin and dioxin-like compounds (in grams)**	*1,274*	*5,217.775*	*2,075.634*	*284.112*	*121.080*	*4,903.737*	*33,313.286*	*45,915.624*	*53,898.465*	*99,814.089*
	Mercury and Mercury Compounds	**1,596**	**164,492.53**	**2,302.28**	**1,931.72**	**9,781.80**	**91,297.96**	**3,196,983.53**	**3,466,789.83**	**849,872.31**	**4,316,662.14**
7439-97-6	Mercury	566	29,833.13	392.31	1,121.00	255.70	20,280.78	18,164.40	70,047.32	24,490.28	94,537.60
--	Mercury compounds	1,030	134,659.41	1,909.98	810.72	9,526.10	71,017.18	3,178,819.12	3,396,742.51	825,382.03	4,222,124.54
	Polycyclic Aromatic Compounds	**3,550**	**1,916,436.42**	**18,137.05**	**0.00**	**10,000.00**	**201,581.64**	**115,205.99**	**2,261,361.11**	**3,141,614.53**	**5,402,975.63**
191-24-2	Benzo(g,h,i)perylene	1,366	42,318.09	531.22	0.00	0.00	976.14	5,236.07	49,061.52	116,927.71	165,989.23
--	Polycyclic aromatic compounds	2,184	1,874,118.34	17,605.83	0.00	10,000.00	200,605.50	109,969.93	2,212,299.59	3,024,686.82	5,236,986.40
1336-36-3	**Polychlorinated Biphenyls (PCBs)**	**171**	**5,854.15**	**28.82**	**0.60**	**0.00**	**1,371,343.20**	**57,544.00**	**1,434,770.77**	**26,146.07**	**1,460,916.85**
	Pesticides	**138**	**6,339.64**	**330.62**	**3.16**	**0.00**	**33,707.32**	**28,498.00**	**68,878.74**	**13,564.60**	**82,443.34**
309-00-2	Aldrin	11	0.79	0.00	0.00	0.00	2,342.00	0.00	2,342.79	2.58	2,345.37
57-74-9	Chlordane	21	13.70	0.00	0.00	0.00	8,947.74	0.00	8,961.44	828.59	9,790.03
76-44-8	Heptachlor	15	6.60	0.00	0.00	0.00	2,372.56	0.00	2,379.16	221.87	2,601.03
465-73-6	Isodrin	6	0.05	0.00	2.95	0.00	0.00	0.00	3.00	0.00	3.00
72-43-5	Methoxychlor	20	59.83	0.00	0.00	0.00	2,569.00	0.00	2,628.83	31.75	2,660.58
40487-42-1	Pendimethalin	18	733.54	329.00	0.00	0.00	332.00	20,343.00	21,737.54	9,555.00	31,292.54
8001-35-2	Toxaphene	16	20.98	1.62	0.21	0.00	5,928.02	0.00	5,950.83	176.14	6,126.97
1582-09-8	Trifluralin	31	5,504.15	0.00	0.00	0.00	11,216.00	8,155.00	24,875.15	2,748.67	27,623.82
	Other PBTs	**172**	**63,976.18**	**515.29**	**60.27**	**0.02**	**17,578.20**	**205,422.10**	**287,552.06**	**551,362.24**	**838,914.30**
118-74-1	Hexachlorobenzene	100	1,426.24	331.44	48.37	0.02	16,955.00	5,745.20	24,506.26	13,021.04	37,527.30
29082-74-4	Octachlorostyrene	4	0.00	0.00	0.00	0.00	0.00	148.30	148.30	436.90	585.20
608-93-5	Pentachlorobenzene	20	162.54	173.85	11.90	0.00	623.20	1,999.60	2,971.09	355.00	3,326.09
79-94-7	Tetrabromobisphenol A	48	62,387.41	10.00	0.00	0.00	0.00	197,529.00	259,926.41	537,549.30	797,475.71
	Total	**6,901**	**2,157,110.44**	**21,318.64**	**1,996.38**	**19,782.09**	**1,715,519.14**	**3,603,727.08**	**7,519,453.76**	**4,582,678.60**	**12,102,132.35**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

* The chemical category dioxin and dioxin-like compounds is reported in grams. Where the category dioxin and dioxin-like compounds is shown on a table with other TRI chemicals, it is presented in pounds. The grams are converted to pounds by multiplying by 0.002205.

Table 3-2: Quantities of TRI Chemicals in Waste, PBT Chemicals, 2000

CAS Number	Chemical	Recycled On-site Pounds	Recycled Off-site Pounds	Energy Recovery On-site Pounds	Energy Recovery Off-site Pounds	Treated On-site Pounds	Treated Off-site Pounds	Quantity Released On- and Off-site Pounds	Total Production-related Waste Managed Pounds	Non-production-related Waste Managed Pounds
--	**Dioxin and Dioxin-like compounds***	9.81	0.01	0.04	4.40	550.18	71.16	233.09	868.69	59.15
--	*Dioxin and dioxin-like compounds (in grams)**	*4,448.559*	*5.393*	*19.698*	*1,994.612*	*249,513.356*	*32,271.529*	*105,709.934*	*393,963.081*	*26,825.006*
	Mercury and Mercury Compounds	**646,940.05**	**161,929.47**	**77.73**	**126.01**	**19,768.28**	**5,864.61**	**4,041,157.67**	**4,875,863.82**	**18,143.88**
7439-97-6	Mercury	301,682.87	64,712.99	67.73	69.01	365.53	5,334.76	87,957.08	460,189.97	4,903.71
--	Mercury compounds	345,257.18	97,216.48	10.00	57.00	19,402.75	529.84	3,953,200.59	4,415,673.84	13,240.17
	Polycyclic Aromatic Compounds	**2,932,858.97**	**622,842.53**	**7,570,145.81**	**212,142.99**	**25,600,382.12**	**257,264.86**	**5,744,191.79**	**42,939,829.07**	**64,717.07**
191-24-2	Benzo(g,h,i)perylene	100,105.08	9,925.22	1,804,355.26	5,656.33	1,451,368.24	2,665.42	167,216.09	3,541,291.65	639.53
--	Polycyclic aromatic compounds	2,832,753.89	612,917.31	5,765,790.55	206,486.66	24,149,013.88	254,599.44	5,576,975.70	39,398,537.42	64,077.54
1336-36-3	**Polychlorinated Biphenyls (PCBs)**	**358.00**	**752.65**	**1,410.77**	**10,517.00**	**11,906,010.41**	**288,785.81**	**1,481,214.78**	**13,689,049.42**	**22,122.52**
	Pesticides	**11,501.00**	**0.00**	**1,569.00**	**983.00**	**2,312,740.17**	**140,172.19**	**87,061.74**	**2,554,027.10**	**45.00**
309-00-2	Aldrin	0.00	0.00	0.00	0.00	82,504.75	283.00	2,345.32	85,133.07	0.00
57-74-9	Chlordane	0.00	0.00	230.00	0.00	812,322.92	5,686.05	9,010.26	827,249.23	0.00
76-44-8	Heptachlor	0.00	0.00	42.00	0.00	237,739.73	3,773.30	2,394.03	243,949.06	0.00
465-73-6	Isodrin	0.00	0.00	0.00	0.00	6,603.84	0.00	3.00	6,606.84	0.00
72-43-5	Methoxychlor	0.00	0.00	225.00	755.00	290,474.16	431.60	2,682.64	294,568.40	0.00
40487-42-1	Pendimethalin	4,000.00	0.00	0.00	0.00	656,145.00	19,602.00	31,358.55	711,105.55	0.00
8001-35-2	Toxaphene	0.00	0.00	1,072.00	0.00	210,240.69	589.24	6,008.47	217,910.40	0.00
1582-09-8	Trifluralin	7,501.00	0.00	0.00	228.00	16,709.08	109,807.00	33,259.47	167,504.55	45.00
	Other PBTs	**6,605.50**	**12,450.00**	**140,662.00**	**58,434.00**	**6,504,174.17**	**28,488.96**	**839,475.17**	**7,590,289.80**	**21,754.65**
118-74-1	Tetrabromobisphenol A	6,000.50	12,039.00	140,662.00	56,585.00	6,154,926.17	19,461.15	48,420.58	6,438,094.40	21,752.30
29082-74-4	Hexachlorobenzene	0.00	0.00	0.00	0.00	19.00	0.00	585.20	604.20	0.00
608-93-5	Pentachlorobenzene	40.00	401.00	0.00	0.00	342,267.00	1,390.81	3,326.28	347,425.09	2.35
79-94-7	Octachlorostyrene	565.00	10.00	0.00	1,849.00	6,962.00	7,637.00	787,143.11	804,166.11	0.00
	Total	**3,598,273.32**	**797,974.66**	**7,713,865.36**	**282,207.40**	**46,343,625.33**	**720,647.59**	**12,193,334.24**	**71,649,927.90**	**126,842.27**

Note: Data are from Section 8 of Form R.

* The chemical category dioxin and dioxin-like compounds is reported in grams. Where the category dioxin and dioxin-like compounds is shown on a table with other TRI chemicals, it is presented in pounds. The grams are converted to pounds by multiplying by 0.002205.

Waste Management Data

Quantities of TRI Chemicals in Waste

Total production-related waste of PBT chemicals managed in 2000 was 71.6 million pounds, of which polycyclic aromatic compounds accounted for 42.9 million pounds, or 59.9 percent (see Table 3-2). Polychlorinated biphenyls totaled 13.7 million pounds of production-related waste managed, or 19.1 percent of the total for PBT chemicals.

Almost 64.7 percent of all production-related waste of PBT chemicals was treated on-site (46.3 million pounds). Another 17.0 percent was released on- and off-site, and 10.8 percent was used for energy recovery on-site.

While 25.6 million pounds (55.2 percent) of the on-site treatment of PBT chemicals was for the polycyclic aromatic compounds, 11.9 million pounds of polychlorinated biphenyls were treated on-site (25.7 percent of all on-site treatment), and 6.5 million pounds of the group of other PBT chemicals (mainly hexachlorobenzene) accounted for 14.0 percent of all on-site treatment of PBT chemicals in 2000.

Polycyclic aromatic compounds accounted for 59.9 percent of total production-related waste of PBT chemicals in 2000 and 47.1 percent of quantities released on- and off-site. Mercury and mercury compounds accounted for 33.1 percent of all quantities of PBT chemicals released on- and off-site (4.0 million pounds out of 12.2 million pounds), and this represented 82.9 percent of all production-related waste of mercury and mercury compounds managed in 2000.

While on-site energy recovery accounted for 10.8 percent of all production-related waste for PBT chemicals, most of this was the 7.6 million pounds of polycyclic aromatic compounds that were in waste used for energy recovery on-site. This was 17.6 percent of all production-related waste managed for polycyclic aromatic compounds and 98.1 percent of all on-site energy recovery of PBT chem-

Table 3-3: TRI Transfers Off-site for Further Waste Management/Disposal, PBT Chemicals, 2000

CAS Number	Chemical	Transfers to Recycling	Transfers to Energy Recovery	Transfers to Treatment	Transfers to POTWs: Metals and Metal Compounds	Transfers to POTWs: Non-metal TRI Chemicals	Other Off-site Transfers**	Other Off-site Transfers to Disposal***	Total Transfers for Further Waste Management/ Disposal
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
--	**Dioxin and dioxin-like compounds***	**0.02**	**4.80**	**129.00**	**0.00**	**0.24**	**0.04**	**118.94**	**253.04**
--	*Dioxin and dioxin-like compounds (in grams)**	*7.43*	*2,178.71*	*58,504.45*	*0.00*	*108.80*	*17.06*	*53,941.158*	*114,757.612*
	Mercury and Mercury Compounds	**185,172.66**	**1.00**	**62.90**	**322.65**	**0.00**	**0.00**	**898,151.38**	**1,083,710.59**
7439-97-6	Mercury	93,376.58	0.00	58.00	121.90	0.00	0.00	27,784.56	121,341.04
--	Mercury compounds	91,796.09	1.00	4.90	200.75	0.00	0.00	870,366.82	962,369.55
	Polycyclic Aromatic Compounds	**640,243.04**	**213,108.42**	**245,128.83**	**0.00**	**5,113.93**	**144.50**	**3,316,796.67**	**4,420,535.39**
191-24-2	Benzo(g,h,i)perylene	9,812.57	5,780.04	2,661.48	0.00	615.74	19.50	116,945.31	135,834.63
--	Polycyclic aromatic compounds	630,430.47	207,328.38	242,467.35	0.00	4,498.19	125.00	3,199,851.36	4,284,700.75
1336-36-3	**Polychlorinated biphenyls (PCBs)**	**901.22**	**10,481.15**	**282,299.43**	**0.00**	**224.71**	**0.00**	**50,351.99**	**344,258.50**
	Pesticides	**0.00**	**1,003.00**	**126,726.55**	**0.00**	**13.00**	**0.00**	**13,734.60**	**141,477.15**
309-00-2	Aldrin	0.00	0.00	283.30	0.00	0.00	0.00	2.58	285.88
57-74-9	Chlordane	0.00	0.00	4,905.41	0.00	0.00	0.00	828.59	5,734.00
76-44-8	Heptachlor	0.00	0.00	3,773.30	0.00	0.00	0.00	221.87	3,995.17
465-73-6	Isodrin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72-43-5	Methoxychlor	0.00	775.00	430.00	0.00	0.00	0.00	31.75	1,236.75
40487-42-1	Pendimethalin	0.00	0.00	19,602.00	0.00	3.00	0.00	9,555.00	29,160.00
8001-35-2	Toxaphene	0.00	0.00	468.54	0.00	0.00	0.00	176.14	644.68
1582-09-8	Trifluralin	0.00	228.00	97,264.00	0.00	10.00	0.00	2,918.67	100,420.67
	Other PBTs	**13,822.00**	**58,415.00**	**45,082.88**	**0.00**	**11.66**	**0.00**	**562,249.24**	**679,580.78**
118-74-1	Hexachlorobenzene	13,421.00	56,586.00	36,956.28	0.00	10.66	0.00	23,908.04	130,881.98
29082-74-4	Octachlorostyrene	0.00	0.00	19.00	0.00	0.00	0.00	436.90	455.90
608-93-5	Pentachlorobenzene	401.00	0.00	1,390.81	0.00	0.00	0.00	355.00	2,146.81
79-94-7	Tetrabromobisphenol A	0.00	1,829.00	6,716.79	0.00	1.00	0.00	537,549.30	546,096.09
	Total	**840,138.94**	**283,013.38**	**699,429.59**	**322.65**	**5,363.54**	**144.54**	**4,841,402.82**	**6,669,815.45**

Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.
* The chemical category dioxin and dioxin-like compounds is reported in grams. Where the category dioxin and dioxin-like compounds is shown on a table with other TRI chemicals, it is presented in pounds. The grams are converted to pounds by multiplying by 0.002205.

** Other Off-site Transfers are transfers reported without a valid waste management code.
*** Does not include transfers to POTWs of metals and metal compounds.

icals. The 2.9 million pounds of on-site recycling of polycyclic aromatic compounds accounted for 81.5 percent of all on-site recycling of PBT chemicals.

Transfers Off-site for Further Waste Management/Disposal

As shown in Table 3-3, transfers off-site for further waste management and disposal totaled 6.7 million pounds for PBT chemicals for 2000. Polycyclic aromatic compounds accounted for 4.4 million pounds of the total (66.3 percent).

Almost 72.6 percent of all transfers for further waste management and disposal of PBT chemicals was other transfers to disposal (4.8 million pounds out of 6.7 million pounds). Another 12.6 percent was sent off-site for recycling, and 10.5 percent was transferred to treatment.

Other off-site transfers to disposal were the major type of transfer for all PBT chemicals primarily because of the 3.3 million pounds of other transfers to disposal of polycyclic aromatic compounds. Other off-site transfers to disposal of polycyclic aromatic compounds were 75.0 percent of all transfers of polycyclic aromatic compounds in 2000. Transfers to recycling of polycyclic aromatic compounds were 640,243 pounds or 14.5 percent of total transfers for polycyclic aromatic compounds. Similarly, mercury and mercury compounds had 82.9 percent of their transfers as other transfers to disposal and 17.1 percent as transfers to recycling.

Other types of PBT chemicals showed a somewhat different distribution of types of transfers. For polychlorinated biphenyls and pesticides the majority of their transfers were to treatment, 82.0 percent for

Table 3-4: Current Year and Projected Quantities of TRI Chemicals in Waste, PBT Chemicals, 2000-2002

PBT Chemical Group	Current Year 2000 Pounds	Projected 2001 Pounds	Projected 2002 Pounds
Dioxin and dioxin-like compounds*	868.69	916.25	876.56
*Dioxin and dioxin-like compounds (in grams)**	*393,963.081*	*415,534.761*	*397,533.459*
Mercury and Mercury Compounds	4,875,863.82	4,512,608.30	4,460,766.53
Polycyclic Aromatic Compounds	42,939,829.07	38,805,211.25	37,795,370.86
Polychlorinated biphenyls (PCBs)	13,689,049.42	13,599,460.14	13,591,299.85
Pesticides	2,554,027.10	2,303,452.89	2,198,704.45
Other PBTs	7,590,289.80	7,525,656.06	7,479,254.95
Total	**71,649,927.90**	**66,747,304.89**	**65,526,273.20**

PBT Chemical Group	Projected Change 2000-2001 Percent	Projected Change 2001-2002 Percent	Projected Change 2000-2002 Percent
Dioxin and dioxin-like compounds*	5.5	-4.3	0.9
*Dioxin and dioxin-like compounds (in grams)**	*5.5*	*-4.3*	*0.9*
Mercury and Mercury Compounds	-7.5	-1.1	-8.5
Polycyclic Aromatic Compounds	-9.6	-2.6	-12.0
Polychlorinated biphenyls (PCBs)	-0.7	-0.1	-0.7
Pesticides	-9.8	-4.5	-13.9
Other PBTs	-0.9	-0.6	-1.5
Total	**-6.8**	**-1.8**	**-8.5**

Note: Current year and projected amounts are from Section 8 of Form R for 2000.

* The chemical category dioxin and dioxin-like compounds is reported in grams. Where the category dioxin and dioxin-like compounds is shown on a table with other TRI chemicals, it is presented in pounds. The grams are converted to pounds by multiplying by 0.002205.

polychlorinated biphenyls and 89.6 percent for pesticides.

Projected Quantities of TRI Chemicals Managed in Waste, 2000-2002

As described in **Waste Management** in Chapter 1, on each Form R that it submits, a facility reports actual waste management quantities for the current and prior years and projected quantities for the next two years. Most of the groups of PBT chemicals projected reductions in production-related waste for both 2001 and 2002 from their totals in 2000 (as shown in Table 3-4). Expected reductions in the group of pesticides were the largest, with a projected reduction of 13.9 percent by 2002. Total production-related waste of polycyclic aromatic compounds was projected to decline by 12.0 percent by 2002. Mercury and mercury compounds were projected to decline by 8.5 percent by 2002. The group of other PBT chemicals and polychlorinated biphenyls were projected to decrease from 2000 to 2002 by the smallest percentages, by 1.5 percent and 0.7 percent, respectively.

On the other hand, production-related waste of dioxin and dioxin-like compounds showed a projected increase of 5.5 percent from 2000 to 2001 with a decrease of 4.3 percent from 2001 to 2002, for an overall slight increase of 0.9 percent from 2000 to 2002.

Dioxin and Dioxin-like Compounds

Introduction

“Dioxins” refers to a group of chemical compounds that share similar chemical and biological properties. These toxic compounds are members of closely related families: the chlorinated dibenzo-p-dioxins (CDDs) and chlorinated dibenzofurans (CDFs). There are 75 congeners, or related individual compounds, of CDDs and 135 congeners of CDFs (EPA EA, 1999). Of these 210 congeners, seven CDD congeners and ten CDF congeners are thought to exhibit some degree of toxicity. These 17 toxic congeners all have four chlorine atoms attached to the main dioxin or furan molecule in the 2, 3, 7, and 8 positions. Sometimes the term dioxin is used to refer only to the most well-studied and one of the most toxic dioxin compounds, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8,-TCDD). This use of the term dioxin is common in the dioxin literature though chemically imprecise. 2,3,7,8,-TCDD and the 16 other toxic CDD and CDF congeners are collectively referred to as dioxin-like compounds.

Although similar in other ways, all dioxin-like compounds do not have the same level of toxicity. As a result, a toxicity equivalency procedure was developed to quantify the toxicity of these compounds relative to each other for risk assessment purposes. It should be noted that these factors do not relate the toxicity of these chemicals to other chemicals (e.g., benzene). 2,3,7,8-TCDD is given the base toxicity equivalence factor (TEF) of 1.0. Each of the other 16 2,3,7,8-CDD/CDF congeners is then assigned its own toxicity equivalence factor based on estimates of its toxicity relative to that of “dioxin”. The TEFs of the other dioxin-like compounds range from 1 to 0.0001. These TEF values have been adopted by international convention and are

Box 3-2: Dioxin and Dioxin-like Compounds Category and Corresponding TEF Values

CAS Number	Chemical Name	TEF
	CDDs	
1746-01-6	2,3,7,8-tetrachlorodibenzo-p-dioxin	1
40321-76-4	1,2,3,7,8-pentachlorodibenzo-p-dioxin	1
39227-28-6	1,2,3,4,7,8-hexachlorodibenzo-p-dioxin	0.1
57653-85-7	1,2,3,6,7,8-hexachlorodibenzo-p-dioxin	0.1
19408-74-3	1,2,3,7,8,9-hexachlorodibenzo-p-dioxin	0.1
35822-46-9	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin	0.01
3268-87-9	1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin	0.0001
	CDFs	
51207-31-9	2,3,7,8-tetrachlorodibenzofuran	0.1
57117-41-6	1,2,3,7,8-pentachlorodibenzofuran	0.05
57117-31-4	2,3,4,7,8-pentachlorodibenzofuran	0.5
70648-26-9	1,2,3,4,7,8-hexachlorodibenzofuran	0.1
57117-44-9	1,2,3,6,7,8-hexachlorodibenzofuran	0.1
72918-21-9	1,2,3,7,8,9-hexachlorodibenzofuran	0.1
60851-34-5	2,3,4,6,7,8-hexachlorodibenzofuran	0.1
67562-39-4	1,2,3,4,6,7,8-heptachlorodibenzofuran	0.01
55673-89-7	1,2,3,4,7,8,9-heptachlorodibenzofuran	0.01
39001-02-0	1,2,3,4,6,7,8,9-octachlorodibenzofuran	0.0001

listed in Box 3-2. Revisions of TEFs may periodically occur as new scientific data become available. Dioxin-like compounds are often found in complex mixtures. The relative toxicity of such a mixture is known as its toxic equivalency (TEQ). This is calculated by first multiplying the concentrations of the individual congeners by their respective TEFs then summing together the products to find the overall TEQ of the mixture.

Section 1.4 in Part II of the TRI Reporting Form R allows for the reporting of the distribution of each member of the dioxin and dioxin-like compounds category. Section 1.4 is reproduced below:

1.4 Distribution of Each Member of the Dioxin and Dioxin-like Compounds Category.

(If there are any numbers in boxes 1-17, then every field must be filled in with either 0 or some number between 0.01 and 100. Distribution should be reported in percentages and the total should equal 100%. If you do not have speciation data available, check NA.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
NA																	

Each of the dioxin-like compounds in the category is assigned a number between 1 and 17, and the percentage of each compound is recorded in the space provided for its number. This distribution represents either the total quantity released to all media or the facility's best media-specific distribution. This distribution must be reported if the information is available from the data used to calculate thresholds, releases, and other waste management quantities.

Sources and Uses

EPA's draft *Dioxin Reassessment* prepared by EPA's Office of Research and Development (ORD) presents a comprehensive discussion of what is known about dioxin sources. It also provides a quantitative estimate of dioxin releases to the circulating environment for the years 1987 and 1995. The draft reassessment includes a detailed description of the analytical process and rationale that support the estimates including the development of dioxin emission factors. The inventory portion of the draft reassessment has completed independent peer review. Information about acquiring the draft inventory and supporting data can be obtained at http://www.epa.gov/ncea/dioxin.htm.

CDDs and CDFs are not commercially produced except in small quantities for chemical analyses and toxicological research. The only two reported commercial producers of dioxins in the United States are Eagle Picher Industries, Inc. in Lenexa, Kansas, and Cambridge Isotope Laboratories in Andover, Massachusetts. CDD/CDFs are not imported or exported from the United States unless as trace contaminants in a product (EPA EA, 1999).

CDDs and CDFs are formed as unwanted byproducts when chlorinated materials are involved in combustion or other high-temperature processes, such as waste incineration, energy generation, metallurgical processes, chemical manufacturing and other industrial processes. The following types of waste incineration are potential sources of CDD/CDF releases: municipal waste incineration, medical waste incineration, hazardous waste incineration, hazardous waste burned in boilers and industrial furnaces, sewage sludge incineration, crematoria, tire combustion, pulp and paper mill sludge incineration, and biogas combustion.

Energy generation sources of CDD/CDF releases include the combustion of coal, oil, and wood in residential, industrial, and electric utility establishments. Industrial combustion of these fuels occurs in all of the manufacturing sectors. Other high-temperature sources include Portland cement production, pulp mills using the kraft process, asphalt mixing plants, catalyst regeneration at petroleum refineries, carbon reactivation furnaces, cigarette smoking, and the pyrolysis of brominated flame retardants. In addition, minimally controlled or uncontrolled combustion sources may emit CDD/CDFs, including landfill gas in flares, landfill fires, accidental fires in buildings and vehicles, agricultural burning, forest and brush fires, backyard trash burning, and the accidental combustion of PCBs (EPA EA, 1999).

Metallurgical processes that may release CDD/CDFs include ferrous sources such as iron ore sintering, coke production, and the production of steel in electric arc furnaces from scrap feed. Secondary aluminum, copper, and lead smelters may also be sources of CDD/CDFs. The scrap metal feed for secondary nonferrous metal smelting often contains impurities such as plastics, paints, and solvents, and the secondary smelting of aluminum and copper includes the use of chlorine salts. The combustion of such impurities and/or chlorine salts may result in CDD/CDF formation.

CDDs and CDFs can also be formed as unintended byproducts of manufacturing processes. For example, they are generated in pulp and paper mills during chlorine bleaching. CDD/CDFs have been detected in the effluent, sludge, and pulp of pulp and paper mills (EPA EA, 1999). CDD/CDFs may also be unintentionally formed in the manufacture of chlorinated compounds such as chloranil, ethylene dichloride manufactured by oxychlorination, 2,4-D herbicides and pentachlorophenol (TRI Dioxin Guidance Document, EPA 2000). Potential sources of CDD/CDFs from other industrial processes include non-incinerated municipal sewage sludge, industrial effluents processed by publicly owned treatment works (POTWs), and chlorine bleaching (EPA EA, 1999).

CDDs and CDFs accumulate in soils, sediments, and organic matter, and therefore persist in waste disposal sites. These contaminated areas serve as reservoir sources for CDD/CDFs. Another reservoir source is wood preserved with pentachlorophenol. These reservoirs retain CDD/CDFs until potentially redistributing them at a future time. Possible methods of redistribution include settling of dust, air suspension, erosion or dredging of contaminated sediment, decomposition of contaminated material, or combustion of contaminated material.

Chemical Characteristics

Persistence and Bioaccumulation

CDDs and CDFs have persistence half-life values in soil that range from 1.5 years to more than 20 with all but one chemical having a soil half-life of more than 20 years. The persistence half-life values in air range anywhere from 1.2 hours to 29.4 hours. (EPA, PBT Chemicals Final Rule, October, 1999).

CDDs and CDFs have bioconcentration factor values that range from 1,259 to 42,500. Six chemicals have BCF values over 5,000 and 6 have values between 3,500 and 5,000. (EPA, PBT Chemicals Final Rule, October, 1999).

Environmental Fate and Transport

CDDs and CDFs enter the environment through releases to the atmosphere, soil, or water.

If CDD/CDFs are released to the atmosphere, they tend to bind to particulate matter. CDDs and CDFs emitted from point sources may be carried for long distances on fly ash and other particulate matter. Due to this potential for long-range transport, CDD/CDFs are found throughout the globe and are not restricted to areas where they are initially released. Suspended particles fall to the earth’s surface in raindrops, in dust, or simply due to gravity. This process is called atmospheric deposition. CDDs and CDFs may also be removed from the atmosphere when they are broken down directly by sunlight or react to photochemical reactants produced in the atmosphere. This breakdown may occur to CDD/CDFs not bound to particles in the gaseous phase or at the soil- or water-air interface (EPA, NCEA, July 2000).

If CDD/CDFs are released to the soil, they will bind to particulate and organic matter because of their low water solubility. Once bound to particulate matter, CDD/CDFs will not significantly leach or evaporate. The available evidence indicates that CDD/CDFs are biologically and chemically resistant compounds exhibiting extreme stability under most environmental conditions, with environmental persistence measured in decades. Although some evaporation of CDD/CDFs on soil does occur, the predominant fate of CDD/CDFs bound to soil is to remain in place near the surface of undisturbed soil or to move to water bodies with erosion of soil.

CDDs and CDFs deposited on the soil and on vegetation may be taken up by terrestrial organisms. CDDs and CDFs bioaccumulate in the food chain.

If CDD/CDFs are released to water, they tend to bind to bottom sediments or to particulate matter in the water column due to their low water solubility. Once in the sediments, CDD/CDFs can be further transported or ingested by fish and other aquatic organisms. CDDs and CDFs bioaccumulate in aquatic organisms. The ultimate environmental sink of CDDs/CDFs is believed to be aquatic sediments.

Health and Environmental Effects

Data and information on human health effects of CDD/CDFs come primarily from case reports and epidemiological studies. The majority of adverse effects from exposure to CDD/CDFs have been reported among occupationally exposed populations (e.g., producers of such chemicals), and among residents or communities contaminated with CDD/CDFs. Effects associated with exposure to these chemicals include cancer, thyroid effects, effects on serum lipids, diabetes, and cardiovascular, respiratory, immunologic, neurologic, and reproductive effects. Toxicity studies conducted with laboratory animals, involving oral exposure to CDD/CDFs, have shown short and long-term effects including death, and cardiovascular, gastrointestinal, hematological, hepatic, renal, endocrine, dermal, body weight, immunologic, reproductive, and developmental effects. The most consistent effect is weight loss or decreased weight gain in growing rodents (ATSDR, December 1998).

Exposure to CDD/CDFs may also produce a variety of developmental, reproductive, and nervous system effects including skin rashes, skin discoloration, changes in cell growth, birth defects, behavior changes in offspring, autism, liver disease, endometriosis, reduced immunity, and chronic fatigue syndrome.

Most of the population is exposed to low levels of CDD/CDFs. EPA believes that most exposure to CDD/CDFs occurs via food ingestion. The most noted health effect in humans exposed to large amounts of CDD/CDFs is chloracne (EPA, NCEA, July 2000). Chloracne is a severe skin disease with acne-like lesions that occur mainly on the face and upper body.

Cancer is also associated with exposure to CDD/CDFs. Several occupational studies indicate an increased risk of cancer is associated with long term exposure to high levels of CDD/CDFs. Laboratory studies have also shown an increased risk of cancer from long term exposure to CDD/CDFs. In fact, dioxin is classified by the U.S. Department of Health and Human Services as a known human carcinogen.

Efforts to Reduce Pollution from the Chemical

Over the last 20 years, EPA has taken numerous measures to reduce and control CDD/CDFs in all environmental media in the U.S. The majority of the major industrial sources of CDD/CDFs are currently subject to controls and/or regulations. As a result, industrial CDD/CDFs emissions have been reduced. For example, municipal waste combustors which do not report to TRI are estimated to have emitted nearly 18 pounds of dioxin toxic equivalents in 1987. 2002 municipal combustor emissions are expected to be less than 1/2 ounce per year (EPA, NCEA, July 2000). EPA estimates that medical waste incinerators (which do not report to TRI) emitted about 5 pounds of dioxin toxic equivalents in 1987 but under EPA regulations they will be limited to about 1/4 ounce annual emissions in 2002 (EPA, NCEA, July 2000).

In addition, EPA has taken numerous non-regulatory actions to reduce pollution from CDD/CDFs and protect human and environmental health. For example, in 1994, EPA created the Dioxin Exposure Initiative, (DEI), a research program to further evaluate the exposure of Americans to this class of compounds. In addition, EPA works closely with the Food and Drug Administration (FDA) and the US Department of Agriculture (USDA) to ensure that the risks posed by CDD/CDFs in food packaging are minimized.

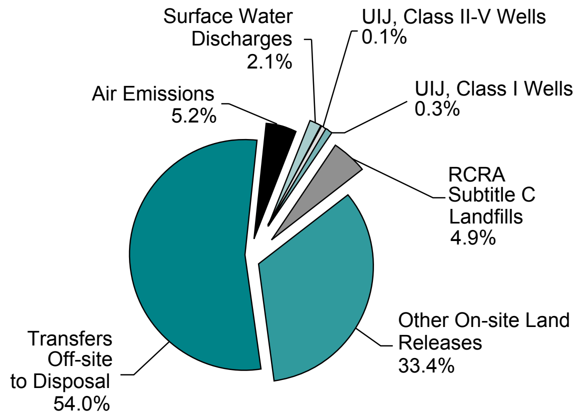
2000 TRI DATA FOR DIOXIN AND DIOXIN-LIKE COMPOUNDS

On-site and Off-site Releases

As shown in Table 3-5, there were 1,274 TRI forms submitted for dioxin and dioxin-like compounds for 2000. On- and off-site releases for dioxin and dioxin-like compounds totaled 99,814 grams. Over half of total releases were released off-site as transfers to disposal, which totaled 53,898 grams or 54.0 percent (see Figure 3-1). The second largest release type was other on-site land releases (that is, other than RCRA subtitle C landfills), which totaled 33,313 grams. (Types of on-site land releases are described in Box 1-4 in Chapter 1.)

Much smaller amounts of other types of releases were reported. Air emissions in 2000 totaled 5,218 grams or 5.2 percent of total releases. On-site land releases to RCRA subtitle C landfills were 4,904 grams, and surface water discharges were 2,076 grams. Underground injection of dioxin and dioxin-like compounds was less than 500 grams.

Figure 3-1: Distribution of TRI On-site and Off-site Releases, 2000: Dioxin and Dioxin-like Compounds



Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

UIJ=underground injection

Waste Management Data

Quantities of TRI Chemicals in Waste

Production-related waste of dioxin and dioxin-like compounds totaled 393,963 grams in 2000, as shown in Table 3-6. Almost two-thirds of this (249,513 grams or 63.3 percent) was treated on-site (see Figure 3-2). The quantity released on- and off-site totaled 105,710 grams or over one-quarter of total production-related waste. A total of 32,272 grams, or 8.2 percent, of dioxin and dioxin-like compounds was treated off-site. Almost 4,449 grams were in waste in which the primary chemical was recycled on-site and almost 1,995 grams were in waste sent for energy recovery off-site.

Transfers Off-site for Further Waste Management/Disposal

Transfers off-site for further waste management and disposal of dioxin and dioxin-like compounds totaled 114,758 grams in 2000 (see Table 3-7). Transfers to treatment accounted for half of this amount, 58,504 grams or 51.0 percent (see Figure 3-3). Other transfers off-site to disposal accounted for 47.0 percent; the amount was 53,941 grams.

Other types of transfers off-site for further waste management and disposal in 2000 accounted for

Table 3-5: TRI On-site and Off-site Releases, 2000: Dioxin and Dioxin-like Compounds

CAS Number	Chemical	Total Forms	On-site Releases: Total Air Emissions	Surface Water Discharges	Underground Injection: Class I Wells	Underground Injection: Class II-V Wells	On-site Land Releases: RCRA Subtitle C Landfills	On-site Land Releases: Other On-site Land Releases	Total On-site Releases	Off-site Releases: Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams
–	Dioxin and dioxin-like compounds	1,274	5,217.775	2,075.634	284.112	121.080	4,903.737	33,313.286	45,915.624	53,898.465	99,814.089

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

about 2 percent of the total, with transfers to energy recovery totaling 2,179 grams. All other types of transfers of dioxin and dioxin-like compounds totaled less than 120 grams in 2000.

TRI Data by State

Facilities in Texas, with 84 forms, submitted the largest number of forms in 2000 for dioxin and dioxin-like compounds. Pennsylvania and Louisiana ranked second and third, with 64 and 59 forms, respectively.

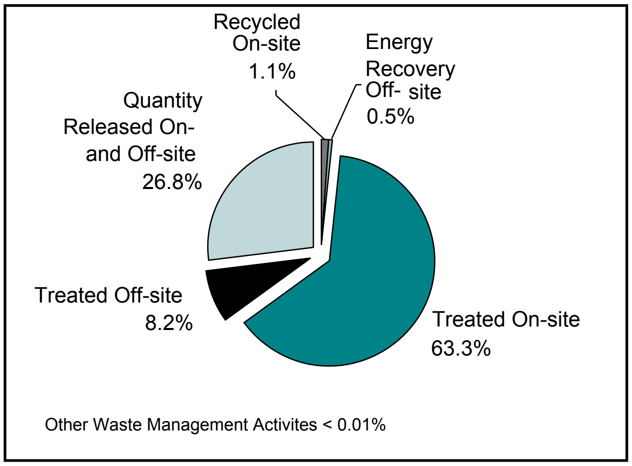
On- and Off-site Releases

In 2000, facilities in Delaware reported the largest total releases on- and off-site of dioxin and dioxin-like compounds (see Table 3-8). They reported a total of 38,682 grams, or 38.8 percent of the total for 2000. Almost all of Delaware's releases of dioxin and dioxin-like compounds were as off-site releases (transfers to disposal). Delaware reported 71.7 percent of all reported off-site releases of dioxin and dioxin-like compounds in 2000.

As shown in Map 3-1, Mississippi and Texas along with Delaware reported the largest amounts of total releases of dioxin and dioxin-like compounds in 2000, with Mississippi reporting 19,979 grams and Texas reporting 17,373 pounds. Fourth ranked was Tennessee with 6,427 grams.

Mississippi, with the second largest total releases, reported the largest amounts of other on-site land releases (that is, other than RCRA subtitle C landfills), with 19,783 grams or 59.4 percent of all such land releases of dioxin and dioxin-like compounds in 2000. Texas, with the third largest total releases, had the largest releases to on-site RCRA subtitle C landfills, amounting to 4,166 grams and second largest off-site releases (11,954 grams).

Figure 3-2: TRI Waste Management, 2000: Dioxin and Dioxin-like Compounds



Note: Data are from Section 8 of Form R.

The state with the largest air emissions of dioxin and dioxin-like compounds in 2000 was Georgia with 995 grams. Louisiana reported the largest surface water discharges, with 935 grams.

Waste Management Data

The state with the largest quantity of total production-related waste of dioxin and dioxin-like compounds in 2000 was Texas (see Table 3-8). Texas's 148,199 grams of total production-related waste was over two and a half times that of any other state. Louisiana ranked second with 54,981 grams, and Michigan ranked third with 48,997 grams.

Texas accounted for almost half of the dioxin and dioxin-like compounds reported as treated on-site, 121,547 grams or 48.7 percent of the total. Texas facilities also reported the largest amount treated off-site, 9,255 grams or 28.7 percent of the total.

Table 3-6: Quantities of TRI Chemicals in Waste Managed, 2000: Dioxin and Dioxin-like Compounds

CAS Number	Chemical	Recycled On-site Grams	Recycled Off-site Grams	Energy Recovery On-site Grams	Energy Recovery Off-site Grams	Treated On-site Grams	Treated Off-site Grams	Quantity Released On- and Off-site Grams	Total Production-related Waste Managed Grams	Non-production-related Waste Managed Grams
–	Dioxin and dioxin-like compounds	4,448.559	5.393	19.698	1,994.612	249,513.356	32,271.529	105,709.934	393,963.081	26,821.006

Note: Data are from Section 8 of Form R.

The state with the largest quantity released on- and off-site was Delaware, with 38,682 grams or 36.6 percent of the total. Mississippi ranked second for releases on- and off-site with 19,985 grams and Texas was third with 17,397 grams.

TRI Data by Industry (2-digit SIC Code)

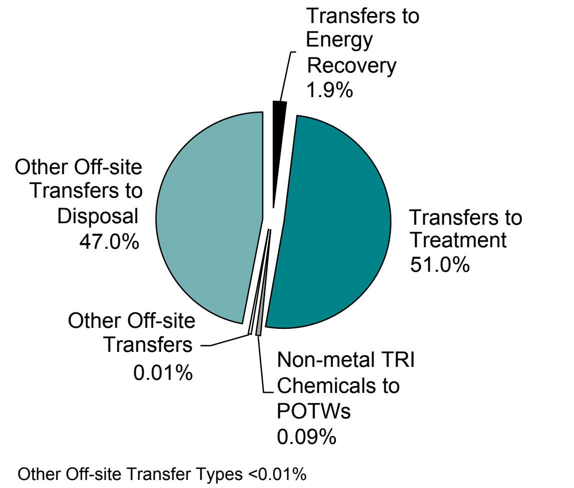
On- and Off-site Releases

The original manufacturing sector industries reported 96,900 grams or 97.1 percent of the total releases on- and off-site of dioxin and dioxin-like compounds in 2000 (see Table 3-9).

Chemical manufacturers accounted for the largest releases, 89,100 grams or 89.3 percent of all industry sectors reporting releases of dioxin and dioxin-like compounds. The chemical industry also reported the largest amounts of all types of releases. The largest type of release reported by the chemical industry was off-site releases (transfers to disposal), with 51,400 grams of off-site releases or 95.3 percent of total off-site releases for dioxin and dioxin-like compounds. The second largest type of release for the chemical industry was other on-site land releases (that is, other than RCRA subtitle C landfills) of 30,300 grams or 91.0 percent of all such releases of dioxin and dioxin-like compounds.

The primary metals industry reported the second largest amount of releases of dioxin and dioxin-like compounds in 2000. Their 4,300 grams of total releases accounted for 4.3 percent of total releases for all industry sectors. The largest types of releases for the primary metals industry were 2,000 grams

Figure 3-3: Distribution of TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Dioxin and Dioxin-like Compounds



Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

of other on-site land releases (other than RCRA subtitle C landfills) and 1,300 grams of off-site releases (transfers to disposal).

Electric utilities, a new industry sector, reported the third largest amount of releases of dioxin and dioxin-like compounds in 2000, with 2,000 grams. Most of their releases were air emissions. Air emissions of dioxin and dioxin-like compounds from electric utilities were 1,150 grams, accounting for 22.1 percent of all air emissions from all industry sectors and was the second largest reported amount of air emissions of any industry sector (behind the chemical industry).

Table 3-7: TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Dioxin and Dioxin-like Compounds

CAS Number	Chemical	Transfers to Recycling	Transfers to Energy Recovery	Transfers to Treatment	Transfers to POTWs: Metals and Metal Compounds	Transfers to POTWs: Non-metal TRI Chemicals	Other Off-site Transfers*	Other Off-site Transfers to Disposal**	Total Transfers for Further Waste Management/ Disposal
		Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams
--	Dioxin and dioxin-like compounds	7.432	2,178.711	58,504.455	0.000	108.800	17.057	53,941.158	114,757.612

Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

* Other Off-site Transfers are transfers reported without a valid waste management code.
** Does not include transfers to POTWs of metals and metal compounds.

Table 3-8: Summary of TRI Information by State, 2000: Dioxin and Dioxin-like Compounds

		On-site Releases							Off-site Releases	
				Underground Injection		On-site Land Releases				
State	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
	Number	Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Alabama	51	902.253	130.657	0.000	0.000	9.000	22.344	1,064.254	89.775	1,154.028
Alaska	3	0.542	0.000	0.000	0.000	0.000	0.000	0.542	0.000	0.542
Arizona	17	14.240	0.000	0.000	0.000	0.000	0.016	14.256	0.000	14.256
Arkansas	23	29.064	12.089	0.000	0.000	0.000	43.756	84.909	27.221	112.130
California	35	34.578	4.075	0.000	0.000	9.000	0.000	47.653	26.908	74.561
Colorado	15	8.256	0.060	0.000	0.000	0.000	0.000	8.316	0.001	8.317
Connecticut	12	7.553	3.000	0.000	0.000	0.000	0.000	10.553	4.309	14.862
Delaware	8	4.958	13.990	0.000	0.000	0.000	1.140	20.088	38,662.358	38,682.446
District of Columbia	1	0.120	0.000	0.000	0.000	0.000	0.000	0.120	0.000	0.120
Florida	46	70.610	4.422	0.000	0.000	0.000	27.983	103.014	0.000	103.014
Georgia	37	994.577	19.613	0.000	0.000	0.000	271.842	1,286.032	139.949	1,425.981
Hawaii	8	4.933	0.000	0.000	0.000	0.000	0.000	4.933	0.960	5.893
Idaho	7	1.884	5.136	0.000	0.000	0.000	3.732	10.752	74.358	85.111
Illinois	38	50.001	0.030	0.000	0.000	0.000	0.000	50.031	36.836	86.867
Indiana	45	190.739	0.026	0.000	0.000	0.000	19.600	210.366	245.021	455.387
Iowa	29	50.963	0.000	0.000	0.000	0.000	0.040	51.003	0.010	51.013
Kansas	20	46.053	0.732	283.787	0.000	0.000	26.500	357.072	1.300	358.372
Kentucky	34	35.198	5.094	0.000	0.480	0.009	250.710	291.490	0.013	291.504
Louisiana	59	103.501	934.682	0.225	0.000	7.700	1,315.351	2,361.458	774.737	3,136.196
Maine	16	8.646	6.219	0.000	0.000	0.000	5.581	20.446	3.440	23.886
Maryland	14	34.157	16.260	0.000	0.000	0.000	2,720.980	2,771.397	0.286	2,771.683
Massachusetts	7	11.662	0.070	0.000	0.000	0.000	0.000	11.732	0.190	11.922
Michigan	30	25.223	5.830	0.000	0.000	320.570	13.407	365.030	145.310	510.340
Minnesota	20	8.330	0.000	0.000	0.000	0.000	723.612	731.942	15.915	747.857
Mississippi	31	20.357	176.233	0.000	0.000	0.000	19,782.585	19,979.175	0.137	19,979.311
Missouri	35	27.238	2.908	0.000	0.000	1.250	0.017	31.413	5.376	36.790
Montana	6	16.108	0.162	0.000	0.000	0.000	0.005	16.274	0.003	16.277
Nebraska	10	432.199	0.000	0.000	0.000	0.000	1.070	433.269	0.000	433.269
Nevada	13	10.916	0.000	0.000	0.000	0.000	0.000	10.916	0.000	10.916
New Hampshire	6	1.379	0.670	0.000	0.000	0.000	1.296	3.345	0.000	3.345
New Jersey	18	8.043	0.544	0.000	0.000	1.760	0.000	10.347	31.280	41.626
New Mexico	6	7.989	0.000	0.000	0.000	0.000	0.000	7.989	0.000	7.989
New York	45	32.594	6.287	0.000	0.000	0.000	0.377	39.258	59.078	98.336
North Carolina	38	68.974	3.462	0.000	0.000	0.250	2.415	75.100	610.993	686.093
North Dakota	10	7.683	0.000	0.000	0.000	0.000	0.790	8.473	0.000	8.473
Ohio	57	53.400	2.765	0.100	0.000	0.000	242.098	298.363	250.490	548.853
Oklahoma	18	67.904	0.181	0.000	0.000	377.382	13.541	459.008	78.463	537.471
Oregon	21	8.747	24.584	0.000	0.000	10.000	1.256	44.587	2.647	47.235
Pennsylvania	64	173.226	4.511	0.000	0.000	0.000	12.472	190.208	157.527	347.735
Puerto Rico	8	16.497	0.002	0.000	0.000	0.000	0.000	16.499	0.658	17.157
Rhode Island	1	0.008	0.000	0.000	0.000	0.000	0.000	0.008	0.002	0.011
South Carolina	35	98.361	5.679	0.000	0.000	0.000	1.487	105.526	3.663	109.189
South Dakota	6	1.086	12.602	0.000	0.000	0.000	0.000	13.688	36.081	49.769
Tennessee	42	49.616	16.097	0.000	0.000	0.000	6,098.276	6,163.989	262.855	6,426.844
Texas	84	528.498	602.327	0.000	120.600	4,166.400	1.765	5,419.590	11,953.526	17,373.116
Utah	14	658.413	0.000	0.000	0.000	0.000	1,667.668	2,326.080	26.920	2,353.000
Vermont	1	1.103	0.000	0.000	0.000	0.000	0.000	1.103	0.000	1.103
Virgin Islands	3	1.011	0.069	0.000	0.000	0.000	0.000	1.080	0.000	1.080
Virginia	38	104.291	6.658	0.000	0.000	0.000	14.768	125.717	51.013	176.730
Washington	26	40.316	44.260	0.000	0.000	0.000	22.046	106.622	71.070	177.692
West Virginia	21	66.625	2.807	0.000	0.000	0.000	0.160	69.592	0.938	70.529
Wisconsin	33	61.976	0.843	0.000	0.000	0.417	2.602	65.837	46.849	112.686
Wyoming	9	15.179	0.000	0.000	0.000	0.000	0.000	15.179	0.000	15.179
Total	**1,274**	**5,217.775**	**2,075.634**	**284.112**	**121.080**	**4,903.737**	**33,313.286**	**45,915.624**	**53,898.465**	**99,814.089**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Table 3-8: Summary of TRI Information by State, 2000: Dioxin and Dioxin-like Compounds (continued)

State	Recycled		Energy Recovery		Treated		Quantity Released On- and Off-site	Total Production-related Waste Managed	Non-production-related Waste Managed
	On-site	Off-site	On-site	Off-site	On-site	Off-site			
	Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Alabama	481.000	0.000	0.000	1,206.928	103.419	1,528.509	1,142.281	4,462.137	2,773.223
Alaska	0.000	0.000	0.000	0.000	0.097	0.000	0.542	0.639	0.000
Arizona	0.000	0.000	0.000	0.000	0.000	0.000	14.256	14.256	0.000
Arkansas	0.000	0.000	0.000	0.000	150.019	0.000	112.853	262.872	0.000
California	0.000	0.010	0.000	1.652	34.450	909.197	7,108.124	8,053.433	0.000
Colorado	0.000	0.000	0.000	0.000	0.001	0.000	8.321	8.321	0.000
Connecticut	0.000	0.000	0.000	0.000	19.000	0.003	10.732	29.736	0.000
Delaware	0.000	0.000	0.000	0.000	0.000	750.000	38,682.456	39,432.456	0.000
District of Columbia	0.000	0.000	0.000	0.000	0.000	0.000	0.120	0.120	0.000
Florida	0.000	0.176	0.000	0.000	0.000	0.002	100.205	100.383	0.000
Georgia	2,801.937	0.000	0.172	597.283	145.701	189.427	1,425.919	5,160.438	1.645
Hawaii	0.000	0.000	0.000	0.000	0.000	0.000	5.893	5.893	0.000
Idaho	0.000	0.000	6.483	0.000	0.000	0.000	85.111	91.594	0.000
Illinois	0.000	0.964	0.000	7.800	0.000	0.597	86.865	96.226	0.000
Indiana	0.000	0.000	0.000	0.000	869.804	0.005	456.336	1,326.146	0.000
Iowa	0.000	0.000	0.000	0.000	0.000	0.000	51.003	51.003	0.000
Kansas	0.000	0.000	0.000	0.000	11,052.000	44.198	346.341	11,442.539	0.000
Kentucky	0.000	0.000	0.000	0.000	38.494	1,500.029	290.573	1,829.096	1.000
Louisiana	830.190	0.210	0.000	0.000	46,872.479	4,974.413	2,303.788	54,981.081	0.000
Maine	0.000	0.527	0.571	0.000	0.000	0.000	27.233	28.331	0.000
Maryland	0.002	0.003	1.300	0.000	2,647.000	0.040	2,771.893	5,420.238	0.000
Massachusetts	0.000	0.008	0.000	0.000	0.099	0.000	11.962	12.069	0.000
Michigan	0.000	0.000	0.000	0.000	48,800.000	8.615	188.469	48,997.084	320.500
Minnesota	0.000	0.025	0.000	174.752	120.761	44.465	747.859	1,087.863	0.225
Mississippi	20.348	1.572	0.660	3.635	11.000	1,365.715	19,984.645	21,387.574	5.018
Missouri	0.000	0.000	0.000	0.607	0.000	1.997	36.803	39.408	1.468
Montana	0.000	0.000	0.000	0.000	0.000	0.000	16.277	16.277	0.000
Nebraska	0.000	0.000	0.000	0.000	0.000	0.004	433.201	433.205	0.000
Nevada	315.000	0.000	0.000	0.000	0.002	630.823	10.916	956.740	0.000
New Hampshire	0.000	0.000	0.000	0.000	0.000	0.000	3.350	3.350	0.000
New Jersey	0.000	1.500	0.000	0.000	0.000	18.730	46.031	66.261	0.000
New Mexico	0.000	0.000	0.000	0.000	0.000	0.000	7.989	7.989	0.000
New York	0.000	0.360	0.004	0.000	12,595.200	28.801	45.830	12,670.195	23,700.000
North Carolina	0.000	0.000	0.000	0.000	22.654	5,865.753	685.967	6,574.374	0.000
North Dakota	0.000	0.000	0.000	0.000	7.000	0.000	8.263	15.263	0.000
Ohio	0.000	0.000	0.000	0.000	845.606	0.000	547.885	1,393.490	0.000
Oklahoma	0.000	0.000	0.000	0.000	13.800	0.000	537.506	551.306	0.000
Oregon	0.000	0.000	0.000	0.000	8.036	3,160.873	49.065	3,217.973	17.897
Pennsylvania	0.000	0.010	9.700	0.000	172.310	0.000	346.928	528.949	0.000
Puerto Rico	0.000	0.000	0.000	0.000	0.000	0.000	16.499	16.499	0.000
Rhode Island	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.011	0.000
South Carolina	0.000	0.000	0.000	1.955	33.598	1,000.000	131.906	1,167.459	0.000
South Dakota	0.000	0.000	0.000	0.000	0.000	51.516	49.769	101.284	0.000
Tennessee	0.000	0.000	0.800	0.000	2,523.091	2.658	6,449.944	8,976.493	0.000
Texas	0.000	0.004	0.000	0.000	121,547.331	9,255.006	17,396.856	148,199.196	0.030
Utah	0.000	0.000	0.000	0.000	8.397	2.300	2,353.000	2,363.697	0.000
Vermont	0.000	0.000	0.000	0.000	0.000	0.000	1.103	1.103	0.000
Virgin Islands	0.000	0.000	0.000	0.000	0.000	0.000	1.080	1.080	0.000
Virginia	0.000	0.000	0.000	0.000	2.700	0.000	176.744	179.444	0.000
Washington	0.082	0.000	0.008	0.000	268.617	937.784	194.725	1,401.216	0.000
West Virginia	0.000	0.000	0.000	0.000	0.000	0.069	70.290	70.359	0.000
Wisconsin	0.000	0.024	0.000	0.000	600.691	0.000	113.040	713.755	0.000
Wyoming	0.000	0.000	0.000	0.000	0.000	0.000	15.179	15.179	0.000
Total	**4,448.559**	**5.393**	**19.698**	**1,994.612**	**249,513.356**	**32,271.529**	**105,709.934**	**393,963.081**	**26,821.006**

Note: Data are from Section 8 of Form R.

Waste Management

The chemical manufacturing industry reported the largest amount of total production-related waste of dioxin and dioxin-like compounds in 2000 (see Table 3-9). With 342,700 grams of production-related waste, it accounted for 87.0 percent of all production-related waste. Two-thirds of the production-related waste reported by the chemical industry (231,200 grams or 67.4 percent) was treated on-site.

The lumber industry reported the second largest amount of production-related waste, with 18,400 grams or 4.7 percent of the total for dioxin and dioxin-like compounds in 2000. Over half of the production-related waste reported by the lumber industry (10,700 grams or 57.9 percent) was treated off-site. The hazardous waste/solvent recovery industry reported the third largest amount of production-related waste. Most of the 11,800 grams reported by the hazardous waste industry was treated on-site.

Projected Quantities of TRI Chemicals Managed in Waste, 2000-2002

TRI facilities expected to increase their production-related waste of dioxin and dioxin-like compounds between 2000 and 2001 by 5.5 percent, from 393,963 grams to 415,535 grams (see Table 3-10). The increase was projected to occur in waste reported as being sent off-site for recycling and energy recovery and the quantity released on- and off-site. From 2001 to 2002, a decrease of 4.3 percent was projected, resulting in a slight decrease from 2000 to 2002 of 0.9 percent. Decreases were expected to occur in waste treated on- and off-site and in amounts recycled and used for energy recovery on-site.

Table 3-9: Summary of TRI Information by Industry, 2000: Dioxin and Dioxin-like Compounds

			On-site Releases							Off-site Releases	
					Underground Injection		On-site Land Releases				
SIC Code	Industry	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams	Grams
20	Food	24	19.138	0.000	0.000	0.000	0.000	0.107	19.244	0.000	19.244
21	Tobacco	2	0.450	0.000	0.000	0.000	0.000	0.000	0.450	0.000	0.450
22	Textiles	1	0.120	0.000	0.000	0.000	0.000	0.000	0.120	0.000	0.120
24	Lumber	103	25.006	357.643	0.000	0.000	0.000	11.267	393.915	711.775	1,105.690
25	Furniture	2	3.113	0.000	0.000	0.000	0.000	0.000	3.113	0.000	3.113
26	Paper	164	112.474	112.190	0.000	0.000	7.947	150.502	383.114	107.954	491.068
28	Chemicals	136	1,253.559	1,567.634	284.012	120.600	4,177.930	30,311.981	37,715.716	51,387.466	89,103.182
29	Petroleum	58	30.109	9.543	0.000	0.000	0.000	0.991	40.643	11.287	51.930
30	Plastics	2	0.794	0.000	0.000	0.000	0.000	0.145	0.939	0.000	0.939
32	Stone/Clay/Glass	113	457.043	0.732	0.000	0.480	0.000	48.290	506.546	0.000	506.546
33	Primary Metals	110	944.778	0.040	0.000	0.000	1.250	2,018.936	2,965.004	1,344.895	4,309.898
34	Fabricated Metals	1	0.821	0.000	0.000	0.000	0.000	0.000	0.821	0.000	0.821
35	Machinery	2	12.638	0.000	0.000	0.000	0.000	0.000	12.638	0.000	12.638
36	Electrical Equip.	1	1.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	1.000
37	Transportation Equip.	5	0.663	0.000	0.000	0.000	0.000	0.000	0.663	0.948	1.611
38	Measure/Photo.	1	2.310	2.680	0.000	0.000	0.000	0.007	4.997	0.542	5.539
	Multiple codes 20-39	43	1,066.582	25.147	0.000	0.000	0.000	21.588	1,113.318	141.506	1,254.823
	No codes 20-39	11	4.987	0.000	0.000	0.000	0.000	0.000	4.987	0.000	4.987
	Subtotal for Original Industries	**779**	**3,935.584**	**2,075.610**	**284.012**	**121.080**	**4,187.127**	**32,563.814**	**43,167.227**	**53,706.372**	**96,873.599**
10	Metal Mining	10	3.328	0.021	0.000	0.000	0.000	13.440	16.789	0.000	16.789
12	Coal Mining	1	0.000	0.000	0.000	0.000	0.000	5.670	5.670	0.000	5.670
491/493	Electric Utilities	466	1,150.726	0.003	0.000	0.000	0.000	729.292	1,880.021	159.681	2,039.702
5171	Petroleum Terminals/Bulk Storage	2	102.800	0.000	0.000	0.000	0.000	0.000	102.800	0.000	102.800
4953/7389	Hazardous Waste/Solvent Recovery	16	25.337	0.000	0.100	0.000	716.610	1.070	743.117	32.413	775.530
	Subtotal for New Industries	**495**	**1,282.191**	**0.024**	**0.100**	**0.000**	**716.610**	**749.472**	**2,748.397**	**192.093**	**2,940.490**
	Total	**1,274**	**5,217.775**	**2,075.634**	**284.112**	**121.080**	**4,903.737**	**33,313.286**	**45,915.624**	**53,898.465**	**99,814.089**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Map 3-1: Total On-and Off-site Releases, 2000: Dioxin and Dioxin-like Compounds

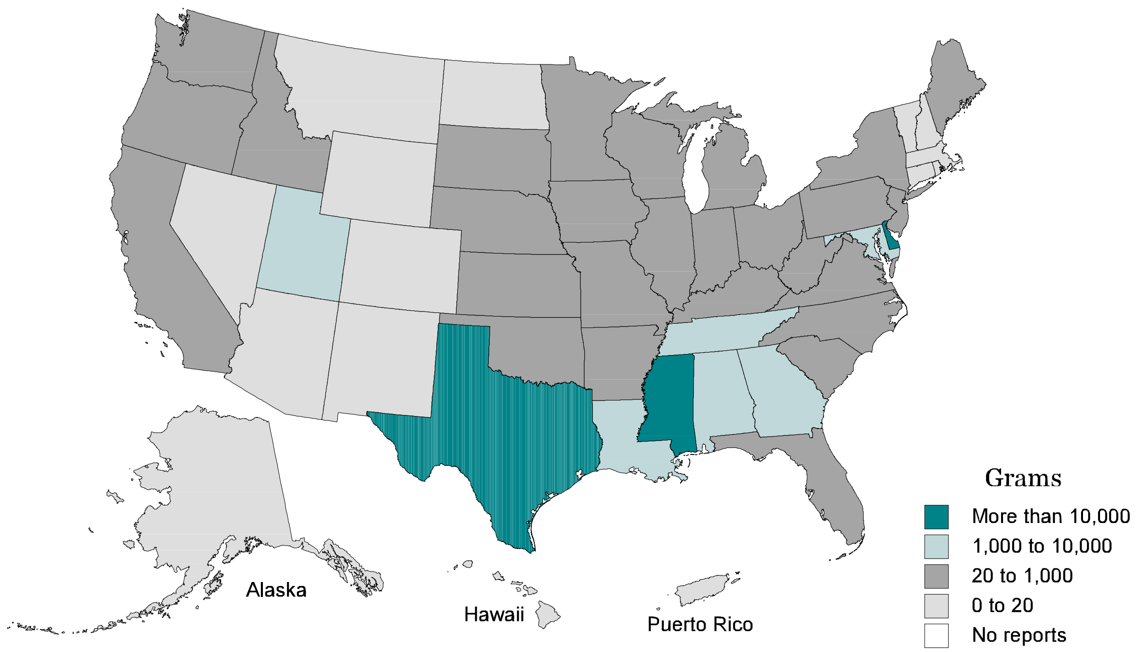


Table 3-9: Summary of TRI Information by Industry, 2000: Dioxin and Dioxin-like Compounds (continued)

		Recycled		Energy Recovery		Treated				
SIC Code	Industry	On-site Grams	Off-site Grams	On-site Grams	Off-site Grams	On-site Grams	Off-site Grams	Quantity Released On- and Off-site Grams	Total Production-related Waste Managed Grams	Non-production-related Waste Managed Grams
20	Food	0.000	0.000	0.000	0.000	0.000	0.000	19.245	19.245	0.000
21	Tobacco	0.000	0.000	0.000	0.000	0.000	0.000	0.450	0.450	0.000
22	Textiles	0.000	0.000	0.000	0.000	0.000	0.000	0.120	0.120	0.000
24	Lumber	4,448.367	0.033	0.000	1,983.204	203.434	10,660.335	1,116.827	18,412.201	2,799.476
25	Furniture	0.000	0.000	0.000	0.000	0.000	0.000	3.113	3.113	0.000
26	Paper	0.000	2.526	11.911	0.000	560.495	7.754	497.539	1,080.225	0.000
28	Chemicals	0.002	0.193	1.300	11.407	231,100.601	16,529.043	95,028.351	342,670.897	24,020.530
29	Petroleum	0.190	0.004	0.000	0.000	92.262	10.548	53.358	156.362	1.000
30	Plastics	0.000	0.000	0.000	0.000	0.000	0.000	0.944	0.944	0.000
32	Stone/Clay/Glass	0.000	0.000	0.004	0.000	0.000	0.000	490.469	490.473	0.000
33	Primary Metals	0.000	1.676	0.000	0.000	6,402.493	4.703	4,251.269	10,660.141	0.000
34	Fabricated Metals	0.000	0.000	0.000	0.000	0.000	0.000	0.820	0.820	0.000
35	Machinery	0.000	0.000	0.000	0.000	0.000	0.000	12.638	12.638	0.000
36	Electrical Equip.	0.000	0.000	0.000	0.000	0.000	0.000	1.000	1.000	0.000
37	Transportation Equip.	0.000	0.000	0.000	0.000	0.000	0.000	1.610	1.610	0.000
38	Measure/Photo.	0.000	0.000	0.000	0.000	34.000	0.001	5.600	39.601	0.000
	Multiple codes 20-39	0.000	0.000	6.483	0.000	46.790	0.297	1,274.584	1,328.154	0.000
	No codes 20-39	0.000	0.000	0.000	0.000	0.097	5,057.000	4.947	5,062.044	0.000
	Subtotal for Original Industries	**4,448.559**	**4.433**	**19.698**	**1,994.612**	**238,440.171**	**32,269.679**	**102,762.885**	**379,940.037**	**26,821.006**
10	Metal Mining	0.000	0.000	0.000	0.000	0.002	0.000	16.789	16.792	0.000
12	Coal Mining	0.000	0.000	0.000	0.000	0.000	0.000	5.670	5.670	0.000
491/493	Electric Utilities	0.000	0.960	0.000	0.000	0.099	0.000	2,048.023	2,049.082	0.000
5171	Petroleum Terminals/Bulk Storage	0.000	0.000	0.000	0.000	0.000	0.000	102.800	102.800	0.000
4953/7389	Hazardous Waste/Solvent Recovery	0.000	0.000	0.000	0.000	11,073.083	1.850	773.767	11,848.700	0.000
	Subtotal for New Industries	**0.000**	**0.960**	**0.000**	**0.000**	**11,073.184**	**1.850**	**2,947.049**	**14,023.044**	**0.000**
	Total	**4,448.559**	**5.393**	**19.698**	**1,994.612**	**249,513.356**	**32,271.529**	**105,709.934**	**393,963.081**	**26,821.006**

Note: Data are from Section 8 Form R.

Table 3-10: Current year and Projected Quantities of TRI Chemicals in Waste, 2000: Dioxin and Dioxin-like Compounds

Waste Management Activity	Current Year 2000		Projected 2001		Projected 2002	
	Total Grams	Percent of Total	Total Grams	Percent of Total	Total Grams	Percent of Total
Recycled On-site	4,448.559	1.1	3,535.192	0.9	3,535.192	0.9
Recycled Off-site	5.393	0.0	8,840.097	2.1	8,840.091	2.2
Energy Recovery On-site	19.698	0.0	13.152	0.0	12.044	0.0
Energy Recovery Off-site	1,994.612	0.5	2,757.980	0.7	2,757.980	0.7
Treated On-site	249,513.356	63.3	241,249.696	58.1	217,930.664	54.8
Treated Off-site	32,271.529	8.2	18,172.608	4.4	18,297.799	4.6
Quantity Released On- and Off-site	105,709.934	26.8	140,966.036	33.9	146,159.688	36.8
Total Production-related Waste Managed	**393,963.081**	**100.0**	**415,534.761**	**100.0**	**397,533.459**	**100.0**

Waste Management Activity	Projected Change 2000-2001	Projected Change 2001-2002	Projected Change 2000-2002
	Percent	Percent	Percent
Recycled On-site	-20.5	0.0	-20.5
Recycled Off-site	163,826.7	0.0	163,826.5
Energy Recovery On-site	-33.2	-8.4	-38.9
Energy Recovery Off-site	38.3	0.0	38.3
Treated On-site	-3.3	-9.7	-12.7
Treated Off-site	-43.7	0.7	-43.3
Quantity Released On- and Off-site	33.4	3.7	38.3
Total Production-related Waste Managed	**5.5**	**-4.3**	**0.9**

Note: Current year and projected amounts are from Section 8 of Form R for 2000.

Source Reduction

In 2000, 57 forms were filed reporting source reduction activities for dioxin and dioxin-like compounds (see Table 3-11). As noted in **Waste Management** in Chapter 1, source reduction—an activity that prevents the generation of waste—is the preferred waste management option. These 57 forms represent 4.5 percent of all forms submitted for dioxin and dioxin-like compounds in 2000.

The most frequently reported source reduction activity was good operating practices (listed on 34 forms). Process modifications came next, with 17 forms, followed by raw materials modification, with 13 forms.

Table 3-11: Number of Forms Reporting Source Reduction Activity, 2000: Dioxin and Dioxin-like Compounds

CAS Number	Chemical	Total Form Rs	Forms Reporting Source Reduction Activity		Category of Source Reduction Activity							
				Percent of All Form Rs	Good Operating Practices	Inventory Control	Spill and Leak Prevention	Raw Materials Modifi-cations	Process Modifi-cations	Cleaning and Degreasing	Surface Preparation and Finishing	Product Modifications
		Number	Number	Percent	Number	Number	Number	Number	Number	Number	Number	Number
--	Dioxin and dioxin-like compounds	1,274	57	4.5	34	5	7	13	17	0	1	2

Note: All source reduction activities on a form are counted in the corresponding category. Totals do not equal the sum of the categories because forms may report more than one source reduction activity.

Mercury and Mercury Compounds

Introduction

Mercury (CAS 7439-97-6) is a heavy, silver-white metal that exists as a liquid at ambient temperatures. It is a precious metal used in chlor-alkali production, wiring devices, switching mechanisms, amalgam dental fillings, and measurement and control instruments. Industries also manufacture and process mercury reagents, catalysts, and medicinal chemicals. Metal ores, coal, crude oil, and fuel oils contain mercury as a trace constituent. Despite industry efforts to reduce mercury use, federal bans on mercury additives in paints and pesticides, and increased state regulation, U.S. industrial demand exceeded 800,000 pounds in 1996 (EPA EA, 1999).

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts", which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compounds, the most common being methylmercury (MeHg) (CAS 22967-92-6) which is primarily produced by small organisms in the water and soil.

Methylmercury has no industrial uses; it is formed in the environment from the methylation of the inorganic mercurial ion (EPA, OAQPS, May 2001). Inorganic mercury compounds have been used in the past in laxatives, skin-lightening creams and soaps, and latex paint. In 1990, EPA canceled registration for all interior paints that contained mercury. Mercury use in exterior paint was discontinued after 1991.

Sources and Uses

Primary mining of mercury ore continued at the largest mercury mine in the U.S., the McDermitt mine in Nevada, until 1990 when operations ceased. At the time, the mine produced an average of 986,000 pounds of mercury every year. Although mercury ore mining has been discontinued in the U.S., mercury is produced as a byproduct of gold ore mining operations at mines located in Utah, California, and Nevada (EPA EA, 1999).

Secondary production of mercury involves the recovery of mercury from dismantled equipment and recovery from scrap and industrial wastes using a thermal or chemical extractive process. Major sources of recycled or recovered mercury include scrap from instrument and electrical manufactures (lamps and switches), wastes and sludge from laboratories and electrolytic refining plants, mercury batteries, and dental amalgams (EPA EA, 1999).

Mercury is also found as a trace contaminant in fossil fuels and waste materials. The combination of the elevated temperature of the process and the volatility of mercury and mercury compounds results in their being emitted in the combustion gas exhaust stream. Two general categories of mercury emissions sources exist involving fuel combustion for energy, steam and heat generation, as well as waste disposal processes (EPA, OAQPS, December 1994). These are point sources and area sources. During 1995, 275,400 pounds of mercury were emitted from combustion point sources. Of these emissions 103,600 pounds were attributable to utility boilers, of which coal combustion boilers were the primary producers of mercury (103,200 pounds). The major producers of mercury were municipal waste combustors, producing 59,200 pounds of mercury and commercial/industrial boilers (56,800 pounds) during 1995 (EPA EA, 1999).

In 1994-1995, mercury emissions from "area sources" (i.e., general emissions rather than a specific fixed source), totaled 3.4 tons (7,500 lbs). More than half of these emissions were from lamp breakage and general laboratory use. Other "area sources" in 1994-1995 included dental preparations, landfills, mobile sources, paint use, and agricultural burning.

In terms of human exposure methylmercury is the most important organic mercury compound. Humans are primarily exposed to methylmercury through diet, with fish and fish products being the dominant source. Sources of past exposure to methylmercury include fungicide-treated grains and meat from animals fed such grain. However, fungicides containing mercury are banned in the United States today, and this source of exposure is now negligible (EPA, OAQPS, May 2001).

Most products containing inorganic mercury compounds have now been banned. Limited exposure could occur through the use of old cans of latex paint, which until 1990, could contain mercury compounds to prevent bacterial and fungal growth (EPA, OAQPS, May 2001).

Chemical Characteristics

Persistence and Bioaccumulation

As with other metals, mercury and the mercury in mercury compounds can convert to different oxidation states but the metal can never be destroyed. (EPA, PBT Chemicals Final Rule, October, 1999).

Mercury and mercury compounds have BCF values that range from 7,000 to 36,000. (EPA, PBT Chemicals Final Rule, October, 1999).

Environmental Fate and Transport

The flux of mercury from the atmosphere to land or water at any one location is comprised of contributions from:

- the natural global cycle;
- the global cycle perturbed by human activities;
- regional sources; and
- local sources.

As a naturally occurring element, mercury is present throughout the environment. It is difficult to separate current mercury concentrations by origin (i.e. anthropogenic or natural) due to the continuous cycling of the element in the environment. The Expert Panel on Mercury Atmospheric Processes (1994) estimated that anthropogenic emissions might currently account for 50-75 percent of the total annual input to the global atmosphere. The Panel further reports recent estimates indicating that of the approximately 200,000 tons of mercury emitted in the atmosphere since 1890, about 95 percent resides in terrestrial soils, approximately 3 percent in the ocean surface waters and 2 percent in the atmosphere (EPA, OAQPS and ORD, December 1997).

Mercury in the Atmosphere: Mercury exists as a trace contaminant in fossil fuels. When these materials are combusted, the mercury and mercury compounds vaporize due to their low volatility and the elevated temperature of the combustion chamber, and they are released into the combustion gas exhaust. When these compounds are released to air, they are transported for varying distances and eventually fall to the ground and surface water in a process called atmospheric deposition. The Mercury Study Report to Congress found that the three principal factors governing deposition rates of mercury are emission source locations; amount of divalent and particulate mercury emitted or formed in the atmosphere; and climate and meteorology (EPA, OAQPS and ORD, December 1997).

Mercury in Soil: When mercury reaches soils, it is bound to bulk organic matter and is susceptible to elution in runoff only by being attached to suspended soil or humus. Some Hg(II) (mercuric mercury) will be absorbed onto dissolvable organic ligands and other forms of dissolved organic carbon (DOC) and may then partition to runoff in the dissolved phase. Currently, the atmospheric input of mercury to soil is thought to exceed greatly the amount leached from soil, and the amount of mercury partitioning to runoff is considered to be a small fraction of the amount of mercury stored in soil. The affinity of mercury species for soil results in soil acting as a large reservoir for anthropogenic mercury emissions (EPA, OAQPS and ORD, December 1997).

Plant and Animal Uptake of Mercury: Once in the soil, Hg(II) and methylmercury complexes become available for plant uptake and translocation, potentially resulting in transfer through the terrestrial food chain. The plant uptake however, is an insignificant amount. Overall, mercury concentrations in plants, even those whose main uptake appears to be from the air, are small. Accordingly, livestock typically accumulates little mercury from foraging or silage/grain consumption, and mercury content in meat is low. The terrestrial pathway is not expected to be significant in comparison to the consumption of fish by humans and wildlife (EPA, OAR, December 1997 and OAQPS December 1994).

Mercury in the Freshwater Ecosystem: There are a number of pathways by which mercury can enter the freshwater environment: Hg(II) and methylmercury from atmospheric deposition (wet and dry) can enter water bodies directly, can be transported to water bodies in runoff (bound to suspended soil/humus or attached to DOC), or can leach into the water body from groundwater flow in the upper soil layers. Once in the freshwater system, similar complexation and transformation processes that occur to mercury species in soil will occur, along with additional processes due to the aqueous environment (EPA, OAR, December 1997 and OAQPS December 1994).

Once entering a water body, mercury can remain in the water column, be lost from the lake through drainage water, re-volatilize into the atmosphere, settle into the sediment, or be taken up by aquatic biota. The movements of mercury through any specific water body may be unique. Mercury in the water column, in the sediment, and in other aquatic biota appears to be available to aquatic organisms for uptake (EPA, OAR, December 1997 and OAQPS December 1994).

Methylation is a key step in the entrance of mercury into the food chain. The biotransformation of inorganic mercury species to methylated organic species in water bodies can occur in the sediment and the water column. Methylmercury is highly bioavailable and accumulates in fish through the aquatic food web; nearly 100% of the mercury found in fish muscle tissue is methylated. It is primarily passed to fish via their diets. Larger, longer-lived fish species at the upper end of the food web typically have the highest concentrations of methylmercury. At this stage fish-consuming wildlife and humans can contact it through ingestion. Methylmercury appears to pass from the gastrointestinal tract into the bloodstream more efficiently than the divalent mercury species (EPA, OAR, December 1997 and OAQPS December 1994).

Miscellaneous Environments for Mercury: Mercury may also enter the environment directly through a facility's wastestream. Wastewater sources of mercury include area washdowns and tank clean outs of processes in which mercury or mercury compounds are manufactured, processed, or otherwise used. If a wet air pollution control device (e.g., scrubber) is used at a process generating mercury emissions, mercury can be transferred from the air stream to the water stream. This wastewater may be treated on site, discharged to surface water or a POTW, or transferred off site for other activities (EPA, OAR, December 1997 and OAQPS December 1994).

In addition to the sources listed above, spills and one-time events may also generate a mercury-containing waste stream. Other solid waste sources include sludge from on-site treatment, bags or filters from air pollution control devices, and ash from combustion operations. Solid material spills and ash may also contribute to fugitive emissions (EPA, OAR, December 1997 and OAQPS December 1994).

Health and Environmental Effects

Inhalation and digestion of mercury and organic mercury compounds have been shown to cause: damage to the brain and nervous system, including personality changes, tremors, changes in vision, deafness, muscle incoordination, loss of sensation, and difficulties with memory, ataxia (difficulty in moving , dysarthia (difficulty in articulating words), paraesthesia (a skin sensation such as burning or itching), impairment of speech, impairment of walking, and in some cases death. Inorganic mercury compounds do not enter the brain as easily as organic mercury or metallic mercury vapor. Animals exposed orally to long-term, high levels of methylmercury or phenylmercury in laboratory studies experienced damage to the kidneys, stomach, and large intestine; changes in blood pressure and heart rate; adverse effects on the developing fetus, sperm, and male reproductive organs; and increases in the number of spontaneous abortions and stillbirths. Adverse effects on the nervous system of animals occur at lower doses than do harmful effects to most other systems of the body. The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified mercury as to its human carcinogenity. The Environmental Protection Agency has determined that mercury chloride and methylmercury are possible human carcinogens.

Data in both humans and experimental animals show that mercury can produce adverse health effects. The best-known methylmercury-poisoning epidemic occurred in Minamata, Japan. Mercury was used as a catalyst in a chemical factory whose discharged waste sludge was drained into Minamata Bay. Once in Minamata Bay, methylation of the metal by plankton and its subsequent incorporation into the food chain caused acute toxicity in wildlife and humans that consumed fish caught within the region. This accidental poisoning (reportedly causing 52 immediate fatalities) facilitated significant insight into human health effects of mercury.

Using field studies to derive conclusive findings regarding the effect of mercury on wildlife and the environment is difficult because other factors that may contribute to the biological effect under study (for example, reproductive success) are often impossible to control. However, scientists have discovered toxic effects in the field at mercury concentrations that are toxic within the lab, and controlled lab studies have found toxic effects at concentrations that are common in certain environments. In addition, a number of poisonings of birds and wildlife from mercury-treated seed grains have been identified. In Minamata, Japan between 1950 and 1952, birds were observed to have severe difficulty flying and exhibited other abnormal behaviors. In addition, signs of neurological disease including convulsions, and highly erratic movements were observed among domestic animals in Minamata, especially cats that consumed seafood, which was later found to have high mercury levels (EPA, OAQPS and ORD, December 1997).

No conclusive studies examining the effects of mercury on entire ecosystems exist. However, based on the known effects of mercury on humans and wildlife, it is likely that mercury would also adversely affect ecosystems as a whole.

Efforts to Reduce Pollution from the Chemical

Mercury is a priority pollutant across numerous U.S. EPA programs including air, water, hazardous waste and pollution prevention. There are numerous activities currently underway to reduce mercury emissions and releases to the environment. These and other conventional regulatory strategies continue to result in reductions in mercury emissions, especially in cases when mercury is emitted to the environment as a result of trace contamination in fossil fuel or other essential feedstock in an industrial process.

Effective control of mercury emissions may be accomplished using a combination of the following control techniques:

- pollution prevention measures;
- coal cleaning;
- flue gas treatment technologies; and
- regulatory and alternative regulatory approaches.

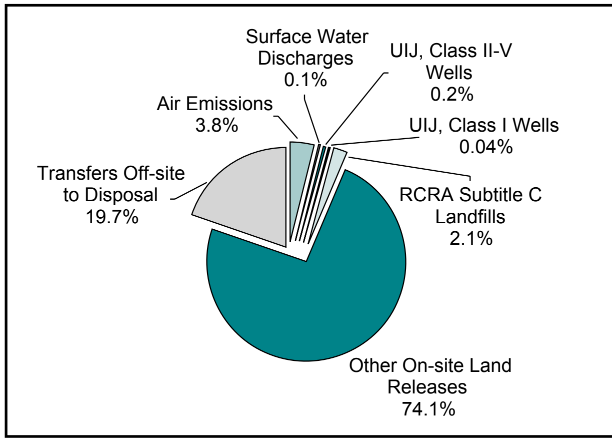
Pollution prevention techniques involve reducing mercury emissions from a particular product or process through changes in processes or inputs.

Applicable pollution prevention measures may include product substitution or process modification. Product substitution is suitable for processes or industries where a mercury substitute or low-mercury constituent has been demonstrated and is available. For example, alternatives to the use of mercury amalgams in dental preparations include gold, ceramic, and porcelain. Another pollution prevention measure is material separation, which is an appropriate approach for processes where mercury is removed from the waste stream prior to fuel combustion, thereby reducing mercury emissions in exhaust gases. For example, numerous communities in the U.S. have implemented household battery separation programs in order to facilitate the reduction of mercury in the waste stream.

Coal cleaning has been used for decades as an approach to improve the quality of boiler/combustion fuels and at the same time to reduce mercury emissions. Coal cleaning uses a combination of crushing and media flotation/separation to remove impurities from coal, which results in reduction of mercury content and a decrease in mercury emissions (EPA, OAQPS and ORD, December 1997).

Flue gas treatment technologies, primarily designed to remove SO_2, are also somewhat effective in removing mercury (and other heavy metals) through a combination of adsorption into droplets, agglomeration, and separation. Flue gas treatment technologies involve the manipulation of operating conditions to induce the condensation of mercury onto particulate matter. Numerous control strategies exist to aid flue gas treatment, including filters (carbon filter beds and selenium filters), scrubbing (wet scrubbing and depleted brine scrubbing), and activated carbon (treated activated carbon adsorption and activated carbon injection) (EPA, OAQPS and ORD, December 1997).

Figure 3-4: Distribution of TRI On-site and Off-site Releases, 2000: Mercury and Mercury Compounds



Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

UIJ = Underground Injection

2000 TRI DATA FOR MERCURY AND MERCURY COMPOUNDS

On-site and Off-site Releases

As shown in Table 3-12, there were 1,596 TRI forms submitted for mercury and mercury compounds for 2000. On- and off-site releases of mercury and mercury compounds totaled 4.3 million pounds, with 4.2 million pounds of this reported as mercury compounds. Almost three-quarters of total

Table 3-12: TRI On-site and Off-site Releases, 2000: Mercury and Mercury Compounds

			On-site Releases							Off-site Releases	
					Underground Injection		On-site Land Releases				
CAS Number	Chemical	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
7439-97-6	Mercury	566	29,833.13	392.31	1,121.00	255.70	20,280.78	18,164.40	70,047.32	24,490.28	94,537.60
--	Mercury compounds	1,030	134,659.41	1,909.98	810.72	9,526.10	71,017.18	3,178,819.12	3,396,742.51	825,382.03	4,222,124.54
	Total	**1,596**	**164,492.53**	**2,302.28**	**1,931.72**	**9,781.80**	**91,297.96**	**3,196,983.53**	**3,466,789.83**	**849,872.31**	**4,316,662.14**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Table 3-13: Quantities of TRI Chemicals in Waste Managed, 2000: Mercury and Mercury Compounds

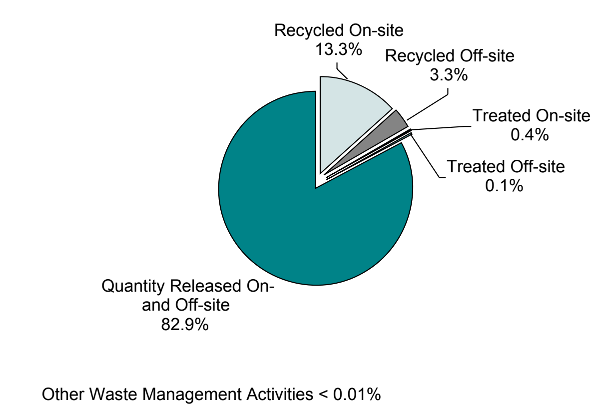
CAS Number	Chemical	Recycled On-site	Recycled Off-site	Energy Recovery On-site	Energy Recovery Off-site	Treated On-site	Treated Off-site	Quantity Released On- and Off-site	Total Production-related Waste Managed	Non-production-related Waste Managed
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
7439-97-6	Mercury	301,682.87	64,712.99	67.73	69.01	365.53	5,334.76	87,957.08	460,189.97	4,903.71
--	Mercury compounds	345,257.18	97,216.48	10.00	57.00	19,402.75	529.84	3,953,200.59	4,415,673.84	13,240.17
	Total	**646,940.05**	**161,929.47**	**77.73**	**126.01**	**19,768.28**	**5,864.61**	**4,041,157.67**	**4,875,863.82**	**18,143.88**

Note: Data are from Section 8 of Form R.

releases of mercury and mercury compounds were other on-site land releases (that is, other than RCRA subtitle C landfills), which totaled 3.2 million pounds (see Figure 3-4). (Types of on-site land releases are described in Box 1-4 in Chapter 1.) The second-largest release type was off-site releases (transfers to disposal), which totaled 849,872 pounds and accounted for one-fifth of total releases.

Much smaller amounts of other types of releases were reported. Air emissions totaled 164,493 pounds or 3.8 percent of total releases of mercury and mercury compounds. On-site land releases to RCRA subtitle C landfills were 91,298 pounds and surface water discharges were 2,302 pounds. Underground injection of mercury and mercury compounds was 9,782 pounds to Class II-V wells and 1,932 pounds to Class I wells.

Figure 3-5: Quantities of TRI Chemicals in Waste, 2000: Mercury and Mercury Compounds



Note: Data are from Section 8 of Form R.

Waste Management Data

Quantities of TRI Chemicals in Waste

Production-related waste of mercury and mercury compounds totaled 4.9 million pounds in 2000, as shown in Table 3-13. Over 90.5 percent was reported as mercury compounds.

Almost 82.9 percent (4.0 million pounds) of the total production-related waste was released on- or off-site (see Figure 3-5). On-site recycling accounted for 13.3 percent, or 646,940 pounds and off-site recycling for 3.3 percent, or 161,929 pounds. Other types of waste management accounted for less than one percent of the total.

Transfers Off-site for Further Waste Management/Disposal

Transfers off-site for further waste management and disposal of mercury and mercury compounds totaled 1.1 million pounds in 2000 (see Table 3-14). Transfers of mercury compounds accounted for 88.8 percent of the total.

Other transfers off-site to disposal were 898,151 pounds or 82.9 percent of all transfers for further waste management and disposal (see Figure 3-6), and transfers to recycling were 185,173 pounds or 17.1 percent. Other types of transfers off-site for further waste management and disposal of mercury and mercury compounds totaled less than 500 pounds for 2000.

TRI Data by State

Facilities in Texas, with 105 forms, submitted the largest number of forms in 2000 for mercury and

Table 3-14: TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Mercury and Mercury Compounds

CAS Number	Chemical	Transfers to Recycling	Transfers to Energy Recovery	Transfers to Treatment	Transfers to POTWs: Metals and Metal Compounds	Transfers to POTWs: Non-metal TRI Chemicals	Other Off-site Transfers*	Other Off-site Transfers to Disposal**	Total Transfers for Further Waste Management/ Disposal
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
7439-97-6	Mercury	93,376.58	0.00	58.00	121.90	0.00	0.00	27,784.56	121,341.04
--	Mercury compounds	91,796.09	1.00	4.90	200.75	0.00	0.00	870,366.82	962,369.55
	Total	**185,172.66**	**1.00**	**62.90**	**322.65**	**0.00**	**0.00**	**898,151.38**	**1,083,710.59**

Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

* Other Off-site Transfers are transfers reported without a valid waste management code.
** Does not include transfers to POTWs of metals and metal compounds.

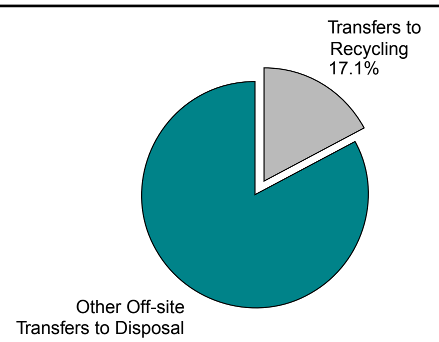
mercury compounds. Pennsylvania and Ohio ranked second and third, with 103 and 96 forms, respectively.

On- and Off-site Releases

In 2000, facilities in Nevada reported the largest total on- and off-site releases of mercury and mercury compounds (see Table 3-15). They reported a total of 3.0 million pounds, or 69.8 percent of the total for mercury and mercury compounds in 2000. This was almost five times the amount of releases from facilities in Texas, which reported the second largest amount, 606,800 pounds or 14.1 percent.

Almost all of Nevada's releases of mercury and mercury compounds were as other on-site land releases (that is, other than RCRA subtitle C landfills). Such releases for Nevada were 3.0 million pounds or 93.8 percent of all such on-site land releases of mercury and mercury compounds in 2000.

Figure 3-6: Distribution of TRI Transfers for Further Waste Management/Disposal, 2000: Mercury and Mercury Compounds



Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

Texas facilities reported the largest amount of off-site releases (transfers to disposal) of any state, with 577,900 pounds or 68.0 percent of total off-site releases of mercury and mercury compounds in 2000. Texas facilities also reported the largest air emissions, with 19,800 pounds or 12.1 percent of all air emissions of mercury and mercury compounds in 2000.

As shown in Map 3-2, releases of mercury and mercury compounds are quite concentrated geographically. The top two states, Nevada and Texas, released 3.6 million pounds of the 4.3 million-pound total. The next four states, Pennsylvania, Illinois, Massachusetts and California, each released between 60 and 80 million pounds, almost one-tenth the amount released by Texas, the state with the second largest releases.

Waste Management Data

The state with the largest quantity of total production-related waste of mercury and mercury compounds in 2000 was Nevada (see Table 3-15). Nevada's 3.1 million pounds of total production-related waste accounted for 62.7 percent of the total, almost three times that of any other state. Texas ranked second with 339,068 pounds, and

Table 3-15: Summary of TRI Information by State, 2000: Mercury and Mercury Compounds

State	Total Forms	On-site Releases							Off-site Releases	
				Underground Injection		On-site Land Releases				
		Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
	Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Alabama	41	6,591.23	51.32	0.00	19.00	32,023.00	1,707.65	40,392.20	2,198.36	42,590.56
Alaska	7	178.63	0.00	0.00	9,367.00	0.00	6,821.80	16,367.43	6.15	16,373.58
Arizona	19	2,101.19	0.00	0.00	0.00	0.00	33,627.55	35,728.75	204.58	35,933.32
Arkansas	18	1,563.56	4.59	0.00	0.00	0.00	146.59	1,714.74	12,169.40	13,884.14
California	94	5,598.29	5.14	0.00	0.20	6,177.70	42,034.92	53,816.26	6,584.49	60,400.75
Colorado	28	912.68	17.15	0.00	0.00	677.70	1,523.90	3,131.43	474.19	3,605.62
Connecticut	15	117.67	0.20	0.00	0.00	0.00	0.00	117.87	13,953.84	14,071.71
Delaware	8	1,552.50	21.20	0.00	0.00	0.00	1,932.40	3,506.10	265.56	3,771.66
District of Columbia	1	8.00	0.00	0.00	0.00	0.00	0.00	8.00	0.00	8.00
Florida	45	2,167.45	14.71	0.00	0.00	454.00	2,164.51	4,800.67	408.93	5,209.60
Georgia	31	4,928.61	18.57	0.00	0.00	0.00	1,301.70	6,248.88	98.72	6,347.60
Hawaii	5	39.28	3.50	0.00	5.60	0.00	0.00	48.38	51.14	99.52
Idaho	9	828.57	2.00	0.00	0.00	0.00	5,173.50	6,004.07	8.87	6,012.95
Illinois	70	6,007.12	18.33	0.00	0.00	8,835.00	1,636.97	16,497.42	51,906.21	68,403.63
Indiana	52	7,420.26	307.71	0.00	0.00	1,100.00	2,523.53	11,351.50	5,751.82	17,103.32
Iowa	43	2,748.52	1.00	0.00	0.00	0.00	146.18	2,895.70	625.27	3,520.96
Kansas	21	2,696.93	0.50	0.00	0.00	0.00	676.00	3,373.43	163.75	3,537.18
Kentucky	46	5,296.63	566.28	0.00	254.70	3.62	2,677.91	8,799.13	9,884.30	18,683.43
Louisiana	46	3,571.36	77.60	445.32	0.00	1,000.00	555.43	5,649.71	8,334.27	13,983.98
Maine	5	50.60	1.71	0.00	0.00	0.00	1.80	54.11	40.10	94.21
Maryland	16	2,513.85	1.86	0.00	134.00	0.00	325.10	2,974.81	351.10	3,325.91
Massachusetts	17	341.94	0.10	0.00	0.00	0.00	3.40	345.44	60,883.49	61,228.94
Michigan	52	3,999.25	495.70	0.00	0.00	12,454.00	1,060.08	18,009.03	4,816.91	22,825.94
Minnesota	21	1,774.41	0.06	0.00	0.00	0.00	890.04	2,664.51	326.19	2,990.70
Mississippi	13	814.87	6.24	57.40	0.00	0.00	335.80	1,214.31	52.26	1,266.58
Missouri	34	2,971.38	3.10	0.00	0.00	29.00	975.99	3,979.47	414.68	4,394.15
Montana	18	4,288.82	0.55	0.00	0.00	0.00	5,282.20	9,571.57	970.81	10,542.38
Nebraska	13	638.73	0.03	0.00	0.00	0.00	497.00	1,135.75	137.90	1,273.65
Nevada	30	12,772.28	1.00	0.00	0.30	0.00	2,999,941.36	3,012,714.94	19.72	3,012,734.66
New Hampshire	5	31.00	0.00	0.00	0.00	0.00	12.00	43.00	91.80	134.80
New Jersey	30	940.06	3.60	0.00	1.00	17.00	0.00	961.66	619.25	1,580.90
New Mexico	11	1,402.44	0.60	0.00	0.00	0.00	7,817.00	9,220.04	614.20	9,834.24
New York	42	1,366.93	55.55	0.00	0.00	570.00	1,157.61	3,150.09	1,730.78	4,880.87
North Carolina	39	3,535.14	23.06	0.00	0.00	4.30	1,820.90	5,383.40	396.45	5,779.84
North Dakota	12	2,469.10	0.10	0.00	0.00	0.00	241.30	2,710.50	364.30	3,074.80
Ohio	96	11,940.27	102.16	740.00	0.00	204.45	4,842.88	17,829.76	3,981.09	21,810.85
Oklahoma	20	1,343.72	3.39	0.00	0.00	1,495.00	141.97	2,984.08	634.26	3,618.34
Oregon	19	461.56	1.02	0.00	0.00	15,534.10	521.55	16,518.23	369.86	16,888.09
Pennsylvania	103	9,983.39	25.04	0.00	0.00	34.00	8,325.90	18,368.34	60,016.06	78,384.40
Puerto Rico	18	239.03	9.40	0.00	0.00	0.00	0.00	248.44	303.63	552.07
Rhode Island	6	0.10	0.00	0.00	0.00	0.00	0.00	0.10	3.43	3.53
South Carolina	36	2,578.81	32.87	0.00	0.00	0.00	1,327.55	3,939.23	158.97	4,098.20
South Dakota	6	212.21	0.02	0.00	0.00	0.00	41.30	253.53	6.00	259.53
Tennessee	45	4,821.79	99.67	0.00	0.00	782.00	2,488.53	8,191.99	1,743.87	9,935.86
Texas	105	19,847.99	62.89	689.00	0.00	125.80	8,153.76	28,879.43	577,922.58	606,802.01
Utah	21	1,007.81	8.20	0.00	0.00	9,586.00	35,627.81	46,229.82	3,220.15	49,449.97
Vermont	1	1.00	0.00	0.00	0.00	0.00	0.00	1.00	3,600.01	3,601.01
Virgin Islands	4	757.00	0.00	0.00	0.00	0.00	289.00	1,046.00	37.68	1,083.68
Virginia	42	4,251.46	24.86	0.00	0.00	0.00	857.94	5,134.26	1,707.67	6,841.93
Washington	26	582.65	50.69	0.00	0.00	2.00	1,651.20	2,286.54	9,350.62	11,637.16
West Virginia	31	7,044.62	174.51	0.00	0.00	0.00	5,933.50	13,152.63	1,126.87	14,279.49
Wisconsin	42	3,491.47	4.50	0.00	0.00	189.29	110.21	3,795.48	713.56	4,509.04
Wyoming	18	1,688.38	0.00	0.00	0.00	0.00	1,658.31	3,346.69	56.22	3,402.91
Total	**1,596**	**164,492.53**	**2,302.28**	**1,931.72**	**9,781.80**	**91,297.96**	**3,196,983.53**	**3,466,789.83**	**849,872.31**	**4,316,662.14**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Table 3-15: Summary of TRI Information by State, 2000: Mercury and Mercury Compounds (continued)

	Recycled		Energy Recovery		Treated				
State	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	Quantity Released On- and Off-site Pounds	Total Production-related Waste Managed Pounds	Non-production-related Waste Managed Pounds
Alabama	20,008.81	47.08	0.00	8.00	0.00	29.00	42,673.69	62,766.58	0.00
Alaska	75.00	0.10	0.00	0.00	0.13	3.00	16,212.17	16,290.40	0.00
Arizona	4,380.00	1,870.17	0.00	0.00	17.00	70.00	35,749.38	42,086.55	0.00
Arkansas	0.00	3,142.10	0.00	38.00	0.00	0.00	14,044.78	17,224.88	686.00
California	811.00	8,771.74	0.00	0.00	1.00	72.61	63,591.89	73,248.24	1,150.00
Colorado	3.70	30.00	0.00	0.00	0.00	0.00	3,654.28	3,687.98	1.50
Connecticut	0.00	3,956.94	0.00	0.00	0.00	62.60	13,971.17	17,990.71	0.20
Delaware	7,880.00	3.00	0.00	0.00	0.00	0.00	5,078.96	12,961.96	1.00
District of Columbia	0.00	40.00	0.00	0.00	0.00	0.00	48.00	88.00	0.00
Florida	0.00	79.01	0.00	0.00	0.00	1.00	4,507.16	4,587.17	0.00
Georgia	7.57	5,680.24	0.00	0.00	0.00	30.84	6,418.17	12,136.82	0.00
Hawaii	0.00	0.00	0.00	0.00	0.00	0.00	98.00	98.00	0.00
Idaho	0.00	137.17	0.00	0.00	0.00	0.00	18,949.88	19,087.05	0.06
Illinois	25.82	6,495.55	0.00	0.00	0.20	7.91	79,775.05	86,304.53	0.05
Indiana	5,215.30	1,701.00	0.00	0.00	2.00	2.22	15,783.21	22,703.73	9.00
Iowa	0.00	96.82	0.00	0.00	12.00	12.30	3,591.92	3,713.04	0.01
Kansas	0.00	864.00	0.00	0.00	0.00	0.00	2,864.20	3,728.20	0.00
Kentucky	15,000.00	11,103.00	0.00	0.00	0.00	0.00	19,021.07	45,124.07	1.00
Louisiana	44,250.00	4,097.18	0.00	0.00	729.41	163.00	14,464.70	63,704.29	0.00
Maine	0.00	0.00	0.00	0.00	0.00	0.00	101.00	101.00	0.00
Maryland	0.00	103.60	0.00	0.00	0.00	0.00	3,199.95	3,303.55	0.00
Massachusetts	1.80	43,140.08	0.00	0.00	0.10	2,276.87	46,944.09	92,362.94	0.16
Michigan	4.00	8,006.75	0.00	0.00	0.00	30.65	22,717.37	30,758.77	0.00
Minnesota	14.69	405.62	0.00	0.00	0.00	0.00	2,977.65	3,397.95	0.00
Mississippi	46.55	298.05	0.00	0.00	0.00	0.00	1,342.78	1,687.38	0.00
Missouri	0.00	193.75	0.00	0.00	80.00	46.98	4,483.65	4,804.38	0.00
Montana	122,562.00	0.45	0.00	0.00	0.00	7.10	11,063.31	133,632.86	91.00
Nebraska	25.00	103.51	0.00	0.00	2,801.00	0.00	1,163.00	4,092.51	0.00
Nevada	49,185.05	1,816.01	0.00	0.00	193.00	0.00	3,004,077.22	3,055,271.28	0.00
New Hampshire	0.00	0.00	0.00	0.00	0.00	44.00	134.90	178.90	0.00
New Jersey	52.50	2,001.50	0.00	0.00	0.00	210.60	1,500.29	3,764.89	0.10
New Mexico	0.00	9.50	0.00	0.00	0.00	0.00	10,397.39	10,406.89	598.00
New York	0.00	875.00	11.73	23.01	10.00	415.00	3,712.59	5,047.33	0.00
North Carolina	0.00	51.50	0.00	0.00	0.00	32.05	6,059.49	6,143.04	0.00
North Dakota	0.00	2.40	0.00	0.00	0.00	0.30	2,825.20	2,827.90	0.00
Ohio	6,604.98	18,621.92	0.00	0.00	18.00	4.90	23,609.76	48,859.56	5.70
Oklahoma	0.00	0.00	0.00	0.00	0.00	2.00	3,622.63	3,624.63	211.00
Oregon	33.00	281.00	0.00	55.00	0.00	0.00	16,887.80	17,256.80	0.00
Pennsylvania	117,597.27	1,331.83	0.00	0.00	0.00	107.67	77,774.08	196,810.85	0.80
Puerto Rico	0.00	4.25	0.00	0.00	0.00	0.00	425.27	429.52	0.00
Rhode Island	0.20	78.00	0.00	0.00	0.00	0.00	3.53	81.73	0.00
South Carolina	270.00	1,052.00	0.00	0.00	13.10	21.79	4,477.88	5,834.76	0.00
South Dakota	0.00	9.00	0.00	0.00	0.00	0.00	249.53	258.53	0.00
Tennessee	16,635.00	303.50	0.00	0.00	0.00	1,435.00	8,385.51	26,759.01	1,406.10
Texas	12,756.00	4,267.04	66.00	2.00	43.00	352.73	321,581.35	339,068.12	2,382.20
Utah	2.00	50.00	0.00	0.00	15,530.24	3.60	46,280.70	61,866.54	11,600.00
Vermont	0.00	3,500.00	0.00	0.00	0.00	0.00	2.00	3,502.00	0.00
Virgin Islands	0.00	0.00	0.00	0.00	0.00	0.00	1,084.00	1,084.00	0.00
Virginia	0.00	331.01	0.00	0.00	0.00	168.20	5,876.89	6,376.10	0.00
Washington	110,000.00	20,959.20	0.00	0.00	318.10	16.20	25,660.38	156,953.88	0.00
West Virginia	105,510.00	243.80	0.00	0.00	0.00	193.80	13,972.41	119,920.01	0.00
Wisconsin	7,982.80	5,774.10	0.00	0.00	0.00	40.50	4,653.41	18,450.81	0.00
Wyoming	0.00	0.00	0.00	0.00	0.00	0.19	3,413.01	3,413.20	0.00
Total	**646,940.05**	**161,929.47**	**77.73**	**126.01**	**19,768.28**	**5,864.61**	**4,041,157.67**	**4,875,863.82**	**18,143.88**

Note: Data are from Section 8 of Form R.

Table 3-16. Summary of TRI Information by Industry, 2000: Mercury and Mercury Compounds

			On-site Releases							Off-site Releases	
					Underground Injection		On-site Land Releases				
SIC Code	Industry	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
20	Food	30	549.13	0.00	0.00	0.00	0.00	20.99	570.12	248.10	818.22
21	Tobacco	4	68.84	2.00	0.00	0.00	0.00	0.00	70.84	155.00	225.84
22	Textiles	1	236.00	0.00	0.00	0.00	0.00	0.00	236.00	0.00	236.00
24	Lumber	10	178.14	0.00	0.00	0.00	0.00	0.04	178.18	0.00	178.18
26	Paper	106	2,650.30	76.88	0.00	0.00	25.39	625.12	3,377.69	2,019.18	5,396.87
27	Printing	1	79.00	0.00	0.00	0.00	0.00	0.00	79.00	0.00	79.00
28	Chemicals	176	20,019.43	169.25	70.72	1.00	988.29	5,603.03	26,851.73	18,890.36	45,742.09
29	Petroleum	123	5,712.46	110.07	3.00	5.80	0.00	220.13	6,051.46	5,667.42	11,718.88
30	Plastics	11	10.98	0.00	0.00	0.00	0.00	0.00	10.98	160.77	171.75
32	Stone/Clay/Glass	159	12,222.62	2.14	0.00	254.70	0.00	2,478.24	14,957.70	41.79	14,999.50
33	Primary Metals	129	10,708.74	343.21	0.00	0.00	1,125.80	7,492.10	19,669.84	71,319.17	90,989.01
34	Fabricated Metals	11	36.35	0.00	0.00	0.00	0.00	0.00	36.35	3.00	39.35
35	Machinery	6	12.44	0.00	0.00	0.00	0.00	0.60	13.04	57.11	70.15
36	Electrical Equip.	37	484.85	0.62	0.00	0.00	0.00	0.01	485.49	5,599.99	6,085.48
37	Transportation Equip.	12	117.35	0.00	0.00	0.00	0.00	0.00	117.35	177.91	295.27
38	Measure/Photo.	14	66.53	4.00	0.00	0.00	29.00	0.00	99.53	1,460.28	1,559.81
39	Miscellaneous	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	7.00
	Multiple codes 20-39	48	1,490.00	29.02	0.00	0.00	25.98	223.90	1,768.90	8,366.97	10,135.87
	No codes 20-39	10	113.60	5.00	0.00	0.00	0.00	31.00	149.60	111.77	261.37
	Subtotal Original Industries	**891**	**54,756.77**	**742.19**	**73.72**	**261.50**	**2,194.46**	**16,695.17**	**74,723.80**	**114,285.83**	**189,009.63**
10	Metal Mining	59	13,017.68	11.40	0.00	9,367.30	0.00	3,127,820.85	3,150,217.24	93.11	3,150,310.35
12	Coal Mining	46	258.82	228.58	0.00	153.00	0.00	5,821.93	6,462.34	20.00	6,482.34
491/493	Electric Utilities	504	94,881.23	1,317.99	0.00	0.00	455.00	46,116.57	142,770.80	16,445.35	159,216.15
5169	Chemical Wholesale Distributors	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5171	Petroleum Terminals/Bulk Storage	32	9.67	0.00	0.00	0.00	0.00	0.00	9.67	5.87	15.54
4953/7389	Hazardous Waste/Solvent Recovery	62	1,568.36	2.12	1,858.00	0.00	88,648.50	529.00	92,605.98	719,022.15	811,628.13
	Subtotal for New Industries	**705**	**109,735.77**	**1,560.10**	**1,858.00**	**9,520.30**	**89,103.50**	**3,180,288.36**	**3,392,066.02**	**735,586.48**	**4,127,652.51**
	Total	**1596**	**164,492.53**	**2,302.28**	**1,931.72**	**9,781.80**	**91,297.96**	**3,196,983.53**	**3,466,789.83**	**849,872.31**	**4,316,662.14**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Map 3-2: Total On- and Off-site Releases, 2000: Mercury and Mercury Compounds

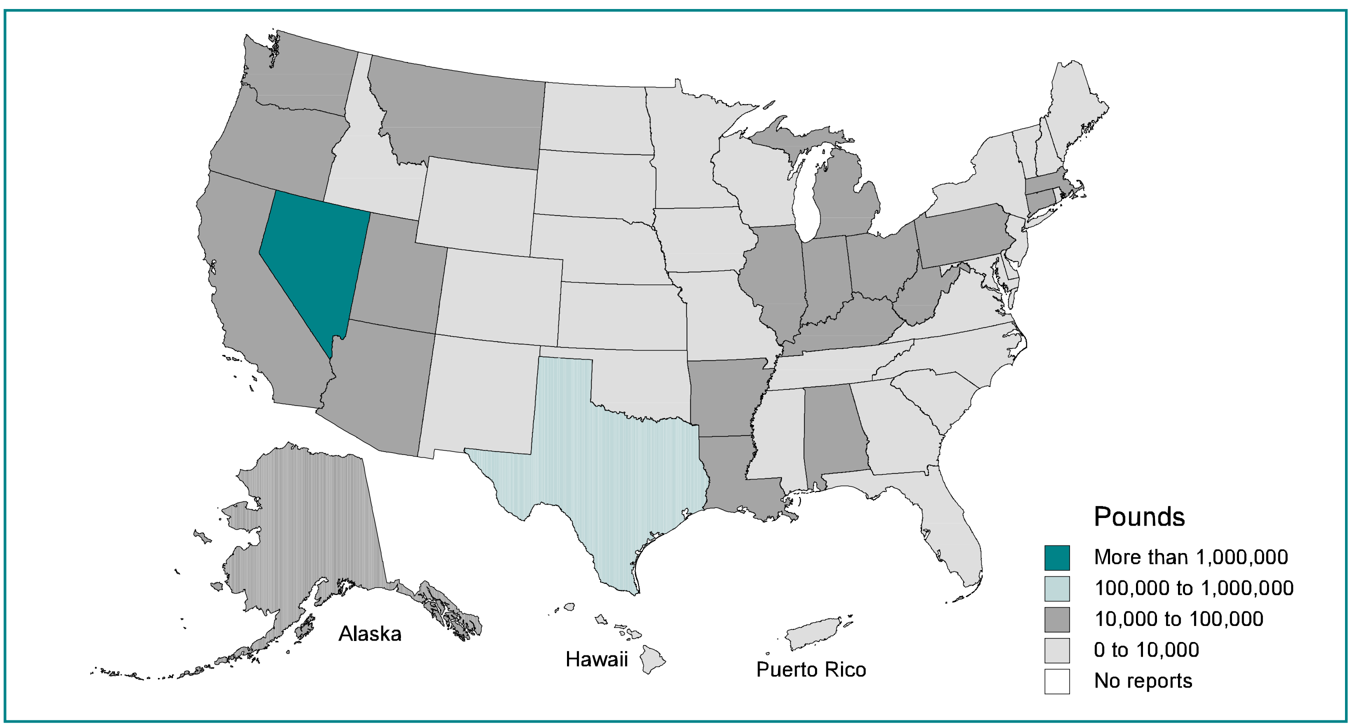


Table 3-16. Summary of TRI Information by Industry, 2000: Mercury and Mercury Compounds (continued)

SIC Code	Industry	Recycled		Energy Recovery		Treated		Quantity Released On- and Off-site	Total Production-related Waste Managed	Non-production-related Waste Managed
		On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	Pounds	Pounds	Pounds
20	Food	0.00	100.48	0.00	0.00	0.00	28.00	907.09	1,035.57	0.00
21	Tobacco	0.00	0.00	0.00	0.00	0.00	155.00	70.84	225.84	0.00
22	Textiles	0.00	0.00	0.00	0.00	0.00	0.00	240.00	240.00	0.00
24	Lumber	0.00	10.01	0.00	0.00	0.00	0.00	179.08	189.09	0.00
26	Paper	0.00	164.30	0.00	0.00	0.00	297.19	3,859.34	4,320.83	0.00
27	Printing	0.00	0.00	0.00	0.00	0.00	0.00	79.00	79.00	0.00
28	Chemicals	231,497.80	18,640.52	0.00	23.00	752.51	572.88	49,469.77	300,956.48	2,888.20
29	Petroleum	122.74	545.98	10.00	10.00	29.00	158.86	12,134.25	13,010.83	218.10
30	Plastics	0.00	0.00	0.00	55.00	0.00	35.98	29.77	120.75	0.10
32	Stone/Clay/Glass	4,591.80	235.52	67.73	0.01	0.00	19.51	14,432.47	19,347.04	643.01
33	Primary Metals	128,552.17	14,742.18	0.00	0.00	0.00	112.20	85,120.35	228,526.91	6,378.50
34	Fabricated Metals	0.00	248.00	0.00	0.00	0.00	15.00	59.35	322.35	0.00
35	Machinery	0.00	25.22	0.00	0.00	0.00	17.00	70.15	112.37	0.00
36	Electrical Equip.	0.00	17,216.84	0.00	0.00	0.10	153.40	2,554.65	19,924.99	5.90
37	Transportation Equip.	0.00	230.12	0.00	0.00	0.00	125.00	237.20	592.32	9.06
38	Measure/Photo.	0.00	7,390.50	0.00	0.00	0.00	1,460.00	72.33	8,922.83	1,401.00
39	Miscellaneous	0.00	9.00	0.00	0.00	0.00	0.00	7.00	16.00	0.00
	Multiple codes 20-39	222,000.98	469.20	0.00	0.00	0.00	377.17	25,255.92	248,103.27	0.00
	No codes 20-39	0.00	32.02	0.00	0.00	10.13	32.25	283.23	357.63	0.00
	Subtotal Original Industries	**586,765.50**	**60,059.90**	**77.73**	**88.01**	**791.74**	**3,559.44**	**195,061.79**	**846,404.10**	**11,543.87**
10	Metal Mining	49,312.05	1,829.10	0.00	0.00	193.00	82.00	3,148,193.65	3,199,609.80	6,000.00
12	Coal Mining	0.00	80.00	0.00	0.00	0.00	0.00	6,071.31	6,151.31	598.00
491/493	Electric Utilities	25.00	3,030.77	0.00	0.00	97.00	15.10	158,344.00	161,511.87	2.01
5169	Chemical Wholesale Distributors	0.00	0.00	0.00	0.00	0.00	2.00	0.00	2.00	0.00
5171	Petroleum Terminals/Bulk Storage	0.00	0.00	0.00	0.00	0.00	1.00	9.67	10.67	0.00
4953/7389	Hazardous Waste/Solvent Recovery	10,837.50	96,929.70	0.00	38.00	18,686.54	2,205.07	533,477.26	662,174.07	0.00
	Subtotal New Industries	**60,174.55**	**101,869.57**	**0.00**	**38.00**	**18,976.54**	**2,305.17**	**3,846,095.88**	**4,029,459.72**	**6,600.01**
	Total	**646,940.05**	**161,929.47**	**77.73**	**126.01**	**19,768.28**	**5,864.61**	**4,041,157.67**	**4,875,863.82**	**18,143.88**

Note: Data are from Section 8 of Form R.

Pennsylvania ranked third with 196,811 pounds.

Nevada released on- and off-site almost three quarters (3.0 million pounds or 74.3 percent) of all mercury and mercury compounds releases in 2000. Texas reported the second largest quantity released on- and off-site, 321,581 pounds or 8.0 percent.

Montana, the fifth-ranked state for total production-related waste, reported the largest amount of mercury and mercury compounds recycled on-site, 122,562 pounds or 18.9 percent of all on-site recycling. Pennsylvania, the fourth ranked for total production-related waste, reported the second largest amount recycled on-site, with 117,597 pounds or 18.2 percent of all on-site recycling of mercury and mercury compounds in 2000.

TRI Data by Industry (2-digit SIC Code)

On- and Off-site Releases

Metal mines reported the largest total releases of mercury and mercury compounds in 2000, 3.2 million pounds or 73.0 percent of the total on- and off-site releases (see Table 3-16). Metal mines reported the largest other on-site land releases (that is, land releases other than RCRA subtitle C landfills), with 3.1 million pounds or 97.8 percent of all such releases.

The hazardous waste/solvent recovery industries reported the second largest total releases. Their 811,628 pounds of releases accounted for 18.8 percent of total releases of mercury and mercury compounds in 2000. These industries reported the largest off-site releases (transfers to disposal) of mercury and mercury compounds, with 719,022 pounds or 84.6 percent of all off-site releases.

Electric utilities reported the third largest total releases, with 159,216 pounds or 3.7 percent of the total releases of mercury and mercury compounds in 2000. They reported the largest air emissions of any industry sector, with 94,881 pounds or 57.7 percent of all air emissions of mercury and mercury compounds.

Table 3-17: Current Year and Projected Quantities of TRI Chemicals in Waste, 2000: Mercury and Mercury Compounds

Waste Management Activity	Current Year 2000 Total Pounds	Current Year 2000 Percent of Total	Projected 2001 Total Pounds	Projected 2001 Percent of Total	Projected 2002 Total Pounds	Projected 2002 Percent of Total
Recycled On-site	646,940.05	13.3	474,362.79	10.5	438,363.79	9.8
Recycled Off-site	161,929.47	3.3	102,599.16	2.3	96,777.07	2.2
Energy Recovery On-site	77.73	0.0	83.36	0.0	83.36	0.0
Energy Recovery Off-site	126.01	0.0	35.00	0.0	36.00	0.0
Treated On-site	19,768.28	0.4	16,634.67	0.4	16,637.67	0.4
Treated Off-site	5,864.61	0.1	4,966.47	0.1	4,432.47	0.1
Quantity Released On- and Off-site	4,041,157.67	82.9	3,913,926.85	86.7	3,904,436.17	87.5
Total Production-related Waste Managed	4,875,863.82	**100.0**	4,512,608.30	**100.0**	4,460,766.53	**100.0**

Waste Management Activity	Projected Change 2000-2001 Percent	Projected Change 2001-2002 Percent	Projected Change 2000-2002 Percent
Recycled On-site	-26.7	-7.6	-32.2
Recycled Off-site	-36.6	-5.7	-40.2
Energy Recovery On-site	7.2	0.0	7.2
Energy Recovery Off-site	-72.2	2.9	-71.4
Treated On-site	-15.9	0.0	-15.8
Treated Off-site	-15.3	-10.8	-24.4
Quantity Released On- and Off-site	-3.1	-0.2	-3.4
Total Production-related Waste Managed	**-7.5**	**-1.1**	**-8.5**

Note: Current year and projected amounts are from Section 8 of Form R for 2000.

Waste Management

The metal mining industry reported the largest amount of total production-related waste of mercury and mercury compounds in 2000 (see Table 3-16). With 3.2 million pounds of production-related waste, it accounted for 65.6 percent of all production-related waste. Over 98 percent of the production-related waste reported by the metal mining industry was released on- and off-site.

The hazardous waste/solvent recovery industries reported the second largest amount of production-related waste, with 662,174 pounds or 13.6 percent of the total for mercury and mercury compounds in 2000. Over 80.5 percent of the production-related waste reported by the hazardous waste/solvent recovery industries (553,477 pounds) was released on- and off-site. The hazardous waste/solvent recovery industries reported the largest amounts recycled off-site and treated on-site, with 96,930 pounds recycled off-site and 18,687 pounds treated on-site.

The chemical industry reported the third largest amount of total production-related waste, with 300,956 pounds. This industry reported the largest amount recycled on-site, with 231,498 pounds. On-site recycling by the chemical industry accounted for 76.9 percent of that industry's production-related waste.

Table 3-18: Forms Reporting Source Reduction Activity, by Category, 2000: Mercury and Mercury Compounds

CAS Number	Chemical	Total Form Rs	Forms Reporting Source Reduction Activity		Category of Source Reduction Activity							
				Percent of All Form Rs	Good Operating Practices	Inventory Control	Spill and Leak Prevention	Raw Materials Modifications	Process Modifications	Cleaning and Degreasing	Surface Preparation and Finishing	Product Modifications
		Number	Number	Percent	Number	Number	Number	Number	Number	Number	Number	Number
7439-97-6	Mercury	566	39	6.9	20	2	4	5	24	0	0	3
	-- Mercury compounds	1,030	65	6.3	34	6	11	12	16	0	0	1
	Total	**1,596**	**104**	6.5	**54**	**8**	**15**	**17**	**40**	**0**	**0**	**4**

Note: All source reduction activities on a form are counted in the corresponding category. Totals do not equal the sum of the categories because forms may report more than one source reduction activity.

Projected Quantities of TRI Chemicals Managed in Waste, 2000-2002

TRI facilities expected to decrease their production-related waste of mercury and mercury compounds between 2000 and 2002 by 8.5 percent, from 4.9 million pounds to 4.5 million pounds (see Table 3-17). The decrease was projected to occur in almost all types of waste management. The quantity released on- and off-site, the largest type of waste management activity, was expected to decline by 3.4 percent. On- and off-site releases are the least-desirable outcome under the waste management hierarchy described in **Waste Management** in Chapter 1 (Figure 1-2).

From 2000 to 2001, a decrease of 7.5 percent was projected, followed by a decrease of 1.1 percent from 2001 to 2002.

Source Reduction

In 2000, 104 forms were filed reporting source reduction activities for mercury and mercury compounds (see Table 3-18). As noted in **Waste Management** in Chapter 1, source reduction—an activity that prevents the generation of waste—is the preferred waste management option. These 104 forms represented 6.5 percent of all forms submitted for mercury and mercury compounds in 2000.

The most frequently reported source reduction activity was good operating practices (listed on 54 forms). Process modification came next, with 40 forms, followed by raw materials modification, with 17 forms, and spill and leak prevention, with 15 forms.

TRI Data for Mercury and Mercury Compounds before 2000

Reporting for mercury and mercury compounds before 2000 was based on the higher TRI thresholds of 25,000 pounds for manufacture or processing of the chemical and 10,000 pounds for otherwise using the chemical. For the reporting year 2000, these thresholds were reduced to 10 pounds for manufacture, processing or otherwise using mercury or mercury compounds. Lowering the threshold, in effect, adds reports by those facilities whose activities were below the higher threshold. Consequently, the amounts for 2000 are not comparable with those for prior years.

Box 3-3 has TRI data reported for mercury and mercury compounds before 2000.

Box 3-3: TRI Data for Mercury and Mercury Compounds Before 2000

Following is a brief summary of releases and transfers and total production-related waste for mercury and mercury compounds for 1998 and 1999. This table includes reporting by both original and new industries.

TRI Data for Mercury and Mercury Compounds, 1998-1999

	1998	1999	Change 1998-1999	
	Number	Number	Number	Percent
Forms	57	78	21	36.8
	Pounds	Pounds	Pounds	Pounds
On-site Releases	9,240,171	3,101,092	-6,139,079	-66.4
Off-site Releases (Transfers to Disposal)	121,896	163,707	41,811	34.3
Total On- and Off-site Releases	**9,362,067**	**3,264,799**	**-6,097,268**	**-65.1**
Total Production-related Waste Managed	**10,602,922**	**4,289,466**	**-6,313,457**	**-59.5**

Mercury and mercury compounds have been on the TRI chemical list since the beginning of TRI. The following is a summary of releases and transfers for 1988-1999. This table does not include reporting by new industries for 1998 and 1999 since new industries did not report to TRI before 1998.

TRI Data for Mercury and Mercury Compounds, 1988-1999

	1988	1995	1998	1999	Change 1988-1999	
	Number	Number	Number	Number	Number	Percent
Forms	52	34	35	46	-6	-11.5
	Pounds	Pounds	Pounds	Pounds	Pounds	Percent
On-site Releases	39,993	17,768	20,750	21,673	-18,320	-45.8
Off-site Releases (Transfers to Disposal)	276,634	221,325	35,579	60,121	-216,513	-78.3
Total On- and Off-site Releases	**316,627**	**239,093**	**56,329**	**81,794**	**-234,833**	**-74.2**

Polycyclic Aromatic Compounds

Introduction

Polycyclic aromatic compounds (PACs), also known as polycyclic aromatic hydrocarbons (PAHs), are a group of over 100 different chemicals that are characterized by hydrogen and carbon arranged in two or more fused benzene rings (EPA EA, 1999). PACs originate from both natural and anthropogenic sources. As pure chemicals, PACs generally exist as colorless, white, or pale yellow-green solids. Most PACs do not occur alone in the environment; rather, they are found as a mixture of two or more PACs. High concentrations of PACs are present in substances such as fuel oil, coal, coal tar pitch, creosote, and road and roofing tar. The TRI PACs category consists of 21 specifically listed compounds as listed in Box 3-4.

Box 3-4: Polycyclic Aromatic Compounds Category

CAS Number	Chemical Name
56-55-3	Benzo(a)anthracene
205-99-2	Benzo(b)fluoranthene
205-82-3	Benzo(j)fluoranthene
207-08-9	Benzo(k)fluoranthene
206-44-0	Benzo(j,k)fluorene
189-55-9	Benzo(r,s,t)pentaphene
218-01-9	Benzo(a)phenanthrene
50-32-8	Benzo(a)pyrene
226-36-8	Dibenzo(a,h)acridine
224-42-0	Dibenzo(a,j)acridine
53-70-3	Dibenzo(a,h)anthracene
194-59-2	7H-Dibenzo(c,g)carbazole
5385-75-1	Dibenzo(a,e)fluoranthene
192-65-4	Dibenzo(a,e)pyrene
189-64-0	Dibenzo(a,h)pyrene
191-30-0	Dibenzo(a,l)pyrene
57-97-6	7,12-Dimethylbenz(a)anthracene
193-39-5	Indeno[1,2,3-cd]pyrene
56-49-5	3-Methylcholanthrene
3697-24-3	5-Methylchrysene
5522-43-0	1-Nitropyrene

For the purpose of this report, these chemicals are profiled as a group. All of the above chemicals, with the exception of 3-methylcholanthrene and benzo(j,k)fluorene, were previously reported to TRI as part of a single PAC category. The previous TRI reporting thresholds for the PAC category were 25,000 pounds for manufacturing and processing and 10,000 pounds for otherwise use. As a result of the PBT chemicals rule, 3-methylcholanthrene and benzo(j,k)fluorene are also reportable to TRI and are included in the PACs category group. In addition, benzo(g,h,i)perylene (CAS 191-24-2) is another PAC, which was not previously TRI-reportable. This chemical is listed separately from the PAC category under the TRI modifications resulting from the PBT chemicals rule and will be discussed separately in this section. Benzo(g,h,i)perylene is listed and discussed separately since, unlike all the members of the PACs category which were added to TRI based on concerns for carcinogenicity, benzo(g,h,i)perylene was added based on concerns for ecotoxicity.

Benzo(g,h,i)perylene

Benzo(g,h,i)perylene (CAS 191-24-2) in its physical state appears as pale yellow-green crystals. It is a five-ring PAC that is a product of incomplete combustion. Benzo(g,h,i)perylene releases toxic fumes when heated. It reacts with NO and NO_2 to form nitro derivatives. It can be absorbed into the body by inhalation of its aerosol and through the skin (CDC, April 2002).

Sources and Uses

There are presently no known commercial uses for PACs. In the past, some PACs were produced in small quantities for research purposes or used in medicines or in the production of dyes, plastics, or pesticides (EPA EA, 1999). For example, dibenz(a,h)acridine was previously used as a dye for pharmaceuticals and medical products; however, the use was abandoned due to its carcinogenic nature

(EPA EA, 1999). Currently, most, if not all, PACs are byproducts of combustion or impurities and not created for use themselves.

PACs may be formed as byproducts of both human and natural activities. They are produced or emitted during thermal processes such as the incomplete combustion of organic compounds, pyrolysis, or the processing of fossil fuels, bitumens, or nonfossil fuels (EPA EA, 1999). Natural sources include forest fires and volcanoes. Internal combustion engines, industrial, commercial, and residential fuel combustion, power generation, cigarette smoke, open burning, and incineration generate anthropogenic emissions.

Residential wood combustion accounts for the largest amount of PAC air emissions. Other major sources include consumer product usage (e.g., cigarette smoke, wood smoke, grilled or charred meats, processed or pickled foods (ATSDR, September 1996), wildfires, prescribed burning, and vehicle emissions. Other industrial contributors are the aerospace industry, coke ovens (various activities), petroleum refining, and primary aluminum production.

Of the profiled PACs, benzo(a)pyrene is the best documented. Benzo(a)pyrene is a slightly odorous, pale yellow crystalline solid. Benzo(a)pyrene is a byproduct of combustion and is also found in creosote, which is a brown, heavy, oily liquid that comes from the high-temperature treatment of coal or wood. Creosote can also be extracted from the resin of the creosote bush. Coal-tar creosote is the most widely used wood preservative in the United States. Sources of lesser significance are cement, lime, silicon carbide, asphalt roofing manufacturing, the creosote and other wood-preserving plants, road surfacing, municipal wastewater effluent, and domestic creosote use (EPA EA, 1999).

Benzo(g,h,i)perylene

Benzo(g,h,i)perylene occurs naturally in crude oils and results from the incomplete combustion of organic matter. It has no known commercial use or production. Emissions typically result from petroleum refining, coal tar distillation, and the combustion of tobacco (EPA EA, 1999), wood, coal, oil, propane, gasoline, and diesel fuels (Spectrum Laboratories, Undated).

Chemical Characteristics

Persistence and Bioaccumulation

PACs have persistence half-life values in soil that range from 20 days to 13 years. All but a few have half-life values well in excess of 6 months. Half-life values in water range from 79 days to 44 years, and those in air range from 4 to 114 days. PACs have BCF values that range from 800 to 31,440, with 16 of the 21 chemicals in this category with BCF values greater than 5,000. (EPA, PBT Chemicals Final Rule, October, 1999).

Benzo(g,h,i)perylene

Benzo(g,h,i)perylene has persistence half-life values in soil of 173 days to 1.8 years and persistence half-life values in water of greater than 100 days. Benzo(g,h,i)perylene has a BCF value of 25,420. (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

PACs primarily enter the environment as air emissions, mostly as releases from volcanoes, forest fires, and burning coal; vehicle emissions; wastewater effluent; spills and leakages; rainwater runoff; and landfill contamination (ATSDR, September 1996).

PACs also enter the atmosphere via evaporation from soil or surface waters. Since PACs tend to have low vapor pressures, they bind to dust and other particulate matter in the atmosphere. PACs remain in the gas phase at temperatures above 150°C, but will rapidly condense onto particulate matter at lower temperatures. PACs can break down by reacting with sunlight and other chemicals in the atmosphere over a period of days to weeks. PACs in the atmosphere may be carried over distances by the wind, but are eventually deposited on the earth’s surface via atmospheric deposition.

In addition to atmospheric deposition, PACs enter the soil system through wastewater effluents from coke and petroleum refining industries, spills and leakages, rainwater runoff, or from waste disposal sites (Karthikeyan, R. and Bhandari, A., 2001). Low water solubilities of PACs often result in their accumulation in soils and sediments. However, certain PACs can move through soil to contaminate groundwater. Microorganisms can break down PACs in soil after a period of weeks to months. Terrestrial organisms may take up PACs. Although PACs have high lipid solubilities, they tend not to bioaccumulate in vertebrates, primarily because they are rapidly and extensively metabolized.

PACs are widely distributed throughout aquatic ecosystems. PACs may enter aquatic environments via atmospheric deposition, runoff of polluted ground sources, accidental spills, and wastewater sources (ATSDR, September 1996). Because of their low water solubilities, PACs bind to particles in the water column and most eventually settle in bottom sediments. Microorganisms breakdown some PACs in aquatic environments. Aquatic organisms bioaccumulate PACs to varying degrees, depending on several factors such as the species and properties of the specific PAC.

Benzo(g,h,i)perylene

Benzo(g,h,i)perylene may be released to the environment through industrial effluents, municipal wastewater treatment facilities and waste incinerators. Benzo(g,h,i)perylene biodegrades slowly in the environment. Its half-life in aerobic soil is approximately 600 to 650 days (Spectrum Laboratories, December 2001). In the atmosphere, benzo(g,h,i)perylene binds to particulate matter and is eventually deposited on the surface of the earth. It may also be broken down by sunlight in the atmosphere (Spectrum Laboratories, December 2001). In aquatic environments, benzo(g,h,i)perylene separates from the water column and binds to bottom sediments or suspended solids. Benzo(g,h,i)perylene also has the potential to bioaccumulate in aquatic systems.

Health and Environmental Effects

Exposure to PACs has produced various toxic health effects in both humans and in animals. Cancer incidence as a result of PAC exposure is a health effect of great concern. The carcinogenicity, or ability of a substance to cause cancer, of individual PACs and PAC-containing mixtures has been well studied in experimental animals. While the carcinogenicity of PACs is better documented in laboratory animals, the few documented cases of occupational exposure to PACs have resulted in an increased incidence of cancer in exposed workers. PACs have caused lung, stomach, and skin cancer in laboratory animals. The site and the type of tumors are dependent on both the species and the route of administration (ATSDR, September 1996). In fact, EPA's Carcinogen Assessment Group has designated most of the PACs as potential carcinogens (HHS, January 2001). All of the members of the TRI PACs category were listed based on concerns for carcinogenicity.

Carcinogenic PACs have also been reported to suppress immune system function in rodents. These PACs are known as immunosuppressants. PACs that are highly carcinogenic in animals tend to also act as strong immunosuppressants, while PACs that are less carcinogenic tend to act as weaker immunosuppressants.

In laboratory experiments on animals, exposure to certain PACs has been shown to adversely affect both female and male reproductive systems and fetal development. Adverse effects include malformations, stillbirths, birth defects, lower body weights, immunosuppression, clastogenicity, and tumorigenicity. Note that effects of PACs on human reproduction and development have not been studied (Illinois Department of Public Health, January 2002).

Effects on genetic material have been repeatedly demonstrated for some PACs, using *in vivo* tests in rodents and *in vitro* tests using mammalian (including human) cell lines. Similar experiments have been conducted with prokaryotes, with similar results. Other PACs, however, appear to have little or no effect on genetic material (Holoubek, I. et al, May 2000).

PACs have been shown to induce a number of additional toxic effects. Eye irritation, photophobia (abnormal sensitivity to light), and skin conditions such as dermatitis (inflammation of the skin) and keratosis (excessive growth of horny tissue of the skin) have been demonstrated in workers occupationally exposed to PACs. PACs may also adversely affect the respiratory system.

Benzo(g,h,i)perylene

In aquatic toxicity tests benzo(g.h.i)perylene was found to have toxicity values of 0.030 milligrams per liter (mg/L) for fish 96-hour LC_{50} (i.e., the concentration that is lethal to 50% of test organisms) and 0.0002 mg/L for fish chronic toxicity. Other tests found chronic toxicity values at similarly low concentrations for daphnids and algae. These toxicity test values for benzo(g,h,i)perylene indicate that it is toxic at relatively low concentrations and thus is highly toxic to aquatic organisms (EPA, PBT Chemicals Proposed Rule, January 1999).

Efforts to Reduce Pollution from the Chemical

Numerous approaches have been employed to reduce pollution and adverse human and environmental health effects from PACs. Treatment of water with chlorine or ozone may reduce the levels of PACs in drinking water.

EPA regulates PACs under RCRA, CERCLA, SDWA, and CWA. In addition, EPA has included some PACs on a list of priority hazardous chemicals subject to reporting requirements under the Superfund Amendments and Reauthorization Act (SARA) (U.S. Department of Health and Human Services, January 2001). As mentioned previously, most PACs were listed under TRI prior to the PBT chemicals rule, but at higher reporting thresholds.

The National Institute for Occupational Safety and Health (NIOSH) and the Occupational Saftey and Health Administration (OSHA) have developed some occupational exposure standards addressing, both directly and indirectly, PACs. NIOSH has set standards for specific PACs, while OSHA indirectly limits exposure to numerous PACs. OSHA also regulates PACs under the Hazard Communication Standard and as chemical hazards in laboratories (ATSDR, September 1996).

In addition, various single PACs are addressed on the state or regional level through projects such as the Great Lakes Binational Toxics Strategy, which addresses among other chemicals, benzo(a)anthracene, benzo(a)pyrene, and benzo(g,h,i)perylene (EPA, GLNPO, November 2001). Benzo(g,h,i)perylene is listed as a priority pollutant under the CWA and is also regulated under CERCLA.

2000 TRI DATA FOR POLYCYCLIC AROMATIC COMPOUNDS

On-site and Off-site Releases

As shown in Table 3-19, there were 3,550 TRI forms submitted for polycyclic aromatic compounds for 2000. On- and off-site releases for polycyclic aromatic compounds totaled 5.4 million pounds, with 5.2 million pounds of this reported as the chemical category of polycyclic aromatic compounds.

Off-site releases (transfers to disposal) were the largest type of release for both the chemical category polycyclic aromatic compounds and the chemical benzo(g,h,i)perylene. Off-site releases accounted for 58.1 percent of total releases or 3.1 million pounds (see Figure 3-7). The second largest release type was air emissions, which accounted for 35.5 percent or 1.9 million pounds. The next largest types of releases were on-site land releases to RCRA subtitle C landfills of 201,582 pounds, accounting for 3.7 percent, and other on-site land releases of 115,206 pounds or 2.1 percent. (Types of on-site land releases are described in Box 1-4 in Chapter 1.)

Much smaller amounts of the other types of releases were reported. Surface water discharges were

18,137 pounds, and underground injection of polycyclic aromatic compounds to Class II-V wells was 10,000 pounds.

Waste Management Data

Quantities of TRI Chemicals in Waste

Production-related waste of polycyclic aromatic compounds totaled 42.9 million pounds in 2000, as shown in Table 3-20. Over 90 percent was reported as the chemical category polycyclic aromatic compounds.

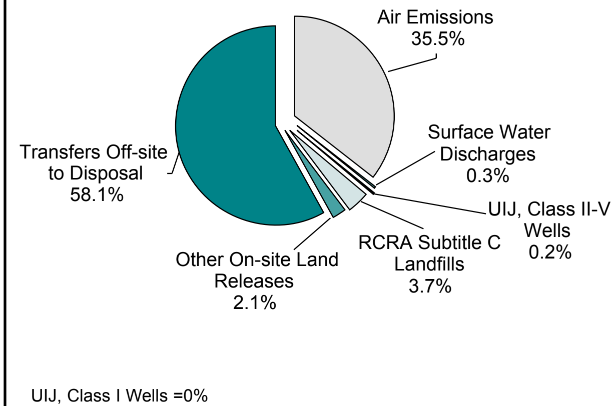
Almost 60 percent (25.6 million pounds) of the total production-related waste of polycyclic aromatic compounds was treated on-site in 2000 (see Figure 3-8). Energy recovery on-site accounted for 17.6 percent or 7.6 million pounds and releases on- and off-site site accounted for 13.4 percent, or 5.7 million pounds. Recycling on-site was 2.9 million pounds or 6.8 percent, and the other types of waste management accounted for about 2.5 percent of the total.

Transfers Off-site for Further Waste Management/Disposal

Transfers off-site for further waste management and disposal of polycyclic aromatic compounds totaled 4.4 million pounds in 2000 (see Table 3-21). Transfers of the chemical category polycyclic aromatic compounds accounted for 4.3 million pounds or 96.9 percent of the total.

Three-quarters of the transfers for further waste management and disposal of polycyclic aromatic compounds were transfers off-site to disposal (3.3 million pounds) (see Figure 3-9). Transfers to recycling accounted for 14.5 percent (640,243 pounds), transfers to treatment were 5.5 percent (245,100 pounds) and transfers to energy recovery were 4.8 percent (213,108 pounds). Other types of transfers were less than one percent of total transfers for further waste management and disposal of polycyclic aromatic compounds for 2000.

Figure 3-7: Distribution of TRI On-site and Off-site Releases, 2000: Polycyclic Aromatic Compounds



Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

UIJ=Underground Injection

TRI Data by State

Facilities in Massachusetts, with 253 forms, submitted the largest number of forms in 2000 for polycyclic aromatic compounds. Two other states, Texas and New York, also had more than 200 forms, with 226 forms from Texas and 206 forms from New York.

Table 3-19: TRI On-site and Off-site Releases, 2000: Polycyclic Aromatic Compounds

CAS Number	Chemical	Total Forms	On-site Releases: Total Air Emissions	On-site Releases: Surface Water Discharges	On-site Releases: Underground Injection: Class I Wells	On-site Releases: Underground Injection: Class II-V Wells	On-site Releases: On-site Land Releases: RCRA Subtitle C Landfills	On-site Releases: On-site Land Releases: Other On-site Land Releases	On-site Releases: Total On-site Releases	Off-site Releases: Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
191-24-2	Benzo(g,h,i)perylene	1,366	42,318.09	531.22	0.00	0.00	976.14	5,236.07	49,061.52	116,927.71	165,989.23
--	Polycyclic aromatic compounds	2,184	1,874,118.34	17,605.83	0.00	10,000.00	200,605.50	109,969.93	2,212,299.59	3,024,686.82	5,236,986.40
	Total	**3,550**	**1,916,436.42**	**18,137.05**	**0.00**	**10,000.00**	**201,581.64**	**115,205.99**	**2,261,361.11**	**3,141,614.53**	**5,402,975.63**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Table 3-20: Quantities of TRI Chemicals in Waste Managed, 2000: Polycyclic Aromatic Compounds

CAS Number	Chemical	Recycled		Energy Recovery		Treated		Quantity Released On- and Off-site	Total Production-related Waste Managed	Non-production-related Waste Managed
		On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	Pounds	Pounds	Pounds
191-24-2	Benzo(g,h,i)perylene	100,105.08	9,925.22	1,804,355.26	5,656.33	1,451,368.24	2,665.42	167,216.09	3,541,291.65	639.53
--	Polycyclic aromatic compounds	2,832,753.89	612,917.31	5,765,790.55	206,486.66	24,149,013.88	254,599.44	5,576,975.70	39,398,537.42	64,077.54
	Total	**2,932,858.97**	**622,842.53**	**7,570,145.81**	**212,142.99**	**25,600,382.12**	**257,264.86**	**5,744,191.79**	**42,939,829.07**	**64,717.07**

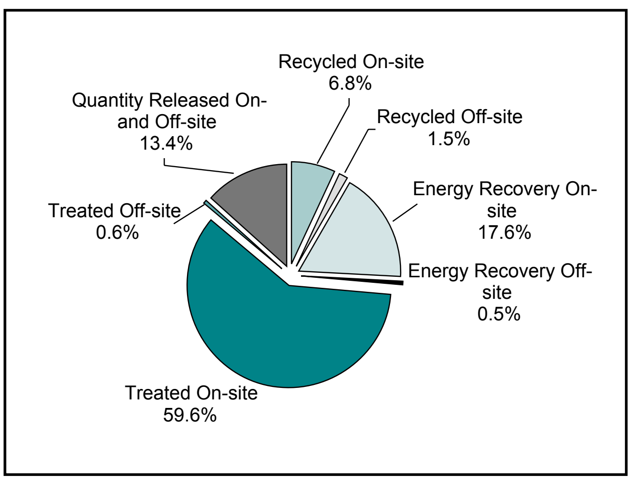
Note: Data are from Section 8 of Form R.

On- and Off-site Releases

In 2000, facilities in the state of Washington reported the largest total on- and off-site releases of polycyclic aromatic compounds (see Table 3-22). They reported a total of 1.8 million pounds, or one-third of the total releases of polycyclic aromatic compounds for 2000. Ohio accounted for 1.2 million pounds of releases, over 21 percent of the total. This was more than two and a half times the amount from facilities in West Virginia, which reported the third largest amount, with 463,102 pounds or 8.6 percent.

Almost all (94.5 percent or 1.7 million pounds) of Washington's releases of polycyclic aromatic compounds were as off-site releases (transfers to disposal). Ohio facilities reported the largest amount of air emissions of any state, with 775,614 pounds or 40.5 percent of total air emissions of polycyclic aromatic compounds. Air emissions represented two-thirds of total releases of polycyclic aromatic compounds in Ohio in 2000.

Figure 3-8: Quantities of TRI Chemicals in Waste, 2000; Polycyclic Aromatic Compounds



Note: Data are from Section 8 of Form R.

As shown in Map 3-3, releases of polycyclic aromatic compounds are quite concentrated geographically. Two states, Washington and Ohio, released 3.0 million pounds of the 5.4 million-pound total (54.9 percent). Eight other states (West Virginia, Oregon, Louisiana, Massachusetts, Pennsylvania, North Carolina, South Carolina and Mississippi) released between 100,000 pounds and 500,000 pounds of polycyclic aromatic compounds in 2000.

Waste Management Data

Texas had the largest quantity of total production-related waste of polycyclic aromatic compounds of any state in 2000 (see Table 3-22). Texas facilities reported 7.7 million pounds of total production-related waste and accounted for 17.9 percent of total production-related waste of polycyclic aromatic compounds. Tennessee ranked second with 6.8 million pounds (15.9 percent of the total), and South Carolina was third with 5.2 million pounds (12.0 percent of the total).

Over 90 percent of production-related waste in Texas was treated on-site. The 6.9 million pounds of polycyclic aromatic compounds treated on-site in Texas accounted for 27.0 percent of all on-site treatment of polycyclic aromatic compounds in 2000.

For Tennessee, the largest component of production-related waste was on-site energy recovery, a total of 5.9 million pounds, representing 78.4 percent of the nation's total on-site energy recovery and 87.0 percent of Tennessee's production-related waste. South Carolina reported the largest amount recycled on-site, 752,000 pounds, which was 25.6 percent of

Table 3-21: TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Polycyclic Aromatic Compounds

CAS Number	Chemical	Transfers to Recycling Pounds	Transfers to Energy Recovery Pounds	Transfers to Treatment Pounds	Transfers to POTWs: Metals and Metal Compounds Pounds	Transfers to POTWs: Non-metal TRI Chemicals Pounds	Other Off-site Transfers* Pounds	Other Off-site Transfers to Disposal** Pounds	Total Transfers for Further Waste Management/ Disposal Pounds
191-24-2	Benzo(g,h,i)perylene	9,812.57	5,780.04	2,661.48	0.00	615.74	19.50	116,945.31	135,834.63
--	Polycyclic aromatic compounds	630,430.47	207,328.38	242,467.35	0.00	4,498.19	125.00	3,199,851.36	4,284,700.75
	Total	**640,243.04**	**213,108.42**	**245,128.83**	**0.00**	**5,113.93**	**144.50**	**3,316,796.67**	**4,420,535.39**

Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

* Other Off-site Transfers are transfers reported without a valid waste management code.
** Does not include transfers to POTWs of metals and metal compounds.

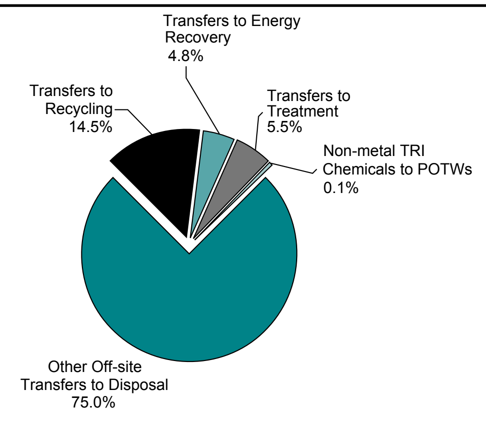
total on-site recycling of polycyclic aromatic compounds in 2000.

TRI Data by Industry (2-digit SIC Code)

On- and Off-site Releases

The primary metals industry reported the largest total releases of any industry sector, 3.1 million pounds or 58.3 percent of the total on- and off-site releases of polycyclic aromatic compounds in 2000 (see Table 3-23). The chemical manufacturing industry had the second largest total releases, with 468,461 pounds of total releases. Two other sectors, petroleum refining and hazardous waste/solvent recovery, had over 200,000 pounds of releases of polycyclic aromatic compounds in 2000.

Figure 3-9: Distribution of TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Polycyclic Aromatic Compounds



Note: **Total Transfers Off-site for Further Management/Disposal** are from Section 6 of Form R.

Two-thirds of the releases of the primary metals industry, the sector with the largest releases, were off-site releases (transfers to disposal) and one-third was air emissions. The 2.1 million pounds of off-site releases from the primary metals industry accounted for 66.9 percent of the total for all industries, and the 1.0 million pounds of air emissions were 54.4 percent of total air emissions.

Over 84 percent of the chemical industry's total releases, the sector with the second largest releases, was off-site releases (transfers to disposal). The chemical industry reported 394,895 pounds of off-site releases. Petroleum refining, with the third largest releases, reported 308,752 pounds of total releases with over half (162,979 pounds or 52.7 percent) as air emissions.

Waste Management

The primary metals industry reported the largest amount of total production-related waste of polycyclic aromatic compounds in 2000 (see Table 3-23). With 17.6 million pounds of production-related waste, this industry sector accounted for 41.1 percent of all production-related waste.

Almost three-quarters (13.1 million pounds) of the production-related waste reported by the primary metals industry were treated on-site. The primary metals industry reported 3.3 million pounds released on- and off-site (18.6 percent of the production-related waste of polycyclic aromatic com-

Table 3-22: Summary of TRI Information by State, 2000: Polycyclic Aromatic Compounds

		On-site Releases							Off-site Releases	
				Underground Injection		On-site Land Releases				
State	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
	Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Alabama	90	26,155.83	506.94	0.00	0.00	12,567.00	2,702.39	41,932.17	56,806.36	98,738.53
Alaska	10	0.35	20.00	0.00	0.00	0.00	26.00	46.35	0.00	46.35
Arizona	34	1,146.54	0.00	0.00	0.00	0.00	98.14	1,244.68	0.00	1,244.68
Arkansas	34	2,408.52	168.60	0.00	0.00	0.00	1,170.69	3,747.81	632.93	4,380.74
California	151	1,362.95	2,185.71	0.00	10,000.00	5,433.94	487.12	19,469.71	606.73	20,076.44
Colorado	34	391.41	68.10	0.00	0.00	0.00	0.00	459.51	145.80	605.31
Connecticut	146	32,097.30	0.00	0.00	0.00	0.00	37.70	32,135.00	409.50	32,544.50
Delaware	18	556.71	16.70	0.00	0.00	0.00	0.30	573.71	2.00	575.71
District of Columbia	3	0.36	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.36
Florida	131	15,919.63	69.56	0.00	0.00	0.00	246.76	16,235.95	149.28	16,385.23
Georgia	101	19,110.83	133.69	0.00	0.00	0.00	116.59	19,361.11	193.58	19,554.69
Guam	3	310.39	0.00	0.00	0.00	81.00	0.00	391.39	0.00	391.39
Hawaii	30	2,572.66	20.00	0.00	0.00	0.00	0.07	2,592.73	0.00	2,592.73
Idaho	4	64.70	27.80	0.00	0.00	0.00	58.00	150.50	0.00	150.50
Illinois	88	26,673.00	94.30	0.00	0.00	0.00	703.80	27,471.10	57,573.34	85,044.44
Indiana	77	9,923.73	82.00	0.00	0.00	0.00	222.00	10,227.73	8,831.01	19,058.74
Iowa	42	35,274.02	0.00	0.00	0.00	0.00	0.00	35,274.02	5,642.89	40,916.92
Kansas	37	717.08	19.90	0.00	0.00	0.00	355.90	1,092.88	49.68	1,142.56
Kentucky	46	56,304.39	35.20	0.00	0.00	56.40	55.30	56,451.29	3,685.61	60,136.90
Louisiana	84	98,910.02	1,934.59	0.00	0.00	280.00	707.20	101,831.81	68,673.89	170,505.71
Maine	92	60,163.48	97.17	0.00	0.00	0.00	590.00	60,850.65	322.30	61,172.95
Maryland	59	19,931.42	9,505.00	0.00	0.00	0.00	300.00	29,736.42	16,750.38	46,486.80
Massachusetts	253	100,143.60	678.99	0.00	0.00	0.00	0.37	100,822.96	40,812.66	141,635.61
Michigan	60	19,556.34	37.98	0.00	0.00	10,326.00	279.29	30,199.61	972.80	31,172.41
Minnesota	61	27,961.92	0.00	0.00	0.00	0.00	0.00	27,961.92	791.23	28,753.15
Mississippi	32	3,212.35	99.34	0.00	0.00	0.00	103.80	3,415.49	96,735.08	100,150.58
Missouri	63	6,008.19	0.30	0.00	0.00	0.00	0.00	6,008.49	1,433.80	7,442.29
Montana	17	37,634.67	9.90	0.00	0.00	0.00	526.28	38,170.85	8.69	38,179.54
Nebraska	11	16.59	0.00	0.00	0.00	0.00	0.00	16.59	78.39	94.98
Nevada	10	6.65	0.00	0.00	0.00	0.00	302.00	308.65	2,600.70	2,909.35
New Hampshire	40	898.27	311.32	0.00	0.00	0.00	18.10	1,227.69	346.25	1,573.94
New Jersey	116	1,517.29	59.56	0.00	0.00	426.00	0.00	2,002.85	615.59	2,618.44
New Mexico	18	58.83	0.00	0.00	0.00	0.00	0.00	58.83	3.30	62.13
New York	206	34,799.81	36.81	0.00	0.00	950.00	57.13	35,843.75	995.86	36,839.62
North Carolina	134	76,323.99	156.01	0.00	0.00	5.00	32,055.50	108,540.50	7,766.35	116,306.84
North Dakota	14	275.13	0.00	0.00	0.00	0.00	16.70	291.83	7.78	299.61
Northern Marianas	4	0.16	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.16
Ohio	154	775,614.50	149.11	0.00	0.00	0.00	49.90	775,813.51	388,592.22	1,164,405.73
Oklahoma	36	3,022.03	10.00	0.00	0.00	83.00	178.20	3,293.23	63,263.38	66,556.61
Oregon	41	56,474.66	75.40	0.00	0.00	170,300.30	3,064.70	229,915.06	52,327.10	282,242.16
Pennsylvania	186	46,583.32	393.19	0.00	0.00	0.00	35,565.70	82,542.21	53,700.57	136,242.78
Puerto Rico	37	21,912.88	150.60	0.00	0.00	0.00	0.00	22,063.48	1.80	22,065.28
Rhode Island	52	14,568.48	7.72	0.00	0.00	0.00	7.87	14,584.07	415.96	15,000.03
South Carolina	95	62,335.33	200.02	0.00	0.00	0.00	203.85	62,739.20	44,665.18	107,404.38
South Dakota	8	142.96	22.20	0.00	0.00	0.00	0.00	165.16	494.10	659.26
Tennessee	66	24,705.01	129.14	0.00	0.00	0.00	33,743.67	58,577.82	2,619.41	61,197.23
Texas	226	46,918.72	129.85	0.00	0.00	1,073.00	808.63	48,930.20	13,071.76	62,001.97
Utah	19	1,314.30	33.00	0.00	0.00	0.00	0.00	1,347.30	1,067.20	2,414.50
Vermont	14	891.22	0.00	0.00	0.00	0.00	0.00	891.22	0.00	891.22
Virgin Islands	8	2,600.02	2.00	0.00	0.00	0.00	0.00	2,602.02	0.00	2,602.02
Virginia	86	19,240.20	92.64	0.00	0.00	0.00	6.98	19,339.82	2,118.18	21,458.00
Washington	70	98,447.11	277.80	0.00	0.00	0.00	233.89	98,958.80	1,701,749.53	1,800,708.33
West Virginia	35	21,076.04	69.69	0.00	0.00	0.00	44.00	21,189.73	441,911.90	463,101.63
Wisconsin	55	661.78	18.04	0.00	0.00	0.00	61.47	741.29	1,840.29	2,581.57
Wyoming	9	1,518.76	1.18	0.00	0.00	0.00	0.00	1,519.94	132.18	1,652.12
Total	**3,550**	**1,916,436.42**	**18,137.05**	**0.00**	**10,000.00**	**201,581.64**	**115,205.99**	**2,261,361.11**	**3,141,614.53**	**5,402,975.63**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Table 3-22: Summary of TRI Information by State, 2000: Polycyclic Aromatic Compounds (continued)

State	Recycled		Energy Recovery		Treated				
	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	Quantity Released On- and Off-site Pounds	Total Production-related Waste Managed Pounds	Non-production-related Waste Managed Pounds
Alabama	259,900.20	48,153.00	0.00	1,430.00	40,248.00	8,212.60	98,507.23	456,451.03	3,463.80
Alaska	0.00	0.00	0.00	0.00	729.02	0.00	0.35	729.37	0.00
Arizona	0.00	0.00	0.00	0.00	461,255.20	0.00	1,245.68	462,500.88	0.00
Arkansas	315.00	4.40	329.30	8,026.00	673,972.60	231.40	3,627.69	686,506.39	11,365.50
California	0.12	555.09	1.10	0.10	9,483.00	1,622.77	10,773.00	22,435.18	451.30
Colorado	0.00	2,337.20	0.00	0.00	4,336.00	161.00	642.81	7,477.01	76.00
Connecticut	345.00	459.35	0.20	0.00	1,526,587.00	47.80	36,970.53	1,564,409.88	0.00
Delaware	0.00	64.00	905.37	0.00	1,700.00	0.00	214,638.30	217,307.67	0.00
District of Columbia	0.00	0.00	0.00	0.00	0.00	3.60	3.94	7.54	0.00
Florida	3,246.00	2,548.60	8,467.85	2,937.94	464.00	21.48	15,903.75	33,589.62	2.50
Georgia	10,129.00	7,482.40	82,297.00	0.50	332.00	80.60	19,731.06	120,052.56	0.00
Guam	0.00	0.00	0.00	0.00	0.00	81.00	369.39	450.39	22.00
Hawaii	0.00	0.00	0.00	40.03	0.00	0.00	2,593.14	2,633.17	0.00
Idaho	0.00	0.00	0.00	0.00	0.00	0.00	150.40	150.40	0.00
Illinois	2,883.00	4,707.02	5.00	82,672.00	17,634.00	15,317.58	86,064.05	209,282.65	1,573.14
Indiana	406,185.00	25,165.90	6,637.00	348.50	392,332.00	18.30	19,277.32	849,964.02	215.71
Iowa	28.00	6,167.00	3,619.00	433.90	0.00	5,243.00	35,514.02	51,004.92	0.00
Kansas	305.00	24.61	0.00	27.00	30.02	3.70	1,113.89	1,504.22	0.00
Kentucky	0.00	8,670.00	200,926.00	46.00	538,683.50	3,353.00	60,133.08	811,811.58	0.00
Louisiana	13,681.20	152,411.00	473,555.00	1,634.00	839,518.01	5,802.33	170,813.93	1,657,415.47	111.04
Maine	0.00	466.88	0.00	0.00	1.00	25.12	97,839.55	98,332.55	2.00
Maryland	20.20	3,892.13	276,668.10	0.00	2,011,460.20	1,224.40	21,089.53	2,314,354.56	26,002.50
Massachusetts	0.00	65.18	35,301.45	745.88	34,298.58	297.96	78,938.70	149,647.74	138.69
Michigan	0.00	6,980.64	1,191.90	274.89	1,842,917.00	84.89	31,073.61	1,882,522.93	0.00
Minnesota	3,223.00	2,144.00	38,999.00	1,435.96	20,086.02	290.15	24,255.34	90,433.47	2.10
Mississippi	416.88	1,738.00	0.00	1,156.80	4,722.00	7,391.20	100,169.32	115,594.20	3,422.30
Missouri	0.00	21,123.20	0.00	470.00	1,341.64	4.20	6,571.11	29,510.15	0.00
Montana	2,533.87	807.00	0.00	0.00	5.64	13.01	38,533.97	41,893.49	430.00
Nebraska	44.34	2,143.00	187.46	0.00	1,794.00	2.05	94.98	4,265.83	0.00
Nevada	0.20	1,900.00	0.00	0.00	0.00	0.50	2,903.25	4,803.95	0.00
New Hampshire	0.00	1.00	53,469.25	56.07	2,746.00	0.00	1,559.40	57,831.72	10.00
New Jersey	91.60	1,851.88	0.00	91.80	16,072.00	137.52	7,255.82	25,500.62	17.56
New Mexico	0.00	2,283.00	0.00	0.00	231,800.00	0.00	62.03	234,145.03	2.10
New York	61,368.00	6,496.47	5,613.60	31.18	373,041.98	5,076.67	39,137.65	490,765.55	878.00
North Carolina	28,986.16	9,624.86	7,278.72	80.30	482,276.60	239.40	85,300.46	613,786.50	2.04
North Dakota	0.00	0.00	0.00	0.00	62,480.00	0.00	303.15	62,783.15	0.00
Northern Marianas	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16	0.00
Ohio	26,381.30	24,928.60	620.40	23,120.00	568,893.20	77,984.71	1,168,889.09	1,890,817.31	1.70
Oklahoma	61,163.00	44,355.60	79,335.00	1,042.40	0.00	138.00	146,607.87	332,641.87	262.20
Oregon	0.00	818.00	1,220.00	1,600.00	19,176.00	2,138.23	241,745.46	266,697.69	1.70
Pennsylvania	646,904.50	93,412.29	58,455.97	270.00	184,818.41	5,378.90	127,801.57	1,117,041.64	2,148.69
Puerto Rico	0.00	0.00	29,400.00	0.00	0.00	7.22	22,066.08	51,473.30	2.80
Rhode Island	0.50	439.05	9,686.01	0.00	0.00	3.30	14,569.65	24,698.51	7.95
South Carolina	751,998.00	54,485.67	22,993.00	0.00	4,179,422.20	48,370.15	107,301.41	5,164,570.43	0.00
South Dakota	0.00	0.00	0.00	0.00	59,460.00	1,164.50	658.96	61,283.46	0.00
Tennessee	86,920.08	11,642.67	5,932,348.38	426.00	726,384.97	2,605.90	61,234.00	6,821,562.00	0.00
Texas	418,449.60	44,939.20	88,832.21	73,465.00	6,915,315.39	57,497.91	67,761.91	7,666,261.22	14,072.95
Utah	2,720.00	0.00	0.00	0.00	5,870.88	145.20	2,528.85	11,264.93	0.00
Vermont	0.00	0.00	0.00	18.20	0.00	0.00	891.42	909.62	0.00
Virgin Islands	0.00	0.00	0.00	0.00	15.00	0.00	2,602.02	2,617.02	0.00
Virginia	41.23	3,682.64	0.00	3.00	3,093,825.50	4,497.00	20,957.33	3,123,006.70	0.00
Washington	135,059.00	1,968.00	130.70	0.02	240,195.60	2,218.30	1,970,195.41	2,349,767.03	30.80
West Virginia	9,520.00	2,616.00	10.89	10,259.52	7,930.33	0.00	471,447.10	501,783.84	0.00
Wisconsin	0.00	19,288.00	6.95	0.00	2,106.40	83.50	2,594.61	24,079.46	0.00
Wyoming	0.00	0.00	151,654.00	0.00	4,621.24	44.80	1,177.44	157,497.48	0.00
Total	**2,932,858.97**	**622,842.53**	**7,570,145.81**	**212,142.99**	**25,600,382.12**	**257,264.86**	**5,744,191.79**	**42,939,829.07**	**64,717.07**

Note: Data are from Section 8 and Form R.

Map 3-3: Total On-site and Off-site Releases, 2000: Polycyclic Aromatic Compounds

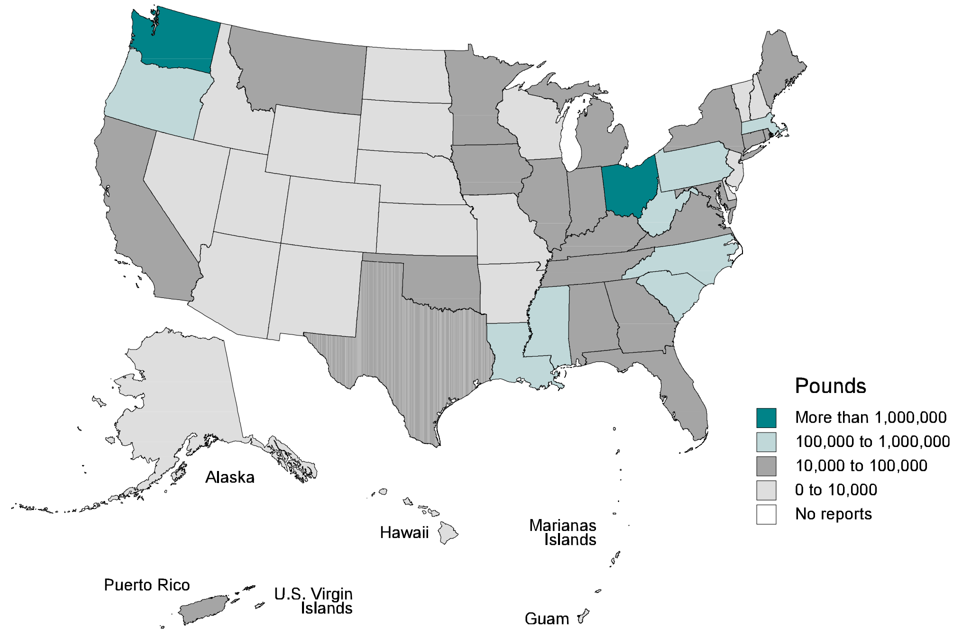


Table 3-23: Summary of TRI Information by Industry, 2000: Polycyclic Aromatic Compounds

			On-site Releases							Off-site Releases	
					Underground Injection		On-site Land Releases				
SIC Code	Industry	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
20	Food	239	189,420.77	1.00	0.00	0.00	0.00	0.00	189,421.77	18.00	189,439.77
22	Textiles	144	90,262.32	0.00	0.00	0.00	0.00	7.87	90,270.19	7.95	90,278.15
24	Lumber	75	4,301.47	2,546.20	0.00	0.00	0.00	0.80	6,848.48	104,069.82	110,918.30
25	Furniture	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Paper	295	117,328.26	1,442.01	0.00	0.00	61.40	2,504.23	121,335.90	1,176.61	122,512.51
27	Printing	6	213.00	0.00	0.00	0.00	0.00	0.00	213.00	0.00	213.00
28	Chemicals	261	70,198.91	2,033.67	0.00	0.00	504.00	828.73	73,565.31	394,895.48	468,460.79
29	Petroleum	567	162,978.80	470.92	0.00	10,000.00	0.00	4,127.14	177,576.86	131,175.03	308,751.89
30	Plastics	116	24,409.03	0.00	0.00	0.00	0.00	0.00	24,409.03	171,501.20	195,910.23
31	Leather	8	19,000.10	0.00	0.00	0.00	0.00	0.00	19,000.10	0.00	19,000.10
32	Stone/Clay/Glass	27	1,624.33	0.00	0.00	0.00	0.00	49.00	1,673.33	648.68	2,322.01
33	Primary Metals	121	1,043,002.03	745.27	0.00	0.00	0.00	3,281.30	1,047,028.60	2,101,829.30	3,148,857.89
34	Fabricated Metals	40	12,520.81	0.00	0.00	0.00	0.00	0.00	12,520.81	87.00	12,607.81
35	Machinery	16	5,392.10	0.00	0.00	0.00	0.00	30.37	5,422.47	0.37	5,422.84
36	Electrical Equip.	67	54,548.52	116.62	0.00	0.00	0.00	38,443.34	93,108.48	34,753.48	127,861.96
37	Transportation Equip.	69	8,710.08	0.00	0.00	0.00	0.00	335.00	9,045.08	312.00	9,357.08
38	Measure/Photo.	27	11,393.03	1.70	0.00	0.00	0.00	0.01	11,394.73	1.00	11,395.73
39	Miscellaneous	17	1,213.04	0.00	0.00	0.00	0.00	0.00	1,213.04	118.10	1,331.14
	Multiple codes 20-39	137	63,460.55	266.24	0.00	0.00	0.00	1,066.46	64,793.25	34,380.61	99,173.86
	No codes 20-39	18	7,107.07	30.00	0.00	0.00	0.00	29.26	7,166.33	93.23	7,259.56
	Subtotal for Original Industries	**2,251**	**1,887,084.23**	**7,653.63**	**0.00**	**10,000.00**	**565.40**	**50,703.51**	**1,956,006.77**	**2,975,067.88**	**4,931,074.66**
10	Metal Mining	5	1,137.00	0.00	0.00	0.00	0.00	0.00	1,137.00	0.00	1,137.00
491/493	Electric Utilities	638	11,421.14	9,727.31	0.00	0.00	0.00	64,018.27	85,166.72	29,551.39	114,718.11
5169	Chemical Wholesale Distributors	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5171	Petroleum Terminals/Bulk Storage	550	16,016.87	752.84	0.00	0.00	81.00	3.21	16,853.92	136,051.32	152,905.24
4953/7389	Hazardous Waste/Solvent Recovery	104	777.18	3.27	0.00	0.00	200,935.24	481.00	202,196.69	943.93	203,140.62
	Subtotal for New Industries	**1,299**	**29,352.19**	**10,483.42**	**0.00**	**0.00**	**201,016.24**	**64,502.48**	**305,354.33**	**166,546.64**	**471,900.98**
	Total	**3,550**	**1,916,436.42**	**18,137.05**	**0.00**	**10,000.00**	**201,581.64**	**115,205.99**	**2,261,361.11**	**3,141,614.53**	**5,402,975.63**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

pounds from the sector), and 1.2 million pounds recycled on-site (6.7 percent of the total reported by the primary metals industry).

Electric utilities had the second largest amount of production-related waste, with 8.5 million pounds or 19.9 percent of the total for polycyclic aromatic compounds in 2000, with most of it treated on-site.

The electrical equipment industry reported the third largest amount of total production-related waste, with 8.2 million pounds or 19.2 percent of total production-related waste of polycyclic aromatic compounds in 2000. This industry reported the largest amount of energy recovery on-site, 6.2 million pounds. On-site energy recovery by the electrical equipment industry accounted for 81.4 percent of all on-site energy recovery of polycyclic aromatic compounds in 2000.

Projected Quantities of TRI Chemicals Managed in Waste, 2000-2002

TRI facilities expected to decrease their production-related waste of polycyclic aromatic compounds between 2000 and 2001 by 9.6 percent, from 42.9 million pounds to 38.8 million pounds and another 2.6 percent from 2001 to 2002 (see Table 3-24). The decrease was projected to occur in the quantity released on- and off-site, a decrease of 41.8 percent from 2000 to 2002. On- and off-site releases are the least-desirable outcome under the waste management hierarchy described in **Waste Management** in Chapter 1 (Figure 1-2).

On-site energy recovery was also projected to decrease by 35.1 percent from 2000 to 2002. Recycling, both on- and off-site, was projected to increase. As a result, the quantity released on- and off-site was expected to decline as a percentage of total production-related waste from 13.4 percent in 2000 to 8.8 percent in 2002.

Table 3-23: Summary of TRI Information by Industry, 2000: Polycyclic Aromatic Compounds (continued)

SIC Code	Industry	Recycled On-site Pounds	Recycled Off-site Pounds	Energy Recovery On-site Pounds	Energy Recovery Off-site Pounds	Treated On-site Pounds	Treated Off-site Pounds	Quantity Released On- and Off-site Pounds	Total Production-related Waste Managed Pounds	Non-production-related Waste Managed Pounds
20	Food	3,199.00	808.50	310,151.40	2.50	90,175.63	18.00	402,677.02	807,032.05	18.96
22	Textiles	0.00	0.00	34,876.00	0.00	0.00	3.00	27,373.55	62,252.55	7.95
24	Lumber	349.60	11.00	34,700.00	6,563.80	35,037.10	129,789.80	116,765.85	323,217.15	20,316.90
25	Furniture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	Paper	0.00	21.68	133,195.95	131.00	16,842.88	1,226.40	130,030.95	281,448.86	0.00
27	Printing	0.00	0.00	0.00	0.00	0.00	0.00	213.00	213.00	0.00
28	Chemicals	76,214.20	39,099.50	608,728.71	99,010.87	690,216.43	84,749.64	467,902.50	2,065,921.85	120.20
29	Petroleum	110,624.85	155,749.85	231,492.00	84,598.78	609,025.59	20,891.60	384,190.02	1,596,572.71	15,209.51
30	Plastics	857,798.34	139,117.97	0.00	2,510.60	23,005.00	522.96	199,264.70	1,222,219.58	110.00
31	Leather	0.00	0.00	963.25	0.00	0.00	0.00	54,200.10	55,163.35	0.00
32	Stone/Clay/Glass	0.00	0.00	6,637.00	52.88	19,815.08	0.00	2,320.77	28,825.73	0.00
33	Primary Metals	1,173,385.00	63,747.30	5,310.30	20.00	13,108,379.10	4,816.00	3,273,998.15	17,629,655.85	1,091.00
34	Fabricated Metals	0.00	0.00	637.00	0.00	0.00	0.00	12,644.62	13,281.62	0.00
35	Machinery	0.00	0.00	0.00	17.20	0.00	9.50	5,422.00	5,448.70	0.37
36	Electrical Equip.	118,898.00	26,634.29	6,158,762.57	10,970.22	1,801,470.30	10,472.51	120,381.86	8,247,589.75	29.00
37	Transportation Equip.	0.00	0.00	0.00	0.00	0.00	0.00	8,650.08	8,650.08	2.00
38	Measure/Photo.	0.00	0.00	0.00	3.00	28.00	0.00	11,477.15	11,508.15	0.00
39	Miscellaneous	0.00	0.00	0.00	0.00	0.00	2,100.00	1,331.14	3,431.14	0.00
	Multiple codes 20-39	361,602.66	56,770.74	43,139.00	180.73	16,562.00	339.70	99,287.34	577,882.17	181.09
	No codes 20-39	230,000.00	127.35	0.00	0.00	72.00	0.00	7,230.61	237,429.96	58.00
	Subtotal Original Industries	**2,932,071.65**	**482,088.19**	**7,568,593.18**	**204,061.58**	**16,410,629.11**	**254,939.12**	**5,325,361.41**	**33,177,744.24**	**37,144.99**
10	Metal Mining	0.00	102.00	0.00	0.00	0.00	0.00	1,137.00	1,239.00	0.00
491/493	Electric Utilities	0.00	357.48	1,223.62	718.37	8,480,921.77	11.40	56,901.05	8,540,133.69	27,506.07
5169	Chemical Wholesale Distributors	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5171	Petroleum Terminals/Bulk Storage	787.32	4,633.87	0.01	932.04	132.36	848.88	157,031.53	164,366.01	66.01
4953/7389	Hazardous Waste/Solvent Recovery	0.00	135,661.00	329.00	6,431.00	708,698.88	1,465.46	203,760.80	1,056,346.14	0.00
	Subtotal for New Industries	**787.32**	**140,754.35**	**1,552.63**	**8,081.41**	**9,189,753.01**	**2,325.74**	**418,830.38**	**9,762,084.84**	**27,572.08**
	Total	**2,932,858.97**	**622,842.53**	**7,570,145.81**	**212,142.99**	**25,600,382.12**	**257,264.86**	**5,744,191.79**	**42,939,829.07**	**64,717.07**

Note: Data are from Section 8 and Form R.

Table 3-24: Current Year and Projected Quantities of TRI Chemicals in Waste, 2000: Polycyclic Aromatic Compounds

Waste Management Activity	Current Year 2000		Projected 2001		Projected 2002	
	Total Pounds	Percent of Total	Total Pounds	Percent of Total	Total Pounds	Percent of Total
Recycled On-site	2,932,858.97	6.8	3,090,394.08	8.0	3,152,185.19	8.3
Recycled Off-site	622,842.53	1.5	637,141.16	1.6	640,878.54	1.7
Energy Recovery On-site	7,570,145.81	17.6	6,550,729.66	16.9	4,909,766.03	13.0
Energy Recovery Off-site	212,142.99	0.5	199,826.51	0.5	199,148.48	0.5
Treated On-site	25,600,382.12	59.6	24,848,387.76	64.0	25,294,583.03	66.9
Treated Off-site	257,264.86	0.6	255,862.78	0.7	255,299.94	0.7
Quantity Released On- and Off-site	5,744,191.79	13.4	3,222,869.30	8.3	3,343,509.65	8.8
Total Production-related Waste Managed	**42,939,829.07**	**100.0**	**38,805,211.25**	**100.0**	**37,795,370.86**	**100.0**
Waste Management Activity	**Projected Change 2000-2001**		**Projected Change 2001-2002**		**Projected Change 2000-2002**	
	Percent		Percent		Percent	
Recycled On-site	5.4		2.0		7.5	
Recycled Off-site	2.3		0.6		2.9	
Energy Recovery On-site	-13.5		-25.1		-35.1	
Energy Recovery Off-site	-5.8		-0.3		-6.1	
Treated On-site	-2.9		1.8		-1.2	
Treated Off-site	-0.5		-0.2		-0.8	
Quantity Released On- and Off-site	-43.9		3.7		-41.8	
Total Production-related Waste Managed	**-9.6**		**-2.6**		**-12.0**	

Note: Current year and projected amounts are from Section 8 of Form R for 2000.

Source Reduction

In 2000, 173 forms were filed reporting source reduction activities for polycyclic aromatic compounds (see Table 3-25). As noted in **Waste Management** in Chapter 1, source reduction—an activity that prevents the generation of waste—is the preferred waste management option. These 173 forms represented 4.9 percent of all forms submitted for polycyclic aromatic compounds in 2000.

The most frequently reported source reduction activity was good operating practices (listed on 94 forms). Spill and leak prevention came next, with 49 forms, followed by process modifications, with 45 forms.

Table 3-25: Number of Forms Reporting Source Reduction Activity, 2000: Polycyclic Aromatic Compounds

CAS Number	Chemical	Total Form Rs	Forms Reporting Source Reduction Activity		Category of Source Reduction Activity							
				Percent of All Form Rs	Good Operating Practices	Inventory Control	Spill and Leak Prevention	Raw Materials Modifi-cations	Process Modifi-cations	Cleaning and Degreasing	Surface Preparation and Finishing	Product Modifi-cations
		Number	Number	Percent	Number	Number	Number	Number	Number	Number	Number	Number
191-24-2	Benzo(g,h,i)perylene	1,366	67	4.9	37	10	18	6	19	2	0	0
--	Polycyclic aromatic compounds	2,184	106	4.9	57	14	31	12	26	2	1	4
	Total	**3,550**	**173**	**4.9**	**94**	**24**	**49**	**18**	**45**	**4**	**1**	**4**

Note: All source reduction activities on a form are counted in the corresponding category. Totals do not equal the sum of the categories because forms may report more than one source reduction activity.

TRI Data for Polycyclic Aromatic Compounds Before 2000

Reporting for the chemical category polycyclic aromatic compounds before 2000 was based on the higher TRI thresholds of 25,000 pounds for manufacture or processing of the chemical and 10,000 pounds for otherwise using the chemical. For the reporting year 2000, these thresholds were reduced to 10 pounds for manufacture, processing or otherwise using polycyclic aromatic compounds. Lowering the threshold, in effect, adds reports by those facilities whose activities were below the higher threshold. Consequently, the amounts for 2000 are not comparable with those for prior years. The chemical benzo(g,h,i)perylene was added to the TRI list for the 2000 reporting year so amounts for this chemical are not included here.

Box 3-5 has TRI data reported for polycyclic aromatic compounds before 2000.

Box 3-5: TRI Data Reported for Polycyclic Aromatic Compounds Before 2000

Following is a brief summary of releases and transfers and total production-related waste for chemical category polycyclic aromatic compounds for 1998 and 1999. This table includes reporting by both original and new industries.

TRI Data for Polycyclic Aromatic Compounds, 1998-1999

	1998	1999	Change 1998-1999	
	Number	Number	Number	Percent
Forms	270	286	16	5.9
	Pounds	Pounds	Pounds	Percent
On-site Releases	1,724,066	1,564,951	-159,115	-9.2
Off-site Releases (Transfers to Disposal)	1,552,059	2,079,317	527,258	34.0
Total On- and Off-site Releases	**3,276,125**	**3,644,268**	**368,143**	**11.2**
Total Production-related Waste Managed	**14,563,779**	**16,344,836**	**1,781,057**	**12.2**

The chemical category, polycyclic aromatic compounds, has been on the TRI chemical list since the 1995 reporting year. The following is a summary of releases and transfers and total production-related waste for 1995-1999. This table does not include reporting by new industries for 1998 and 1999 since new industries did not report to TRI before 1998.

TRI Data for Polycyclic Aromatic Compounds, 1995-1999

	1995	1998	1999	Change 1995-1999	
	Number	Number	Number	Number	Percent
Forms	162	191	201	39	24.1
	Pounds	Pounds	Pounds	Pounds	Percent
On-site Releases	497,692	1,607,138	1,337,714	840,022	168.8
Off-site Releases (Transfers to Disposal)	1,226,135	1,856,496	2,229,396	1,003,261	81.8
Total On- and Off-site Releases	**1,723,827**	**3,463,634**	**3,567,110**	**1,843,283**	**106.9**
Total Production-related Waste Managed	**16,418,453**	**14,333,965**	**15,466,171**	**-952,282**	**-5.8**

Polychlorinated Biphenyls (PCBs)

Introduction

Polychlorinated biphenyls (CAS 1336-36-3), otherwise known as PCBs, were first created in 1881, and commercial manufacture began in 1929. PCBs were commercially produced by the chlorination of a biphenyl with anhydrous chlorine using iron filings or ferric chloride as a catalyst. Domestic production of PCBs was banned in 1976 under the Toxic Substances Control Act (TSCA). PCBs were used in a wide range of applications (electrical transformers and capacitors, hydraulic systems, heat transfer systems, and carbonless copy paper, among others), owing to a rare combination of properties, including high dielectric constant (good insulator), low flammability, high heat capacity, low chemical reactivity, long-term resistance to degradation, and low acute toxicity. PCBs are a group of 209 halogenated aromatic hydrocarbons that were commercially used and sold as a mixture of isomers. PCBs may be either oily liquids or solids, with a color ranging from colorless to light yellow (EPA EA, 1999). Of the 209 possible PCBs, only about 100 individual isomers are likely to occur at significant concentrations in commercial PCB mixtures (EPA EA, 1999).

The primary U.S. producer was Monsanto Industrial Chemicals Company, which sold PCBs under the trade names “Aroclor” and “Askarel.” Other PCB commercial trade names included Chlorextol, Dykanol, Inerteen, No-Famol, Pyranol, Kennechlor, Chlorphen, Fenclor, and Phenoclor (EPA EA, 1999). In the U.S., more than 1.25 billion pounds of PCBs were produced from 1930 to 1975.

Sources and Uses

Prior to 1976, PCBs were mostly used as a dielectric fluid in electrical equipment (e.g., transformers and capacitors). PCBs were used in high-voltage power capacitors for power factor correction in the distribution of electric power; in low-voltage power capacitors to improve the efficiency of lighting systems; and in small industrial capacitors for power factor improvement in equipment such as air conditioners, pumps, and fans. Additional PCB uses included hydraulic fluids and lubricants, plasticizers (materials incorporated into plastic to increase its workability and flexibility), heat transfer fluids (materials that absorb thermal energy from a source and deliver heat to a place of utilization), and investment castings (used as a filler for investment casting wax to decrease shrinkage of the ceramic mold). PCBs were also used as laminates in adhesive formulations involving polyurethanes and polycarbonates to prepare safety and acoustical glasses. PCBs have also been used in adhesive formulas in metals and ceramics to improve toughness and resistance to oxidative and thermal degradation during lamination. Due to PCBs’ ability to resist photochemical degradation, oxidation, and fires, they were used as textile coating mixtures for ironing board covers and waterproof canvas (EPA EA, 1999). Other PCB uses include the following: paints, varnishes, electrical coatings, insulating tapes, protective lacquers, epoxy resins, sealing and caulking solutions, pressure-sensitive record and colored copying papers, floor tiles, brake linings, petroleum additives, soil erosion retardants, insecticides, bactericides, metal quenchers, gasket sealers, synthetic rubber, automobile body sealants, asphalt, plastic decorative articles, and lubricants in natural gas pipeline compressors.

Between 1929 and 1975 (EPA EA, 1999), closed electrical systems (e.g., capacitors and transformers) accounted for approximately 77% of industrial uses. Open-ended applications (e.g., plasticizers, carbonless copy paper, petroleum additives, and others) accounted for 15% of industrial uses. Finally, nominally closed systems (e.g., heat transfer fluids, hydraulic fluids, and lubricants) accounted for an additional 8% of industrial uses (EPA EA, 1999). Recent estimates suggested that 141,000 tons (282 million pounds) of PCBs were still in service at the end of 1988, the last time a comprehensive inventory was conducted (EPA, GLNPO, October, 1998).

Chemical Characteristics

Persistence and Bioaccumulation

PCBs have persistence half-life values in soil that range from 1 to 7 years and half-life values in water that range from 56 to 98 days (EPA, PBT Chemicals Final Rule, October 1999).

PCBs have BCF values that range from 4,922 to 196,600 and BAF values of greater than 200,000. All of the PCBs, except 2,3,3',4,4',5,5' heptachlorobiphenyl (BCF 4,922) have BCF values far exceeding 5,000 (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

Even though PCBs are no longer produced in the U.S., PCBs may be released from the following sources:

- incineration of PCB-contaminated waste;
- redistribution of PCBs in soil and water to air;
- disposal sites containing transformers, capacitors, and other PCB-contaminated waste;
- the improper disposal of other PCB-contaminated materials (e.g., residues and debris from the shredding of automobiles, appliances, building demolition wastes, and fluorescent light ballasts); and
- the combustion of residual fuel oil (EPA EA, 1999).

PCBs have dispersed throughout the globe and are found in soils, surface waters, sediments, and air. PCBs primarily enter the atmosphere through emissions, but may also evaporate from soil and surface water. Once in the atmosphere, PCBs may travel long distances carried by the wind. Eventually, PCBs are returned to the earth's surface by atmospheric deposition.

Once PCBs reach the soil system, they bind strongly to particulate matter. PCBs deposited on soil and vegetation can also reach water bodies as a result of wash out by precipitation. The types of soils and land use influence the amount of leakage to freshwater. PCBs are highly persistent, although some microbial degradation may occur in soils. PCBs may be taken up from the soil and vegetation by terrestrial organisms and may bioaccumulate (ATSDR, February 2001).

PCBs enter aquatic environments primarily through atmospheric deposition. PCBs evaporate very slowly and are not very soluble in water. Therefore, PCBs tend to bind to organic particles and bottom sediments, although small amounts may remain dissolved (ATSDR, February 2001). Due to the presence of suspended particles in the water column to which PCBs have bound, the amount of PCBs in water bodies can sometimes exceed what would be expected from PCB water solubility. Water bodies act as a major transport mechanism for PCBs.

Health and Environmental Effects

The excellent properties of PCBs for industrial use also make them hazardous to environmental and human health. However, toxic effects are difficult to predict because of the complex nature of PCBs and the common mixture of other chemicals as impurities. Health effects from PCBs have been observed due to both chronic (long-term) and acute (short-term) exposure (EPA, ORD, September 1996).

Results from extensive animal studies clearly indicate the severe toxic effects of PCBs on animal health. Effects from exposure to PCBs have been observed on the immune system, reproductive system, central nervous system, and the endocrine system (EPA, OPPT, June 2001).

Both human and animal studies indicate the ability of PCBs to adversely affect the immune system. Animal studies have indicated a correlation between exposure to PCBs and decreased thymus gland size. The thymus gland produces lymphocytes, a type of blood cell, which promotes immunity and aids in immune function. In addition, an increased susceptibility to the Epstein-Barr virus was observed in animals exposed to PCBs. Similarly, a human study found a link between individuals infected with Epstein-Barr virus and PCB exposure (EPA, OPPT, June 2001).

PCBs affect the reproductive system and development of offspring. Reproductive effects, such as decreased fertility, decreased conception, and prolonged menstruation, have been observed in laboratory experiments. PCB exposure was found to reduce the birth weight, conception rates, and live birth rates of Rhesus monkeys and several other animal species. Strong similarities between human and Rhesus monkeys suggest the ability of PCBs to affect the human reproductive system. Numerous human studies have confirmed PCBs' ability to affect the human reproductive system. Most of the studies examined children of mothers who were exposed to PCBs. Correlations between the level of PCB exposure and lower birth weights and shortened gestational age in humans have been established (EPA, OPPT, June 2001). In addition, a link between human exposure to PCBs through the consumption of contaminated fish and developmental effects were observed, such as motor deficits at birth, impaired psychomotor index, impaired visual recognition, and deficits in short-term memory in infants of mothers exposed to PCBs (EPA, OPPT, June 2001).

Evidence suggests a correlation between PCB exposure and cancer. PCB exposure was linked to liver and biliary tract cancer in humans, although these studies were inconclusive due to the lack of exposure quantification (ATSDR, February 2001). Another occupational study found a correlation between PCB exposure and increased melanoma rates (EPA, ORD, September 1996). However, other studies have found no increase in cancer rates following PCB exposure. The lack of consistent findings in studies of occupational PCB exposure indicates the need for additional studies. Experiments on animals have conclusively demonstrated carcinogenic effects, however. Oral exposure studies in animals show an increase in liver tumors in laboratory animals exposed to several commercial mixtures of PCBs and to several specific congeners (EPA, ORD, September 1996). EPA has classified all PCBs as probable human carcinogens (EPA EA, 1999). Similarly, HHS and the International Agency for Research on Cancer have concluded that PCBs may reasonably be anticipated to be carcinogens (ATSDR, February 2001).

Other health effects linked to PCB exposure include thyroid hormone level disruption and other endocrine system effects, skin and eye effects, and increased blood pressure (EPA, OPPT, June 2001).

Efforts to Reduce Pollution from the Chemical

In 1976, domestic PCB production was banned under TSCA, and in 1977 EPA initiated a PCB destruction and disposal program. In 1979, further restrictions to PCB use were implemented; all non-totally enclosed PCB activity was to be authorized by EPA. Examples of EPA-authorized activities included servicing PCB transformers and PCB-contaminated transformers; use in and servicing of railroad transformers and mine equipment; use in heat transfer systems, hydraulic systems, and natural gas pipeline compressors; servicing electromagnets; small quantities for research and development; and microscopy mounting medium (EPA EA, 1999). In addition, the following uses of PCBs were eliminated: transformers at food and feed facilities in 1985; transformers of 480 volts and above in 1990; and transformers below 480 volts in 1993.

PCB waste is presently required to be disposed in TSCA-approved chemical waste landfills (EPA EA, 1999). The finalized PCB disposal rule allows bulk waste to be disposed in RCRA Subtitle C landfills if the PCB concentration is less than 500 ppm.

In the early 1980s, EPA found that some synthetic organic chemicals (i.e., dyes and pigments) inadvertently generate PCBs during manufacturing. EPA subsequently issued regulations under TSCA (40 CFR 761.3) that banned the sale of any products containing an annual average PCB concentration of 25 mg/kg or greater (50 mg/kg maximum concentration at any time). In addition, EPA required manufacturers and importers of products that inadvertently generate PCBs to report to EPA any process or import that produces or contains PCB concentrations greater than 2 mg/kg (EPA EA, 1999). PCBs were listed at a higher reporting threshold prior to the PBT chemical modifications to TRI reporting requirements.

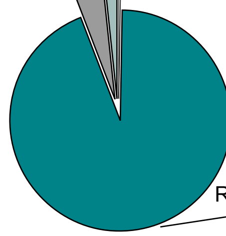
2000 TRI DATA FOR POLYCHLORINATED BIPHENYLS

On-site and Off-site Releases

As shown in Table 3-26, there were 171 TRI forms submitted for polychlorinated biphenyls for 2000. On- and off-site releases for polychlorinated biphenyls totaled 1.5 million pounds. On-site releases to land to RCRA subtitle C landfills were the largest type of release, accounting for 93.9 percent of total releases or 1.4 million pounds (see Figure 3-10). The second largest release type was other on-site land releases, which accounted for 3.9 percent or 57,544 pounds. (Types of on-site land releases are described in Box 1-4 in Chapter 1.)

Much smaller amounts of other types of releases were reported. Off-site releases (transfers to disposal) totaled 26,146 pounds; air emissions were 5,854 pounds; and releases to surface water and underground injection of polychlorinated biphenyls totaled less than 30 pounds.

Figure 3-10: Distribution of TRI On-site and Off-site Releases, 2000: Polychlorinated Biphenyls



Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Waste Management Data

Quantities of TRI Chemicals in Waste

Production-related waste of polychlorinated biphenyls totaled 13.7 million pounds in 2000, as shown in Table 3-27. Most (11.9 million pounds or 87.0 percent) of the total production-related waste was treated on-site (see Figure 3-11).

Another 10.8 percent (1.5 million pounds) was released on- and off-site site. Treatment off-site was 288,786 pounds or 2.1 percent, and other types of waste management totaled less than 15,000 pounds.

Table 3-26: TRI On-site and Off-site Releases, 2000: Polychlorinated Biphenyls

			On-site Releases							Off-site Releases	
					Underground Injection		On-site Land Releases				
CAS Number	Chemical	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1336-36-3	Polychlorinated biphenyls (PCBs)	171	5,854.15	28.82	0.60	0.00	1,371,343.20	57,544.00	1,434,770.77	26,146.07	1,460,916.85

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Table 3-27: Quantities of TRI Chemicals in Waste Managed, 2000: Polychlorinated Biphenyls

CAS Number	Chemical	Recycled On-site Pounds	Recycled Off-site Pounds	Energy Recovery On-site Pounds	Energy Recovery Off-site Pounds	Treated On-site Pounds	Treated Off-site Pounds	Quantity Released On- and Off-site Pounds	Total Production-related Waste Managed Pounds	Non-production-related Waste Managed Pounds
1336-36-3	Polychlorinated biphenyls (PCBs)	358.00	752.65	1,410.77	10,517.00	11,906,010.41	288,785.81	1,481,214.78	13,689,049.42	22,122.52

Note: Data are from Section 8 of Form R.

Transfers Off-site for Further Waste Management/Disposal

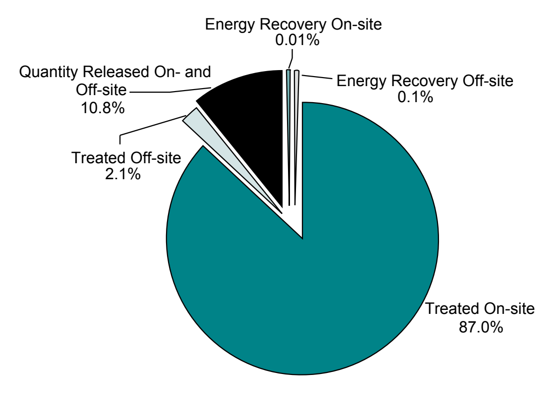
Transfers off-site for further waste management and disposal of polychlorinated biphenyls totaled 344,258 pounds in 2000 (see Table 3-28).

Transfers to treatment accounted for 82.0 percent of the transfers for further waste management and disposal of polychlorinated biphenyls in 2000 (see Figure 3-12). Transfers to treatment totaled 282,299 pounds. Other transfers to disposal were 50,352 pounds or 14.6 percent and transfers to energy recovery were 10,481 pounds or 3.0 percent of total transfers for further waste management and disposal of polychlorinated biphenyls for 2000. Other types of transfers were less than 1,200 pounds.

TRI Data by State

Facilities in Ohio submitted 12 forms, the largest number of forms in 2000 for polychlorinated biphenyls. North Carolina submitted 11 forms, had more than 10 forms, and three states submitted 9 forms: Massachusetts, New York and Texas.

Figure 3-11: Quantities of TRI Chemicals in Waste, 2000: Polychlorinated Biphenyls



Note: Data are from Section 8 of Form R.

On- and Off-site Releases

In 2000, facilities in Alabama reported the largest total on- and off-site releases of polychlorinated biphenyls (see Table 3-29). They reported a total of 530,868 pounds, or 36.3 percent of the total for 2000. New York accounted for 499,719 pounds, which was 34.2 percent of the total. The states with the third and fourth largest amounts were Oregon, which reported 120,099 pounds or 8.2 percent of the total, and Michigan, which reported 117,871 pounds or 8.1 percent of the total.

Almost all (over 99.9 percent or 530,700 pounds) of Alabama's releases of polychlorinated biphenyls were on-site land releases to RCRA subtitle C landfills. The same was true for New York and Michigan. They reported more than 99 percent of their total releases as on-site land releases to RCRA subtitle C landfills (499,300 pounds and 117,619 pounds, respectively). Most of Oregon's total releases were also on-site land releases to RCRA subtitle C landfills, with 100,046 pounds or 83.3 percent of its total releases.

Facilities in Utah had the largest amount of other on-site land releases, with 28,594 pounds representing 49.7 percent of the total other on-site land releases for polychlorinated biphenyls in 2000. Massachusetts had the largest air emissions with 3,903 pounds, which were two-thirds of all air emissions of polychlorinated biphenyls. Oregon reported the largest amount of off-site releases (transfers to disposal), with 13,971 pounds or 53.4 percent of the total off-site releases from all states.

Table 3-28: TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Polychlorinated Biphenyls

CAS Number	Chemical	Transfers to Recycling	Transfers to Energy Recovery	Transfers to Treatment	Transfers to POTWs: Metals and Metal Compounds	Transfers to POTWs: Non-metal TRI Chemicals	Other Off-site Transfers*	Other Off-site Transfers to Disposal**	Total Transfers for Further Waste Management/ Disposal
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1336-36-3	Polychlorinated biphenyls (PCBs)	901.22	10,481.15	282,299.43	0.00	224.71	0.00	50,351.99	344,258.50

Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

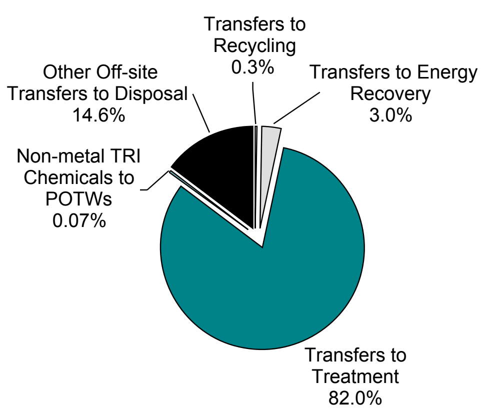
* Other Off-site Transfers are transfers reported without a valid waste management code.
** Does not include transfers to POTWs of metals and metal compounds.

As shown in Map 3-4, releases of polychlorinated biphenyls are quite concentrated geographically. Four states, Alabama, New York, Oregon and Michigan, released over 100,000 pounds. The total releases from these four states represented 86.8 percent of total releases of polychlorinated biphenyls in 2000.

Waste Management Data

Utah had the largest quantity of total production-related waste of polychlorinated biphenyls of any state in 2000 (see Table 3-29). Utah reported 9.7 million pounds of total production-related waste and accounted for 70.7 percent of the total. Texas ranked second with 2.3 million pounds (16.5 percent of the total).

Figure 3-12: Distribution of TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Polychlorinated Biphenyls



Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

Over 99 percent of production-related waste in Utah and Texas was treated on-site. The 9.6 million pounds treated on-site in Utah accounted for 80.8 percent of all on-site treatment of polychlorinated biphenyls in 2000. Texas facilities reported 2.2 million pounds treated on-site, which was 18.8 percent of the total polychlorinated biphenyls treated on-site in 2000.

New York reported the third largest total production-related waste of polychlorinated biphenyls in 2000, with 618,767 pounds. Over 80 percent of its production-related waste was released on- and off-site. The 499,689 pounds of polychlorinated biphenyls released on- and off-site in New York accounted for 33.7 percent of the total quantity released on- and off-site in 2000.

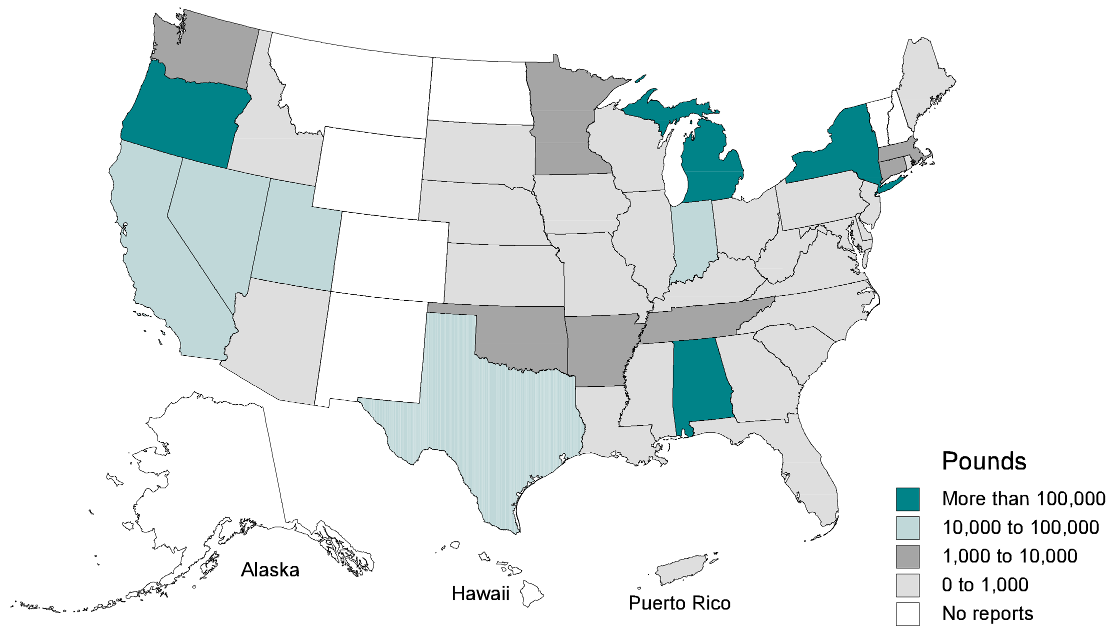
Alabama's releases on- and off-site totaled 541,325 pounds or 36.5 percent of the total quantity of polychlorinated biphenyls released on- and off-site in 2000.

TRI Data by Industry (2-digit SIC Code)

On- and Off-site Releases

The hazardous waste/solvent recovery industries reported the largest total releases of any industry sector, with 1.4 million pounds or 96.5 percent of the total releases on- and off-site of polychlorinated biphenyls in 2000 (see Table 3-30). The hazardous waste/solvent recovery industries also reported the largest amounts of on-site land releases, both releases to RCRA subtitle C landfills and other on-site land releases, with 1.37 million pounds to

Map 3-4: Total On- and Off-site Releases, 2000: Polychlorinated Biphenyls



RCRA subtitle C landfills and 34,708 pounds of other on-site land releases.

The industrial machinery industry had the second largest total releases, with 17,707 pounds of total releases, all of which were releases to other on-site land releases (that is, other than RCRA subtitle C landfills). The industrial machinery industry's other on-site land releases accounted for 30.8 percent of the total of such releases of polychlorinated biphenyls in 2000.

The plastics industry reported the third largest total releases and the largest off-site releases (transfers to disposal), with 13,971 pounds of total releases, all of which were as off-site release. The food industry reported the largest air emissions, with 3,406 pounds of total releases, all of which were as air emissions.

Waste Management

The hazardous waste/solvent recovery industries reported the largest amount of total production-related waste of polychlorinated biphenyls in 2000 (see Table 3-30). With 13.5 million pounds of production-related waste, the hazardous waste/solvent recovery industries accounted for 98.9 percent of all production-related waste of polychlorinated biphenyls. Almost 11.9 million pounds of polychlorinated biphenyls were treated on-site by the hazardous waste/solvent recovery industries. The 11.9 million pounds represented 87.8 percent of these industries' total production-related waste. The hazardous waste/solvent recovery industries also released on- and off-site 1.4 million pounds, which was 10.6 percent of its total production-related waste.

The chemical manufacturing industry reported the second largest amount of total production-related waste of polychlorinated biphenyls, with a total of 67,025 pounds. This was less than one percent of total production-related waste of polychlorinated biphenyls in 2000. About half (52.7 percent or 35,332 pounds) of the chemical industry's total production-related waste was treated off-site, about one-third (31.6 percent or 21,171 pounds) was treated on-site and 15.6 percent or 10,446 pounds were

Table 3-29: Summary of TRI Information by State, 2000: Polychlorinated Biphenyls

		On-site Releases							Off-site Releases	
				Underground Injection		On-site Land Releases				
State	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
	Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Alabama	5	167.62	0.00	0.00	0.00	530,700.00	0.00	530,867.62	0.00	530,867.62
Arizona	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Arkansas	3	0.00	0.00	0.00	0.00	0.00	3,168.00	3,168.00	0.00	3,168.00
California	7	0.57	0.00	0.00	0.00	27,912.00	3.00	27,915.57	76.00	27,991.57
Connecticut	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2,700.00	2,700.00
Delaware	2	0.00	0.20	0.00	0.00	0.00	0.00	0.20	188.30	188.50
District of Columbia	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Florida	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11	1.11
Georgia	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Idaho	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Illinois	5	276.00	0.00	0.00	0.00	0.00	0.00	276.00	0.00	276.00
Indiana	4	11.70	0.00	0.00	0.00	0.00	17,707.00	17,718.70	0.00	17,718.70
Iowa	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	412.00	412.00
Kansas	4	96.37	0.52	0.00	0.00	0.00	0.00	96.89	77.49	174.38
Kentucky	4	18.37	0.00	0.00	0.00	0.00	0.00	18.37	0.36	18.73
Louisiana	4	0.00	0.00	0.00	0.00	8.00	0.00	8.00	820.00	828.00
Maine	4	31.30	0.00	0.00	0.00	0.00	0.00	31.30	0.00	31.30
Maryland	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	275.00	275.00
Massachusetts	9	3,903.00	0.00	0.00	0.00	0.00	0.00	3,903.00	0.00	3,903.00
Michigan	5	55.00	0.00	0.00	0.00	117,619.00	0.00	117,674.00	197.00	117,871.00
Minnesota	3	78.15	0.00	0.00	0.00	0.00	0.00	78.15	1,454.00	1,532.15
Mississippi	1	0.00	0.00	0.00	0.00	0.00	175.40	175.40	0.00	175.40
Missouri	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nebraska	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nevada	1	0.00	0.00	0.00	0.00	66,420.00	0.00	66,420.00	0.00	66,420.00
New Jersey	5	0.49	2.63	0.00	0.00	15.00	0.00	18.12	9.10	27.22
New York	9	330.50	1.03	0.00	0.00	499,300.00	0.00	499,631.53	87.90	499,719.43
North Carolina	11	731.00	0.00	0.00	0.00	0.00	0.00	731.00	0.00	731.00
Ohio	12	0.00	0.00	0.00	0.00	0.00	17.30	17.30	130.00	147.30
Oklahoma	1	2.00	0.00	0.00	0.00	6,090.00	0.00	6,092.00	0.00	6,092.00
Oregon	3	0.00	0.00	0.00	0.00	100,046.20	6,082.30	106,128.50	13,970.57	120,099.07
Pennsylvania	6	107.45	0.00	0.00	0.00	33.00	28.00	168.45	162.33	330.78
Puerto Rico	2	16.60	0.00	0.00	0.00	0.00	0.00	16.60	0.00	16.60
Rhode Island	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.79	1.79
South Carolina	4	23.01	0.00	0.00	0.00	0.00	0.00	23.01	0.00	23.01
South Dakota	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tennessee	8	0.00	1.00	0.00	0.00	0.00	1,769.00	1,770.00	2,468.72	4,238.72
Texas	9	0.03	23.44	0.60	0.00	19,940.00	0.00	19,964.07	49.00	20,013.07
Utah	3	5.00	0.00	0.00	0.00	322.00	28,594.00	28,921.00	0.00	28,921.00
Virginia	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Washington	3	0.00	0.00	0.00	0.00	2,938.00	0.00	2,938.00	2,999.00	5,937.00
West Virginia	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wisconsin	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.40	66.40
Total	**171**	**5,854.15**	**28.82**	**0.60**	**0.00**	**1,371,343.20**	**57,544.00**	**1,434,770.77**	**26,146.07**	**1,460,916.85**

Note: On-site Releases are from Section 5 of Form R. Off-site Releases are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

released on- and off-site.

The industrial machinery industry reported the third largest amount of total production-related waste of polychlorinated biphenyls in 2000, with a total of 44,064 pounds, with 26,357 pounds (59.8 percent of its production-related waste) treated off-site and 17,707 pounds (40.2 percent) released on- and off-site.

Projected Quantities of TRI Chemicals Managed in Waste, 2000-2002

TRI facilities expected to decrease their production-related waste of polychlorinated biphenyls between 2000 and 2002 by 0.7 percent, from 13.7 million pounds to 13.6 million pounds (see Table 3-31). The decrease was projected to occur in the amount treated off-site, which was expected to decrease by 15.6

Table 3-29: Summary of TRI Information by State, 2000: Polychlorinated Biphenyls (continued)

State	Recycled		Energy Recovery		Treated		Quantity Released On- and Off-site	Total Production-related Waste Managed	Non-production-related Waste Managed
	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	Pounds	Pounds	Pounds
Alabama	0.00	0.00	0.00	0.00	48.10	10,312.00	541,325.10	551,685.20	0.00
Arizona	0.00	0.00	0.00	20.00	0.00	12,024.00	0.00	12,044.00	0.00
Arkansas	0.00	0.00	0.00	10,477.00	1,334.00	6,422.50	0.00	18,233.50	3,168.00
California	358.00	17.35	0.00	3.00	0.00	2,472.47	36,074.67	38,925.49	0.00
Connecticut	0.00	141.00	0.00	0.00	22.58	3,150.00	0.00	3,313.58	0.00
Delaware	0.00	0.00	0.00	0.00	0.00	1,200.00	188.50	1,388.50	0.00
District of Columbia	0.00	0.00	0.00	0.00	0.00	66.00	66.00	132.00	0.00
Florida	0.00	0.10	0.57	0.00	0.00	0.00	0.00	0.67	1.11
Georgia	0.00	0.00	0.00	0.00	27.00	9,511.00	9,511.00	19,049.00	0.00
Idaho	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Illinois	0.00	0.00	0.00	0.00	164.00	692.00	276.81	1,132.81	0.00
Indiana	0.00	0.00	0.00	0.00	155.40	17,707.10	17,853.70	35,716.20	17,707.00
Iowa	0.00	23.20	0.00	0.00	15.00	0.00	412.00	450.20	278.00
Kansas	0.00	20.00	0.00	0.00	26,261.00	55,813.29	97.04	82,191.33	0.00
Kentucky	0.00	0.00	0.00	0.00	286.00	24.00	18.71	328.71	0.00
Louisiana	0.00	0.00	0.00	0.00	6,917.00	255.54	828.00	8,000.54	0.00
Maine	0.00	0.00	0.00	0.00	0.00	0.00	38.30	38.30	0.00
Maryland	0.00	0.00	0.00	0.00	64.00	275.00	0.00	339.00	0.00
Massachusetts	0.00	0.00	0.00	0.00	0.00	0.00	3,903.00	3,903.00	0.00
Michigan	0.00	0.00	0.00	0.00	113.00	1,810.01	117,871.20	119,794.21	0.00
Minnesota	0.00	0.00	0.00	0.00	0.00	65.00	1,537.45	1,602.45	0.00
Mississippi	0.00	0.00	0.00	0.00	0.00	0.00	175.40	175.40	0.00
Missouri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nebraska	0.00	0.00	0.00	0.00	51.00	0.00	0.00	51.00	0.00
Nevada	0.00	493.00	0.00	0.00	0.00	311.00	66,419.00	67,223.00	0.00
New Jersey	0.00	0.00	0.00	0.00	70.00	14.00	41.10	125.10	0.00
New York	0.00	0.00	0.00	0.00	0.00	119,077.20	499,689.40	618,766.60	916.80
North Carolina	0.00	0.00	50.00	0.00	0.00	281.50	731.00	1,062.50	0.00
Ohio	0.00	0.00	0.00	0.00	653.00	2,084.00	147.70	2,884.70	0.00
Oklahoma	0.00	0.00	0.00	0.00	0.00	0.00	6,091.00	6,091.00	0.00
Oregon	0.00	0.00	0.00	0.00	0.00	6,047.00	106,124.00	112,171.00	0.00
Pennsylvania	0.00	0.00	1,333.00	0.00	279.00	4.00	301.70	1,917.70	0.00
Puerto Rico	0.00	0.00	0.00	17.00	0.00	0.00	16.60	33.60	0.00
Rhode Island	0.00	0.00	0.00	0.00	0.00	0.00	1.79	1.79	0.00
South Carolina	0.00	0.00	1.20	0.00	0.00	8,200.00	23.01	8,224.21	0.00
South Dakota	0.00	0.00	0.00	0.00	34.00	0.00	0.00	34.00	0.00
Tennessee	0.00	0.00	0.00	0.00	9,873.53	22,796.00	4,204.71	36,874.24	51.61
Texas	0.00	58.00	0.00	0.00	2,238,820.70	218.70	20,328.00	2,259,425.40	0.00
Utah	0.00	0.00	0.00	0.00	9,617,871.00	7,316.00	46,778.00	9,671,965.00	0.00
Virginia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Washington	0.00	0.00	0.00	0.00	2,938.00	0.00	61.00	2,999.00	0.00
West Virginia	0.00	0.00	0.00	0.00	0.00	613.00	0.00	613.00	0.00
Wisconsin	0.00	0.00	26.00	0.00	13.10	23.50	79.90	142.50	0.00
Total	**358.00**	**752.65**	**1,410.77**	**10,517.00**	**11,906,010.41**	**288,785.81**	**1,481,214.78**	**13,689,049.42**	**22,122.52**

Note: Data are from Section 8 of Form R.

percent. The quantity released on- and off-site was projected to decrease by 3.3 percent. On- and off-site releases are the least-desirable outcome under the waste management hierarchy described in **Waste Management** in Chapter 1 (Figure 1-2). The amount treated on-site, the largest component of total production-related waste, was projected to stay about the same.

The projected decrease of 0.7 percent was expected to occur primarily from 2000 to 2001, with a small decrease of 0.1 percent projected to take place from 2001 to 2002.

Source Reduction

In 2000, 8 forms were filed reporting source reduction activities for polychlorinated biphenyls (see Table 3-32). As noted in **Waste Management** in

Table 3-30: Summary of TRI Information by Industry, 2000: Polychlorinated Biphenyls

			On-site Releases							Off-site Releases	
					Underground Injection		On-site Land Releases				
SIC Code	Industry	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
20	Food	9	3,406.45	0.00	0.00	0.00	0.00	0.00	3,406.45	0.00	3,406.45
22	Textiles	6	1,281.00	0.00	0.00	0.00	0.00	0.00	1,281.00	0.00	1,281.00
24	Lumber	1	0.00	0.00	0.00	0.00	0.00	3,168.00	3,168.00	0.00	3,168.00
26	Paper	23	31.30	0.00	0.00	0.00	0.00	0.00	31.30	216.50	247.80
28	Chemicals	35	18.04	25.20	0.00	0.00	15.00	322.40	380.64	515.11	895.75
29	Petroleum	5	0.01	0.02	0.00	0.00	0.00	0.00	0.03	0.00	0.03
30	Plastics	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13,970.57	13,970.57
32	Stone/Clay/Glass	2	0.00	0.00	0.00	0.00	0.00	23.00	23.00	1.33	24.33
33	Primary Metals	20	100.99	0.03	0.00	0.00	0.00	1,616.00	1,717.02	2,780.90	4,497.92
34	Fabricated Metals	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	Machinery	3	0.00	0.00	0.00	0.00	0.00	17,707.00	17,707.00	0.00	17,707.00
36	Electrical Equip.	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	32.00
37	Transportation Equip.	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	Measure/Photo.	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2,700.00	2,700.00
39	Miscellaneous	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Multiple codes 20-39	6	0.00	1.00	0.00	0.00	0.00	0.00	1.00	2,445.61	2,446.61
	No codes 20-39	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Subtotal Original Industries	**123**	**4,837.79**	**26.25**	**0.00**	**0.00**	**15.00**	**22,836.40**	**27,715.44**	**22,662.02**	**50,377.46**
12	Coal Mining	1	0.00	0.00	0.00	0.00	0.00	17.30	17.30	0.00	17.30
491/493	Electric Utilities	20	689.01	0.00	0.00	0.00	0.00	0.00	689.01	33.11	722.12
4953/7389	Hazardous Waste/Solvent Recovery	27	327.36	2.57	0.60	0.00	1,371,328.20	34,690.30	1,406,349.03	3,450.94	1,409,799.97
	Subtotal for New Industries	**48**	**1,016.37**	**2.57**	**0.60**	**0.00**	**1,371,328.20**	**34,707.60**	**1,407,055.34**	**3,484.05**	**1,410,539.38**
	Total	**171**	**5,854.15**	**28.82**	**0.60**	**0.00**	**1,371,343.20**	**57,544.00**	**1,434,770.77**	**26,146.07**	**1,460,916.85**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Chapter 1, source reduction—an activity that prevents the generation of waste—is the preferred waste management option. These 8 forms represented 4.7 percent of all forms submitted for polychlorinated biphenyls in 2000.

The most frequently reported source reduction activity was inventory control (listed on 3 forms). Other source reduction activities cited were good operating practices, spill and leak prevention and raw materials modifications, with 2 forms each.

Table 3-31: Current Year and Projected Quantities of TRI Chemicals in Waste, 2000: Polychlorinated Biphenyls

Waste Management Activity	Current Year 2000		Projected 2001		Projected 2002	
	Total Pounds	Percent of Total	Total Pounds	Percent of Total	Total Pounds	Percent of Total
Recycled On-site	358.00	0.0	370.00	0.0	380.00	0.0
Recycled Off-site	752.65	0.0	605.50	0.0	608.05	0.0
Energy Recovery On-site	1,410.77	0.0	1,478.10	0.0	1,548.10	0.0
Energy Recovery Off-site	10,517.00	0.1	10,447.00	0.1	10,447.00	0.1
Treated On-site	11,906,010.41	87.0	11,901,998.08	87.5	11,902,075.08	87.6
Treated Off-site	288,785.81	2.1	247,007.16	1.8	243,620.42	1.8
Quantity Released On- and Off-site	1,481,214.78	10.8	1,437,554.30	10.6	1,432,621.20	10.5
Total Production-related Waste Managed	**13,689,049.42**	**100.0**	**13,599,460.14**	**100.0**	**13,591,299.85**	**100.0**
Waste Management Activity	**Projected Change 2000-2001**		**Projected Change 2001-2002**		**Projected Change 2000-2002**	
	Percent		Percent		Percent	
Recycled On-site	3.4		2.7		6.1	
Recycled Off-site	-19.6		0.4		-19.2	
Energy Recovery On-site	4.8		4.7		9.7	
Energy Recovery Off-site	-0.7		0.0		-0.7	
Treated On-site	0.0		0.0		0.0	
Treated Off-site	-14.5		-1.4		-15.6	
Quantity Released On- and Off-site	-2.9		-0.3		-3.3	
Total Production-related Waste Managed	**-0.7**		**-0.1**		**-0.7**	

Note: Current year and projected amounts are from Section 8 of Form R for 2000.

Table 3-30: Summary of TRI Information by Industry, 2000: Polychlorinated Biphenyls (continued)

		Recycled		Energy Recovery		Treated				
SIC Code	Industry	On-site	Off-site	On-site	Off-site	On-site	Off-site	Quantity Released On- and Off-site	Total Production-related Waste Managed	Non-production-related Waste Managed
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
20	Food	0.00	0.00	0.00	0.00	0.00	0.00	3,406.85	3,406.85	0.00
22	Textiles	0.00	0.00	0.00	0.00	0.00	0.00	1,281.00	1,281.00	0.00
24	Lumber	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,168.00
26	Paper	0.00	0.00	26.00	0.00	0.00	80.70	256.50	363.20	0.00
28	Chemicals	0.00	58.00	0.00	17.00	21,171.28	35,332.34	10,446.30	67,024.92	1.00
29	Petroleum	358.00	0.00	0.00	0.00	21.00	68.20	0.03	447.23	0.00
30	Plastics	0.00	0.00	0.00	0.00	0.00	0.00	30.80	30.80	0.00
32	Stone/Clay/Glass	0.00	0.00	1,333.00	0.00	0.00	4.00	24.30	1,361.30	0.00
33	Primary Metals	0.00	141.00	0.00	0.00	266.10	3,944.00	12,794.98	17,146.08	278.00
34	Fabricated Metals	0.00	0.00	0.00	0.00	0.00	16.00	0.00	16.00	0.00
35	Machinery	0.00	0.00	0.00	0.00	0.00	26,357.00	17,707.00	44,064.00	17,707.00
36	Electrical Equip.	0.00	20.00	0.00	20.00	0.00	12,148.00	0.00	12,188.00	0.00
37	Transportation Equip.	0.00	0.00	0.00	0.00	0.00	240.00	0.00	240.00	0.00
38	Measure/Photo.	0.00	0.00	0.00	0.00	0.00	2,700.00	0.00	2,700.00	0.00
39	Miscellaneous	0.00	23.20	0.00	0.00	0.00	0.00	0.00	23.20	0.00
	Multiple codes 20-39	0.00	0.00	0.00	0.00	5.03	196.00	2,671.00	2,872.03	51.61
	No codes 20-39	0.00	0.00	0.00	0.00	0.00	289.65	0.15	289.80	916.80
	Subtotal Original Industries	**358.00**	**242.20**	**1,359.00**	**37.00**	**21,463.41**	**81,375.89**	**48,618.91**	**153,454.41**	**22,122.41**
12	Coal Mining	0.00	0.00	0.00	0.00	0.00	0.00	17.30	17.30	0.00
491/493	Electric Utilities	0.00	0.10	51.77	0.00	116.00	66.00	788.01	1,021.88	0.11
4953/7389	Hazardous Waste/Solvent Recovery	0.00	510.35	0.00	10,480.00	11,884,431.00	207,343.92	1,431,790.57	13,534,555.84	0.00
	Subtotal New Industries	**0.00**	**510.45**	**51.77**	**10,480.00**	**11,884,547.00**	**207,409.92**	**1,432,595.88**	**13,535,595.02**	**0.11**
	Total	**358.00**	**752.65**	**1,410.77**	**10,517.00**	**11,906,010.41**	**288,785.81**	**1,481,214.78**	**13,689,049.42**	**22,122.52**

Note: Data are from Section 8 of Form R.

Table 3-32: Number of Forms Reporting Source Reduction Activity, 2000: Polychlorinated Biphenyls

			Forms Reporting Source Reduction Activity		Category of Source Reduction Activity							
CAS Number	Chemical	Total Form Rs		Percent of All Form Rs	Good Operating Practices	Inventory Control	Spill and Leak Prevention	Raw Materials Modifi- cations	Process Modifi- cations	Cleaning and Degreasing	Surface Preparation and Finishing	Product Modifi- cations
		Number	Number	Percent	Number	Number	Number	Number	Number	Number	Number	Number
1336-36-3	Polychlorinated biphenyls (PCBs)	171	8	4.7	2	3	2	2	0	0	0	0

Note: All source reduction activities on a form are counted in the corresponding category. Totals do not equal the sum of the categories because forms may report more than one source reduction activity.

TRI Data for Polychlorinated Biphenyls Before 2000

Reporting for polychlorinated biphenyls before 2000 was based on the higher TRI thresholds of 25,000 pounds for manufacture or processing of the chemical and 10,000 pounds for otherwise using the chemical (see Box 3-6). For the reporting year 2000, these thresholds were reduced to 10 pounds for manufacture, processing or otherwise using polychlorinated biphenyls. Lowering the threshold, in effect, adds reports by those facilities whose activities were below the higher threshold. Consequently, the amounts for 2000 are not comparable with those for prior years. Box 3-6 has TRI data reported for polychlorinated biphenyls before 2000.

Box 3-6 has TRI data reported for polychlorinated biphenyls before 2000.

Box 3-6: TRI Data for Polychlorinated Biphenyls Before 2000

Following is a brief summary of releases and transfers and total production-related waste for polychlorinated biphenyls for 1998 and 1999. This table includes reporting by both original and new industries.

TRI Data for Polychlorinated Biphenyls, 1998-1999

	1998	1999	Change 1998-1999	
	Number	Number	Number	Percent
Forms	21	23	2	9.5
	Pounds	Pounds	Pounds	Percent
On-site Releases	3,742,838	10,165,009	6,422,171	171.6
Off-site Releases (Transfers to Disposal)	4,327	1,641	-2,686	-62.1
Total On- and Off-site Releases	**3,747,165**	**10,166,650**	**6,419,485**	**171.3**
Total Production-related Waste Managed	**12,903,465**	**19,444,912**	**6,541,447**	**50.7**

Polychlorinated biphenyls have been on the TRI chemical list since the beginning of TRI. The following is a summary of releases and transfers for 1988-1999. This table does not include reporting by new industries for 1998 and 1999 since new industries did not report to TRI before 1998.

TRI Data for Polychlorinated Biphenyls, 1988-1999

	1988	1995	1998	1999	Change 1988-1999	
	Number	Number	Number	Number	Number	Percent
Forms	120	9	7	8	-112	-93.3
	Pounds	Pounds	Pounds	Pounds	Pounds	Percent
On-site Releases	768	0	134,160	0	-768	-100.0
Off-site Releases (Transfers to Disposal)	410,996	34,432	1,203	11,406	-399,590	-97.2
Total On- and Off-site Releases	**411,764**	**34,432**	**135,363**	**11,406**	**-400,358**	**-97.2**

Pesticides

This section contains a discussion of the pesticides that have been classified as PBT chemicals: aldrin, chlordane, heptachlor, isodrin, methoxychlor, pendimethalin, toxaphene, and trifluralin.

ALDRIN

Introduction

Aldrin (CAS 309-00-2) is an organochlorine compound first introduced to the U.S. in 1950 as a cotton pesticide. Pure aldrin is a white powder with a mild chemical odor. The less pure commercial powders have a tan color (ASTDR, April 1993). Aldrin does not occur naturally in the environment. It was used as an insecticide from the 1950s to early 1970s on cotton and corn crops. In 1974, all uses except termite control were canceled under FIFRA, and production in the United States ceased. Aldrin has not been imported since 1985 due to health concerns and insect resistance (EPA EA, 1999).

Sources and Uses

Aldrin is created by condensing hexachlorocyclopentadiene (produced by the reaction of n-pentane and chlorine) with bicycloheptadiene (EPA EA, 1999). Aldrin was used as a soil insecticide to control root worms, beetles, and other crop pests, and as a treatment for timber, plastic and rubber coverings to control termites and other pests. Aldrin use peaked in 1966 at 19 millions pounds but had dropped to 10.5 million pounds by 1970. Because aldrin is not currently produced or imported into the U.S., its use is believed to be minimal.

Chemical Characteristics

Persistence and Bioaccumulation

Aldrin has persistence half-life values in soil of 291 days to 9 years, a persistence half-life value in water of 24 days, and persistence half-life values in air of 1 to 10 hours (EPA, PBT Chemicals Final Rule, October 1999).

Aldrin has a BCF value of 3,715 (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

In the past, aldrin entered the environment through pesticide application. Aldrin may also enter the environment from accidental spills or leaks from storage containers at waste sites. Once in the environment, aldrin breaks down to dieldrin, another insecticide with a similar structure. Aldrin may be converted to dieldrin by bacteria or sunlight (Spectrum Laboratories, Internet site, accessed December 2001). Aldrin is no longer produced or used in the U.S., and any past releases have likely been converted to dieldrin. Dieldrin is extremely persistent.

In the atmosphere, dieldrin binds to dust and may travel significant distances before being deposited back to the earth's surface. In the soil, aldrin and dieldrin bind strongly to particulate matter. Some aldrin and dieldrin evaporate from the soil surface and enter the atmosphere. Plants take up aldrin and dieldrin from the soil. Terrestrial organisms bioaccumulate these substances. If aldrin is ingested, it is quickly broken down to dieldrin. In aquatic environments, evaporation is significant. Dieldrin binds to bottom sediments and particulate matter in the water column. Aquatic organisms also significantly bioaccumulate aldrin and dieldrin (ATSDR, April 1993).

Health and Environmental Effects

Information on the heath effects of aldrin and dieldrin in humans is available from case reports of accidental or intentional poisonings and from studies of workers who were exposed to these chemicals either while manufacturing or applying them. The most commonly known and best documented effect of acute high-level exposure to aldrin or dieldrin is central nervous system excitation culminating in convulsions.

Aldrin and dieldrin mainly affect the central nervous system. Exposure to high levels of aldrin and dieldrin may result in convulsions and/or death (ATSDR, April 1993). Long-term exposure to moderate levels of aldrin or dieldrin may also cause convulsions, primarily because these substances bioaccumulate. Workers occupationally exposed to aldrin and dieldrin experienced health effects including nervous system effects, convulsions, headaches, dizziness, vomiting, irritability, and uncontrolled muscle movements (ATSDR, April 1993).

A few case reports have associated oral exposure to aldrin or dieldrin with liver and kidney toxicity and hemolytic anemia, but these effects were not observed in larger occupational studies, suggesting that these are likely to be rare. Animal studies have focused on oral exposure of aldrin or dieldrin. As with humans, these studies have shown that exposure to aldrin or dieldrin causes effects to the central nervous system, but these studies also exhibited additional effects, including liver and kidney toxicity, immunosuppression, fetal toxicity and increased postnatal mortality, neuro-developmental effects, and decreased reproductive function. Laboratory studies also indicate that aldrin and dieldrin may reduce the body's ability to resist infection (ATSDR, April 1993).

Occupational studies generally found no increase in cancer or deaths due to cancer resulting from aldrin and dieldrin exposure. EPA recognizes aldrin as a probable human carcinogen (ATSDR, April 1993). Although there is no conclusive evidence linking these compounds to cancer in humans, mice given large amounts did develop liver cancers (ASTSDR, September 2000).

Efforts to Reduce Pollution from the Chemical

In 1970, the U.S. Department of Agriculture (USDA) canceled all uses of aldrin based on the concern that this chemical could cause severe aquatic environmental change and is potentially carcinogenic. Early in 1971, EPA initiated cancellation proceedings for aldrin but did not order the suspension of aldrin use. In 1972, under the authority of FIFRA as amended by the Federal Pesticide Control Act of 1972, an EPA order lifted the cancellation of aldrin use in three cases: subsurface ground insertion for termite control; dipping of nonfood plant roots and tops; and moth-proofing in manufacturing processes using completely closed systems. In 1974, the registrant, Shell Chemical Company, voluntarily abandoned the latter two registered uses. Also in 1974, EPA issued a final decision canceling all uses of aldrin except those exempted in 1972. EPA was petitioned in 1987 to ban aldrin, and the final registered use of aldrin was voluntarily cancelled by Shell in 1987 (EPA EA, 1999). EPA defines aldrin and dieldrin as hazardous solid waste. Aldrin was listed in TRI at a higher reporting threshold prior to the PBT chemical modifications to TRI reporting requirements.

EPA has set allowable amounts of aldrin and dieldrin that can be present in water and seafood (ATSDR, April 1993). The FDA regulates the residues of aldrin and dieldrin and has set allowable levels in raw foods. In addition to regulatory controls, a number of states and local governments sponsor programs to encourage the proper disposal of banned and/or restricted pesticides, including aldrin.

CHLORDANE

Introduction

Chlordane (CAS 57-74-9) is a organochlorine compound used as a general pesticide. Pure chlordane is a white crystalline solid with a mild, pungent odor (EPA EA, 1999). It was first marketed in 1948 in a variety of formulations. Concern over the health effects and particularly the carcinogenicity of chlordane lead to an eventual ban on all domestic uses of chlordane in 1988.

Sources and Uses

Chlordane is produced by chlorinating cyclopentadiene to form hexachlorocyclopentadiene and condensing the latter cyclopentadiene to form chlordene. The addition of chlorine to a chlordene intermediate yields chlordane and heptachlor (EPA EA, 1999). Technical grade chlordane contains a maximum of 7% heptachlor as well as a mixture of at least 140 related chemicals.

Chlordane was once widely used as an insecticide on corn, citrus, and home gardens and as a fumigant in termite and carpenter ant control. In 1978, a cancellation notice was issued that banned all uses of chlordane except for root dipping of non-food plants and underground treatment against termites. The minor use allowance of chlordane treatment on non-food plants was canceled in 1983, and the subterranean use of chlordane for termite control was banned in 1988.

Chemical Characteristics

Persistence and Bioaccumulation

Chlordane has persistence half-life values in soil of 0.4 to 8 years, a persistence half-life value in water of 239 days, and persistence half-life value in air of 12 hours to 5 days (EPA, PBT Chemicals Final Rule, October 1999).

Chlordane has a BCF value of 11,050 and BAF values of greater than 6,000,000 (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

Chlordane has been released to the environment primarily from its application as a pesticide, but it may also enter the environment at waste disposal sites (Spectrum Laboratories, December 2001). Chlordane persists in the environment for many years and is still found in air, water, and soil.

If released to the atmosphere, chlordane exists primarily as a vapor. It breaks down by reacting with light and with various chemicals in the atmosphere. However, its persistence in the atmosphere is long enough to allow it to travel significant distances before it is deposited on land or water (Spectrum Laboratories, December 2001).

In soil, it binds to particulate matter and is unlikely to enter groundwater. It is very persistent and may remain in the soil for over 20 years (ATSDR, September 1995). Chlordane is lost from soil by evaporation. In water, chlordane binds strongly to sediment and particulate matter in the water column. Some chlordane is lost from the water column by evaporation (Spectrum Laboratories, December 2001). It is extremely persistent in aquatic environments, and bioaccumulates in both aquatic and terrestrial organisms.

Health and Environmental Effects

Chlordane is an insecticide that was used to treat field crops and as a soil treatment to kill termites. Chlordane is of high concern because it causes adverse effects to human health and has been found in breast milk and adipose tissue and is persistent in all environmental media. Chlordane persists in soil which may lead to dermal exposure to humans or oral exposure from eating foods from contaminated soils. Human exposure has occurred from ingesting contaminated drinking water or fish from contaminated waters. Inhalation exposure to chlordane has occurred in areas (e.g., homes) treated with chlordane. Acute exposure to chlordane in humans causes gastrointestinal upset and neurological effects such as tremors and convulsions. In extreme cases chlordane exposure has caused death preceded by convulsions. In animal studies, neurological effects have consistently been recorded confirming chlordane as a neurotoxicant. Animal studies showed increased mortality rates of offspring that received substantial amounts of chlordane residues from their mothers' milk. (ATSDR, May 1994).

Human studies of accidental exposure and animal studies conducted under laboratory conditions indicate the high degree of chlordane's toxicity. Chlordane exposure has been linked to health effects on the nervous system, digestive system, and liver. Effects have included headaches, irritation, confusion, weakness, vision problems, upset stomach, vomiting, stomach cramps, diarrhea, and jaundice. Exposure may also induce convulsions and death (ATSDR, September 1995). An occupational study in Japan found minor changes in liver function in workers who used chlordane as a pesticide. Data is insufficient to determine chlordane's carcinogenicity for humans. However, laboratory experiments have demonstrated a link between long-term exposure to low levels of chlordane and increased cancer rates in mice.

Efforts to Reduce Pollution from the Chemical

As described above, EPA banned all uses of chlordane because of concerns about chlordane's effects on human and environmental health. Chlordane was listed in TRI at a higher reporting threshold prior to the PBT chemical modifications to TRI reporting requirements. Other programs such as the Great Lakes Binational Toxics Strategy (BNTS) have been implemented to eliminate and reduce use of 37 chemicals, including chlordane (Council of Great Lakes Industries, December 2001). Also, a number of states and local governments sponsor programs to encourage the proper disposal of banned and/or restricted pesticides, including chlordane.

HEPTACHLOR

Introduction

Heptachlor (CAS 76-44-8) is an organochlorine insecticide, which was first isolated from technical chlordane in 1946. Technical heptachlor is a mixture of pure heptachlor and many related chemicals. Heptachlor does not occur naturally in the environment. It is a white powder that smells like mothballs.

Sources and Uses

Heptachlor is produced by the chlorination of chlordane. Technical heptachlor contains 20 percent chlordane. Heptachlor was first registered in the U.S. in 1952 for use as a general insecticide on a wide range of agricultural crops. Heptachlor was also used for home and garden insect control, for termite control, and as a seed treatment (EPA EA, 1999). In 1974, EPA issued a Notice of Intent to Cancel all registered uses of heptachlor except those for subterranean termite control and dipping of non-food plants. In March 1978, most other uses of heptachlor were canceled. Its use is now severely restricted and is presently only used in the U.S. to control fire ants in buried, pad-mounted electric power transformers and in underground cable television and telephone cable boxes (EPA EA, 1999).

Chemical Characteristics

Persistence and Bioaccumulation

Heptachlor has persistence half-life values in soil of 8 days to 4 years, persistence half-life values in water of 23.1 to 129.4 hours, and persistence half-life values in air of 1 to 10.5 hours (EPA, PBT Chemicals Final Rule, October 1999).

Heptachlor has a BCF value of 19,953 (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

Heptachlor is released to the environment from its use in the control of fire ants in power transformers and was also released during previous pesticide use. Heptachlor also enters the environment from waste disposal sites. When heptachlor enters the environment, it is changed by bacteria into a more toxic substance, heptachlor epoxide, and into other less toxic substances. In the atmosphere, both heptachlor and heptachlor epoxide can travel significant distances in the wind and may then be deposited to land and water. In the soil system, heptachlor binds strongly to soil particles and evaporates slowly into the atmosphere. It is very persistent. Heptachlor may be taken up by plants, and bioaccumulates in terrestrial organisms, which also convert heptachlor to heptachlor epoxide in their bodies (ATSDR, April 1993). In aquatic environments, heptachlor binds to particulate matter. Heptachlor has a low water solubility, while heptachlor epoxide dissolves more easily in water. Heptachlor is also very persistent in aquatic environments. Heptachlor bioaccumulates in aquatic organisms; they also convert heptachlor to heptachlor epoxide in their bodies (ATSDR, April 1993).

Health and Environmental Effects

Exposure to heptachlor and heptachlor epoxide occurs mostly from eating contaminated foods and milk, or through skin contact with contaminated soils. At high levels, heptachlor can cause damage to the nervous system. Heptachlor has been found in at least 129 of 1,300 National Priorities List sites identified by EPA (ATSDR, April 1993).

Heptachlor and heptachlor epoxide are toxic to humans and animals. There are some human data on brief exposures to high levels of heptachlor. People who accidentally swallowed pesticides containing heptachlor, or who spilled pesticides on their clothes, were reported to have become dizzy, confused, or have convulsions (ATSDR, April 1993).

Heptachlor can be absorbed through the skin, lungs, and gastrointestinal tract. A majority of the health effects of this pesticide comes from studies on rodents. Some of the observed effects were aggravated central nervous system, disrupted nerve transmission and enzyme production, infertility and/or abnormal offspring development, decreased postnatal survival, and liver damage (EXTOXNET, September 1993 and ATSDR, April 1993).

These studies showed that the consumption of very high levels of heptachlor for short periods produced serious liver problems. Longer-term exposure lead to damaged livers of rats and the livers and adrenal glands of mice. Animals that consumed heptachlor before and/or during pregnancy were found to have smaller litters or were unable to reproduce. Some of the offspring had cataracts and some died soon after birth (ATSDR, April 1993).

These adverse effects on animals due to exposure to heptachlor indicate that the liver and nervous system could be a target for humans as well. Animal studies have also shown that acute oral exposure of heptachlor caused 40% and 100% mortality rates in mice and rats respectively. Intermediate and chronic inhalation exposure of humans to heptachlor, either through occupational exposure or use of termiticides in homes, has been associated with leukemia and aplastic and hemolytic anemias. Further, animal studies have shown that oral heptachlor exposure causes statistically significant increases in white blood cell counts in rats (ATSDR, April 1993).

Symptoms of exposure observed in laboratory animals include lethargy, in-coordination, tremors, convulsions, stomach cramps and pain, and coma (EXTOXNET, September 1993). EPA has classified heptachlor (and heptachlor epoxide) as probable human carcinogens. Heptachlor is also toxic to aquatic life, but its toxicity varies highly from species to species.

Efforts to Reduce Pollution from the Chemical

The phase-out of heptachlor use began in 1978. In 1988, EPA canceled all uses of heptachlor in the U.S. except for fire ant control in power transformers. Note that heptachlor is still available outside the United States. Heptachlor was listed in TRI at a higher reporting threshold prior to the PBT chemical modifications to TRI reporting requirements. In addition to regulatory restrictions, a number of states and local governments sponsor programs to encourage the proper disposal of banned and/or restricted pesticides, including heptachlor (EXTOXNET, September 1993).

ISODRIN

Introduction

Isodrin (CAS 465-73-6) is an insecticide which is no longer used or manufactured in the U.S. Isodrin is a white crystalline solid (ECDIN). Isodrin is made by the slow reaction of cyclopentadiene with the condensation product of vinyl chloride and hexachlorocyclopentadiene.

Sources and Uses

Isodrin, a solid chlorinated hydrocarbon, has a melting point of 465 degrees Fahrenheit, but it is unstable and may react with light or acids. In soil it may undergo oxidation by microbes and be converted to endrin. It is not combustible, but can be decomposed at high temperatures for the production of noxious gases (e.g. chlorine, other chlorinated hydrocarbons) (EPA, EA, 1999).

Chemical Characteristics

Persistence and Bioaccumulation

Isodrin has persistence half-life values in soil of 180 days to 5 years and persistence half-life values in air of 1 to 10 hours (EPA, PBT Chemicals Final Rule, October 1999).

Isodrin has a BCF value of 20,180 (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

Release of isodrin to the environment is not expected to be significant since isodrin is no longer used in the U.S. If released to soil, isodrin may be converted to endrin. Endrin is a similar toxic substance, which may also be used as a pesticide (ATSDR, September 1997). If released to air, isodrin can bind to airborne particulate matter and may then be deposited (Spectrum Laboratories, December 2001). In soil systems, isodrin binds to soil particles. Based on experimental data, the half-life of isodrin in soil has been estimated to range from 0.5 years to a maximum of 5 years. If released to water, isodrin may bioaccumulate in aquatic organisms, bind to suspended solids and sediments, evaporate and undergo slow transformation, possibly to endrin.

Health and Environmental Effects

Isodrin can be absorbed by inhalation, ingestion or skin absorption. Isodrin may absorb onto the surface of dust particles, which may be swallowed as well as inhaled (Colorado Department of Health and Environment, April 4th, 2002). Case reports of insecticide manufacturing workers show that exposure to isodrin can result in convulsions, sometimes without premonitory symptoms. Convulsive episodes may alternate with periods of severe central nervous depression. Death from respiratory arrest may occur during coma, which commonly outlasts the convulsive phase and may persist for a few days. In animals, isodrin was more toxic than most organochlorines when exposed to chick embryos. Isodrin is related to the pesticide aldrin but was shown to be at least twice as toxic in laboratory rodents. If released to water, isodrin may bioconcentrate in aquatic organisms, adsorb to suspended solids and sediments, and undergo very slow microbial transformation, possibly to endrin (NIH, TOXNET, January 2002).

Limited studies of isodrin's effects on health exist because it is no longer commercially used. Many theories of isodrin's health effects come from observations of other organochlorine pesticides. Organochlorines, including isodrin, are convulsants causing excitation of the central nervous system (CNS). Symptoms of CNS toxicity include nausea, vomiting, seizures, dizziness, headache, tremors, elevated blood pressure, fever, rapid heart beat, coma and altered behavior (EPA, CEPP, Undated). Exposure can also cause skin effects and liver and kidney damage.

Efforts to Reduce Pollution from the Chemical

Prior to the PBT chemical modifications to TRI reporting requirements, isodrin was listed in TRI at a higher reporting threshold. Isodrin is also regulated under CERCLA (EPA, CEPP, Undated).

METHOXYCHLOR

Introduction

Methoxychlor (CAS 72-43-5) is an organochlorine used as a general insecticide. It is a pale-yellow powder with a slightly fruity or musty odor. However, it is available in many forms, including powders, emulsifiable concentrates, granules, and an aerosol. Methoxychlor is similar in structure to dichlorodiphenyltrichloroethane (DDT), but it is less toxic.

Sources and Uses

Methoxychlor is produced by reacting the chemical anisole with chloral, in the presence of an aluminum chloride catalyst. Methoxychlor is used on agricultural crops, livestock, grain storage, home gardens, and pets. EPA has approved the use of methoxychlor as a pesticide and fumigant on more than 85 crops such as fruits, vegetables, forage crops, and shade trees. It may also be applied to large areas such as beaches, estuaries, and marshes for control of flies and mosquito larvae and may be used for spray treatment of barns, grain bins, mushroom houses, other agricultural premises, and garbage and sewage areas (EPA EA, 1999).

Chemical Characteristics

Persistence and Bioaccumulation

Methoxychlor has persistence half-life values in soil of 81 to 136 days, persistence half-life values in water of 5 to 15.2 days, and persistence half-life values in air of 1 to 12 hours (EPA, PBT Chemicals Final Rule, October 1999).

Methoxychlor has a BCF value of 8,128 (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

Releases are expected to be the result of its use as a pesticide, and also due to losses during manufacturing, formulation, packaging, and disposal. In the atmosphere, sunlight may slowly break down methoxychlor. It does not evaporate into the atmosphere. In soil systems, microscopic organisms and sunlight may slowly break down methoxychlor. It binds to soil particles and is very persistent. In aquatic environments, methoxychlor binds to particulate matter because it has a low water solubility. Sunlight and microscopic organisms may break down methoxychlor within days (EPA, OW, February 2002). Methoxychlor bioaccumulates in aquatic species such as algae, bacteria, snails, clams, and some fish.

Health and Environmental Effects

According to HHS' ATSDR, no reports are available that relate adverse human health effects to methoxychlor exposure. The effects of methoxychlor have been primarily seen in animal studies through oral exposure. High doses of methoxychlor exposure cause neurological effects such as tremors and convulsions, but most studies indicate that the reproductive system is the most sensitive target for methoxychlor exposure.

In laboratory animals, exposure to high levels of methoxychlor has produced seizures, as well as changes in liver, kidney, intestines, heart muscle, mammary glands, and reproductive organs (EPA, OAQPS, May 2001). Reproductive and developmental effects observed in laboratory animals include abortions, reduced fertility for both males and females, reduced litter size, and skeletal effects (EPA, OAQPS, May 2001). Although there are no data that report adverse effects on the reproductive systems of humans, *in vitro* studies show that human liver microsomes can metabolize methoxychlor to estrogenic compounds. Therefore, methoxychlor could cause reproductive estrogen-like effects in humans if exposure levels were in the right range (ATSDR, September 1995).

In rats, a slight increase in liver cancer was observed in lab experiments, but there is inconclusive evidence regarding human carcinogenicity.

Efforts to Reduce Pollution from the Chemical

Numerous efforts to reduce pollution from methoxychlor have been implemented. EPA restricts the amount of methoxychlor that may be released to the environment during burning or by disposal in landfills. EPA requires that spills or accidental releases of methoxychlor to the environment of one pound or more must be reported. Methoxychlor was listed in TRI at a higher reporting threshold prior to the PBT chemical modifications to TRI reporting requirements.

Under the Safe Drinking Water Act, EPA has developed guidelines for methoxychlor concentration in drinking water. EPA has also set limits of 1–100 ppm on the amount of methoxychlor that may be present in crops, fruit, vegetables, grains, meats, milk, and food for livestock. The FDA limits the amount of methoxychlor in bottled water to 0.1 ppm (ATSDR, September 1995).

PENDIMETHALIN

Introduction

Pendimethalin (CAS 40487-42-1) is used as an insecticide and herbicide. It is also known as benzenamine. Pendimethalin was first registered as a pesticide in 1972 and marketed in 1976 (EPA EA, 1999). Pendimethalin is a orange-yellow crystalline solid and is formulated in liquid, solid, and granular forms, and also as an emulsifiable concentrate.

Sources and Uses

Pendimethalin is produced by the reaction of N-(1-ethylpropyl)amine with 2,6-dinitro-3,4-dimethylchlorobenzene, which is obtained by nitrating p-chloro-o-xylene in the presence of sulfuric acid. It is also produced by reacting o-xylene with diethyl ketone in the presence of nitric or sulphuric acid (EPA EA, 1999).

Pendimethalin is used as a pre-emergence and post-emergence herbicide on cotton, dry bulbs, onions, dry bulb shallots, edible beans, corn, legumes, garlic, grain, nonbearing fruit, nut crops, peanuts, potatoes, rice, soybeans, sugar cane, sunflowers, sweet corn, and sweet lupine (EPA EA, 1999). It is also used for pre-emergence control of many annual grasses and certain broadleaf weeds (EPA EA, 1999). Pendimethalin is applied by broadcasting, directed spray, and soil treatment. Fifty eight pendimethalin products are registered for agricultural, domestic, and commercial uses (EPA EA, 1999).

Chemical Characteristics

Persistence and Bioaccumulation

Pendimethalin has persistence half-life values in soil of 54 to 1,300 days and persistence half-life values in air of 2 to 21 hours (EPA, PBT Chemicals Final Rule, October 1999).

Pendimethalin has a BCF value of 1,944 (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

Pendimethalin may enter the environment from pesticide application and disposal sites. Pendimethalin is persistent, with a half-life of approximately 54 to 1,300 days. Pendimethalin may evaporate from soil and enter the atmosphere. In soil systems, pendimethalin binds to soil particles. Microbes do not degrade pendimethalin significantly, except under anaerobic conditions. Plants may absorb pendimethalin (EXTOXNET, June 1996). Pendimethalin has a low water solubility, and thus binds to sediments in aquatic environments. It may be broken down by sunlight.

Health and Environmental Effects

Animal studies assessing the effects of pendimethalin show that it has a low acute toxicity. It is slightly toxic if exposed by oral and eye routes, and is practically non-toxic by dermal and inhalation routes. However, despite its relatively low toxicity, pendimethalin has been shown to cause thyroid follicular cell adenomas in rats, and has been classified as a possible human carcinogen. In terms of its ecotoxicity, pendimethalin binds to and is essentially immobile from soil. Therefore, pendimethalin's potential to contaminate water bodies is relatively low. Pendimethalin may cause adverse effects in terrestrial and semi-aquatic plants and invertebrates, but at relatively low levels of risk (U.S. EPA, R.E.D. Facts, June 1997). Some studies have shown pendimethalin to be highly toxic to coldwater fish, highly to moderately toxic to warm-water fish, and highly to moderately toxic to freshwater invertebrates (NIH, TOXNET, January 2002).

Laboratory experiments indicate that pendimethalin exposure produces chronic and reproductive effects at elevated levels of exposure. Long-term studies in mice and rats have not found a conclusive correlation between exposure and increased cancer rates (WHO, 1993). Chronic exposure to pendimethalin has resulted in increased liver weights in laboratory animals (EXTOXNET, June 1996). Pendimethalin is slightly toxic to birds, and is highly toxic to fish and aquatic invertebrates.

Efforts to Reduce Pollution from the Chemical

EPA's Office of Pesticide Programs (OPP) requires hazardous substances to bear a signal word on product labels to reflect the toxicity of the product and/or the chemicals in the product. There are four toxicity classes that are based on acute oral, acute dermal, acute inhalation, and skin and eye irritation studies. Products and chemicals that fall under Toxicity Category I (very toxic) have to bear the word "DANGER" on their label, those in Toxicity Category II (somewhat toxic) have "WARNING" on their labels, and those in Toxicity Category III or IV (least or not-toxic) have the word "CAUTION" on their labels. Pendimethalin is in EPA Toxicity Category III. Products containing pendimethalin must bear the Signal Word "Caution" or "Warning," depending on the formulation. Under the CWA, allowable levels of pendimethalin in wastewater are determined in conjunction with the National Pollutant Discharge Elimination System (NPDES) (Pesticide Management Education Program, March 1985). Pendimethalin was listed in TRI at a higher reporting threshold prior to the PBT chemical modifications to TRI reporting requirements.

TOXAPHENE

Introduction

Toxaphene (CAS 8001-35-2) is a polychlorinated camphene, which was widely used as an insecticide in the U.S. until 1990. Toxaphene is a man-made mixture containing more than 670 chemicals. It is a yellow or amber, waxy solid that smells like turpentine.

Sources and Uses

Technical toxaphene can be produced commercially by reacting chlorine gas with technical camphene in the presence of ultraviolet radiation and catalysts, yielding chlorinated camphene containing 67-69 percent chlorine by weight. It has been available in various forms: as a solid, solution, wettable powder, dusts, granules, and emulsifiable concentrates (EPA EA, 1999).

Toxaphene is an insecticide that was primarily used in the southern U.S. to control pests on cotton, vegetables, livestock and poultry, soybeans, and alfalfa, wheat, and sorghum. Other uses included controlling unwanted fish growth in lakes and pests on livestock. All registered uses of toxaphene in the U.S. were canceled in 1990 (EPA EA, 1999). It is still commonly used as an insecticide on bananas and pineapples in Puerto Rico and the Virgin Islands (EPA EA, 1999).

Chemical Characteristics

Persistence and Bioaccumulation

Toxaphene has persistence half-life values in soil of 1 to 11 years, persistence half-life values in water of 1 to 5 years, and persistence half-life values in air of 19 hours to 16 days (EPA, PBT Chemicals Final Rule, October 1999).

Toxaphene has a BCF value of 34,050 (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

Although toxaphene does not occur naturally in the environment and all uses of toxaphene have been banned, it is still present in the environment largely as a result of past releases through its use as a pesticide. It was applied to crops and bodies of water. Toxaphene may also enter the environment from hazardous waste sites (ATSDR, August 1996). In the atmosphere, toxaphene can be transported unchanged for significant distances before it is deposited to the earth. It may persist for weeks to years, depending on conditions. In soil systems, toxaphene also has similarly strong persistence, although some may evaporate. Toxaphene bioaccumulates in aquatic and terrestrial organisms. In aquatic environments, toxaphene is found mostly in bottom sediments because of its low water solubility, although some may remain in the water column. Toxaphene has a strong persistence in water, although some may evaporate from surface water (EPA, OW, September 1999).

Health and Environmental Effects

Exposure to toxaphene may result from food, drinking water, outdoor air, and contaminated soil at hazardous waste sites. Acute exposure to high levels of toxaphene, though rare even for hazardous waste sites, produces significant adverse effects to both humans and animals. These primarily include adverse effects to the central nervous system and include hyper-salivation, hyper-excitability, behavioral changes, muscle spasms, convulsions, and death. Additionally, inhalation exposure to toxaphene can also cause adverse respiratory effects in both humans and animals. Animal studies have shown adverse effects to the liver and kidney and to a lesser extent the heart and immune system (ATSDR, August 1996). Exposure to toxaphene has caused damage to adrenal and thyroid glands and the immune system (EPA, OPPT, March 2001).

Adverse developmental effects have been observed in laboratory animals following toxaphene ingestion at doses below those required to induce maternal toxicity. The most sensitive endpoints of fetal toxicity appear to be behavioral effects and immunosuppression. An increased risk for cancer has been demonstrated in laboratory rodents exposed to high doses of toxaphene. EPA classifies toxaphene as a probable human carcinogen (EPA, OAQPS, May 2001).

Efforts to Reduce Pollution from the Chemical

Toxaphene's registration was canceled in 1982, except for emergency use for corn, cotton, and small grains for specific insect infestation (EPA EA, 1999). Existing stocks were used without restrictions until 1986 (EPA EA, 1999). All uses were banned in 1990 (EPA EA, 1999). In 1993, the EPA banned the importation of food containing toxaphene residues into the United States or any of its territories. EPA has determined that toxaphene is a "hazardous air pollutant" under the Clean Air Act (CAA) and has also established limits on the amount of toxaphene that can be released from a plant into wastewater. Toxaphene was listed in TRI at a higher threshold prior to the PBT chemical modifications to TRI reporting requirements. Several state and local governments have implemented programs to aid in proper disposal of toxaphene.

The federal government has developed regulatory standards and guidelines to protect individuals from the potential harmful health effects of toxaphene in drinking water and food (ATSDR, August 1996). The FDA and EPA have set limits on toxaphene levels in foods including sunflower seeds, soybeans, grains, cottonseed, fruits, and vegetables.

TRIFLURALIN

Introduction

Trifluralin (CAS 1582-09-8) is an herbicide used primarily on cotton and soybean crops. Trifluralin is a yellow-orange crystalline solid.

Sources and Uses

Trifluralin is made by the reaction of di-n-propylamine with 2,6-dinitro-4-trifluoromethylchlorobenzene (EPA EA, 1999). Production of trifluralin has declined since restrictions on product formulation were implemented in 1982 due to carcinogenicity and mutagenicity concerns (EPA EA, 1999). It is used on soybean crops, cotton, wheat, alfalfa, sunflowers and many other crops.

Chemical Characteristics

Persistence and Bioaccumulation

Trifluralin has persistence half-life values in soil of 99 to 394 days, persistence half-life values in water of 5 to 37 days, and persistence half-life values in air of 0.42 to 3.2 hours (EPA, PBT Chemicals Final Rule, October 1999).

Trifluralin has a BCF value of 5,674 (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

Trifluralin may enter the environment through application as a pesticide or from waste disposal sites. In the atmosphere, trifluralin is carried significant distances on dust particles before they are deposited to the earth. In soil systems, microbes degrade trifluralin. Trifluralin remaining on the soil surface may be decomposed by sunlight or may evaporate (EXTOXNET, June 1996). The persistence of trifluralin in soil is highly variable, depending on several factors including depth of incorporation, soil moisture and temperature. Trifluralin binds tightly to soil sediments and particulates in the water column, and it bioaccumulates in terrestrial and aquatic organisms.

Health and Environmental Effects

According to EPA's OPP, trifluralin is technically classified under Toxicity Category IV ("practically non-toxic") for acute oral toxicity and dermal irritation, and Toxicity Category III ("slightly toxic") for acute dermal toxicity, acute inhalation toxicity, and eye irritation potential (see discussion on Toxicity Categories under the section for pendimethalin). Trifluralin is also considered a dermal sensitizer. In ecotoxicity studies, trifluralin also was found to be moderately to highly toxic to aquatic organisms (U.S. EPA, April 1996).

Although no human studies conclusively link trifluralin exposure to cancer, rats have been observed under laboratory conditions to develop malignant tumors in the kidneys, bladder and thyroid after trifluralin exposure (EPA, OAQPS, May 2001). Trifluralin is classified by EPA as a possible human carcinogen. Though the cancer risk to the general population is relatively low, the risk to populations that directly handle the chemical (workers, mixers, applicators, etc.) is significantly higher. Prolonged or repeated exposure to trifluralin may cause skin irritation, and liver and kidney damage. Reproductive and developmental effects, including depressed fetal weight and skeletal abnormalities, have been observed in laboratory animals (EPA, OAQPS, May 2001). Trifluralin also interferes with hormone regulation.

Efforts to Reduce Pollution from the Chemical

Restrictions on product formulation were implemented due to carcinogenicity and mutagenicity concerns. In August, 1979, trifluralin was brought under review by EPA because of the presence of a N-nitrosamine contaminant which had been shown to have adverse health effects in animals. After the review's conclusion in 1982, EPA required N-nitrosamine contaminant levels in trifluralin not to exceed 0.5 ppm (EXTOXNET, September 1993). Furthermore, EPA provides guidelines for the allowable amount of trifluralin in drinking water and requires that products containing trifluralin bear the Signal Words "Caution" or "Warning," depending on the type of formulation. Trifluralin was listed in TRI at a higher reporting threshold prior to the PBT chemical modifications to TRI reporting requirements. A number of states and local governments sponsor programs to encourage the proper disposal of trifluralin.

2000 TRI DATA FOR PESTICIDES

On-site and Off-site Releases

As shown in Table 3-33, there were 138 TRI forms submitted for the group of eight pesticides subject to the lower reporting thresholds for PBT chemicals for 2000. On- and off-site releases for these pesticides totaled 82,443 pounds.

Pendimethalin had the largest releases of this group, with 31,293 pounds or 38.0 percent of the total releases for the eight pesticides. Trifluralin had the second largest releases, with 27,624 pounds or 33.5 percent of the total releases.

On-site releases to RCRA subtitle C landfills were the largest type of release for the group of pesticides, accounting for 40.9 percent of total releases or 33,707 pounds (see Figure 3-13). The second largest release type was other on-site land releases, which accounted for 34.6 percent or 28,498 pounds. (Types of on-site land releases are described in Box 1-4 in Chapter 1.)

Off-site releases (transfers to disposal) totaled 13,565 pounds or 16.5 percent, and air emissions were 6,340 pounds or 7.7 percent. Surface water discharges and underground injection of pesticides totaled less than 350 pounds.

Trifluralin had the largest on-site land releases to RCRA subtitle C landfills, with 11,216 pounds, which was one-third of the releases to RCRA subtitle C landfills reported for all eight pesticides in 2000. Trifluralin also had the largest air emissions, with 5,504 pounds or 86.8 percent of the total for pesticides.

Pendimethalin had the largest other on-site land releases, with 20,343 pounds or 71.4 percent of the total of such releases for the eight pesticides and the largest off-site releases (transfers to disposal) with 9,555 pounds or 70.4 percent of the total off-site releases of the pesticides in 2000.

Waste Management Data

Quantities of TRI Chemicals in Waste

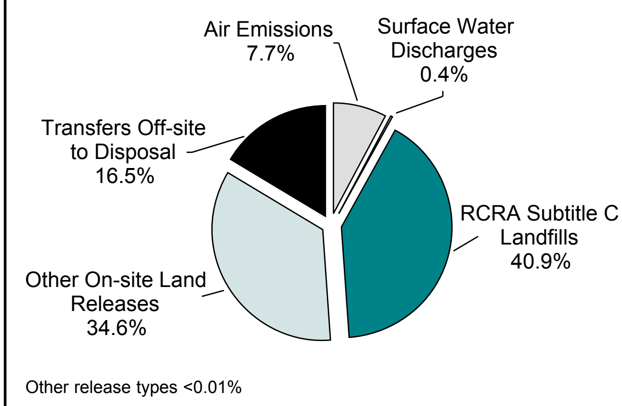
Production-related waste of pesticides totaled 2.6 million pounds in 2000, as shown in Table 3-34. Most (2.3 million pounds or 90.6 percent) of the total production-related waste was treated on-site (see Figure 3-14). Another 5.5 percent (140,172 pounds) was treated off-site site, and 3.4 percent (87,062 pounds) was released on- and off-site. Other types of waste management totaled less than one percent.

The chemical chlordane had the greatest production-related waste, accounting for 32.4 percent (827,249 pounds) of production-related waste for all eight pesticides. Most of the chlordane production-related waste was treated on-site. The 812,323 pounds of chlordane treated on-site represented 98.2 percent of total production-related waste of chlordane in 2000.

The chemical pendimethalin accounted for 27.8 percent or 711,106 pounds of production-related waste of this group of pesticides. Over 92.2 percent (656,145 pounds) of pendimethalin production-related waste was treated on-site, and 4.4 percent (31,359 pounds) was released on- and off-site.

The chemical trifluralin accounted for the largest quantity released on- and off-site, with 33,259 pounds, as well as amounts treated off-site, with 109,807 pounds.

Figure 3-13: Distribution of TRI On-site and Off-site Releases, 2000: Pesticides



Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Transfers Off-site for Further Waste Management/Disposal

Transfers off-site for further waste management and disposal of this group of eight pesticides totaled almost 141,477 pounds in 2000 (see Table 3-35). Transfers to treatment accounted for 89.6 percent of the total transfers for further waste management and disposal of the pesticides in 2000 (see Figure 3-15). Transfers to treatment were 126,727 pounds. Other transfers to disposal were 13,735 pounds or 9.7 percent of total transfers for further waste management and disposal of pesticides for 2000. Other types of transfers were about 1,000 pounds.

Table 3-33: TRI On-site and Off-site Releases, 2000: Pesticides

			On-site Releases							Off-site Releases	
					Underground Injection		On-site Land Releases				
CAS Number	Chemical	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
309-00-2	Aldrin	11	0.79	0.00	0.00	0.00	2,342.00	0.00	2,342.79	2.58	2,345.37
57-74-9	Chlordane	21	13.70	0.00	0.00	0.00	8,947.74	0.00	8,961.44	828.59	9,790.03
76-44-8	Heptachlor	15	6.60	0.00	0.00	0.00	2,372.56	0.00	2,379.16	221.87	2,601.03
465-73-6	Isodrin	6	0.05	0.00	2.95	0.00	0.00	0.00	3.00	0.00	3.00
72-43-5	Methoxychlor	20	59.83	0.00	0.00	0.00	2,569.00	0.00	2,628.83	31.75	2,660.58
40487-42-1	Pendimethalin	18	733.54	329.00	0.00	0.00	332.00	20,343.00	21,737.54	9,555.00	31,292.54
8001-35-2	Toxaphene	16	20.98	1.62	0.21	0.00	5,928.02	0.00	5,950.83	176.14	6,126.97
1582-09-8	Trifluralin	31	5,504.15	0.00	0.00	0.00	11,216.00	8,155.00	24,875.15	2,748.67	27,623.82
	Total	**138**	**6,339.64**	**330.62**	**3.16**	**0.00**	**33,707.32**	**28,498.00**	**68,878.74**	**13,564.60**	**82,443.34**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

The chemical trifluralin accounted for 71.0 percent (100,421 pounds) of total transfers for further waste management and disposal of pesticides for 2000. Most (96.9 percent or 97,264 pounds) of this was transferred to treatment.

Pendimethalin accounted for 20.6 percent or 29,160 pounds of total transfers for further waste management and disposal. Two-thirds of it (19,602 pounds) was transferred to treatment and one-third (9,555 pounds) to disposal.

TRI Data by State

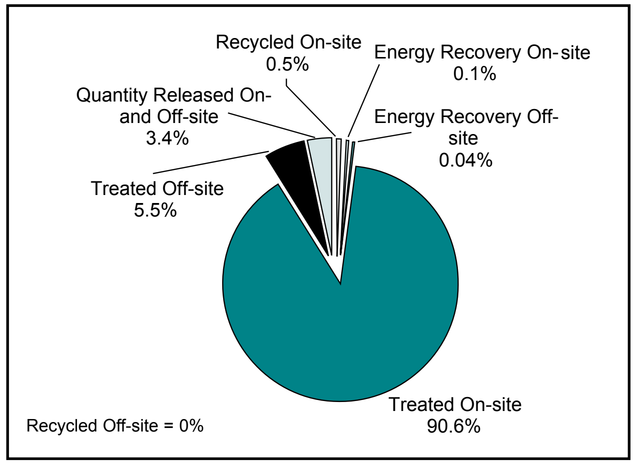
Facilities in Ohio, with 18 forms, and Texas, with 16 forms, submitted the largest number of forms in 2000 for the group of eight PBT chemical pesticides. All other states had less than 10 forms submitted.

On- and Off-site Releases

In 2000, facilities in Florida reported the largest total on- and off-site releases of pesticides (see Table 3-36), a total of 20,342 pounds, or 24.7 percent of the total for 2000.

Alabama reported the second largest total releases, with 19,515 pounds representing 23.7 percent of total releases of this group of pesticides. Ohio reported the third largest amount with 13,053 pounds, which was 15.8 percent of the total. Oregon accounted for 11,820 pounds, the fourth largest amount, which was 14.3 percent of the total releases of the eight pesticides in all the states.

Figure 3-14: Quantities of TRI Chemicals in Waste, 2000: Pesticides



Note: Data are from Section 8 of Form R.

All of Florida's releases of pesticides were other on-site land releases (that is, on-site land releases other than RCRA subtitle C landfills). The 20,342 pounds of such releases in Florida represented 71.4 percent of the total of other on-site land releases for this group of pesticides.

Practically all of Alabama's releases were on-site land releases to RCRA subtitle C landfills. These releases totaled 19,510 pounds and accounted for 57.9 percent of total RCRA subtitle C landfill releases of this group of pesticides in 2000.

Almost 80.7 percent (10,528 pounds out of 13,053 pounds) of total releases in Ohio, the state with the third largest total releases, were off-site releases

Table 3-34: Quantities of TRI Chemicals in Waste Managed, 2000: Pesticides

		Recycled		Energy Recovery		Treated				
CAS Number	Chemical	On-site	Off-site	On-site	Off-site	On-site	Off-site	Quantity Released On- and Off-site	Total Production-related Waste Managed	Non-production-related Waste Managed
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
309-00-2	Aldrin	0.00	0.00	0.00	0.00	82,504.75	283.00	2,345.32	85,133.07	0.00
57-74-9	Chlordane	0.00	0.00	230.00	0.00	812,322.92	5,686.05	9,010.26	827,249.23	0.00
76-44-8	Heptachlor	0.00	0.00	42.00	0.00	237,739.73	3,773.30	2,394.03	243,949.06	0.00
465-73-6	Isodrin	0.00	0.00	0.00	0.00	6,603.84	0.00	3.00	6,606.84	0.00
72-43-5	Methoxychlor	0.00	0.00	225.00	755.00	290,474.16	431.60	2,682.64	294,568.40	0.00
40487-42-1	Pendimethalin	4,000.00	0.00	0.00	0.00	656,145.00	19,602.00	31,358.55	711,105.55	0.00
8001-35-2	Toxaphene	0.00	0.00	1,072.00	0.00	210,240.69	589.24	6,008.47	217,910.40	0.00
1582-09-8	Trifluralin	7,501.00	0.00	0.00	228.00	16,709.08	109,807.00	33,259.47	167,504.55	45.00
	Total	**11,501.00**	**0.00**	**1,569.00**	**983.00**	**2,312,740.17**	**140,172.19**	**87,061.74**	**2,554,027.10**	**45.00**

Note: Data are from Section 8 of Form R.

(transfers to disposal). The rest (2,525 pounds) were air emissions. All of the releases reported by Oregon, the state with the fourth largest releases, were on-site land releases to RCRA subtitle C landfills.

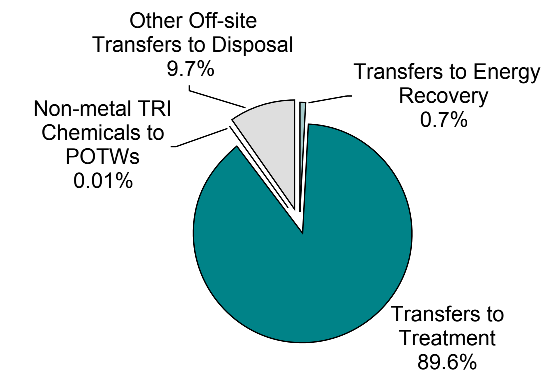
As shown in Map 3-5, the four states of Florida, Alabama, Ohio and Oregon each released over 10,000 pounds of the eight PBT chemical pesticides in 2000. Three other states, Kansas, Iowa and California, released over 1,000 pounds each.

Waste Management Data

The state with the largest quantity of total production-related waste of this group of eight pesticides in 2000 was Missouri (see Table 3-36). Missouri reported 647,483 pounds of total production-related waste and accounted for 25.3 percent of the total production-related waste of the pesticides. Ohio ranked second with 552,604 pounds (21.6 percent of the total). Two other states, Utah and Texas, each reported 13.0 percent of the total with 331,539 pounds and 330,242 pounds respectively.

Each of these four states reported most of their production-related waste of this group of pesticides as treated on-site. Missouri, with the largest total releases and treatment on-site, reported 630,000 pounds treated on-site, which was 97.3 percent of the total production-related waste for the state and 27.2 percent of all waste treated on-site of the eight pesticides in 2000.

Figure 3-15: Distribution of TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Pesticides



Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

Ohio's treatment on-site totaled 520,766 pounds or 94.2 percent of the state's total production-related waste and 22.5 percent of waste treated on-site reported by all the states. Utah reported 331,516 pounds treated on-site, over 99.9 percent of the state's total production-related waste. Texas had 330,235 pounds treated on-site, accounting for practically all of its production-related waste.

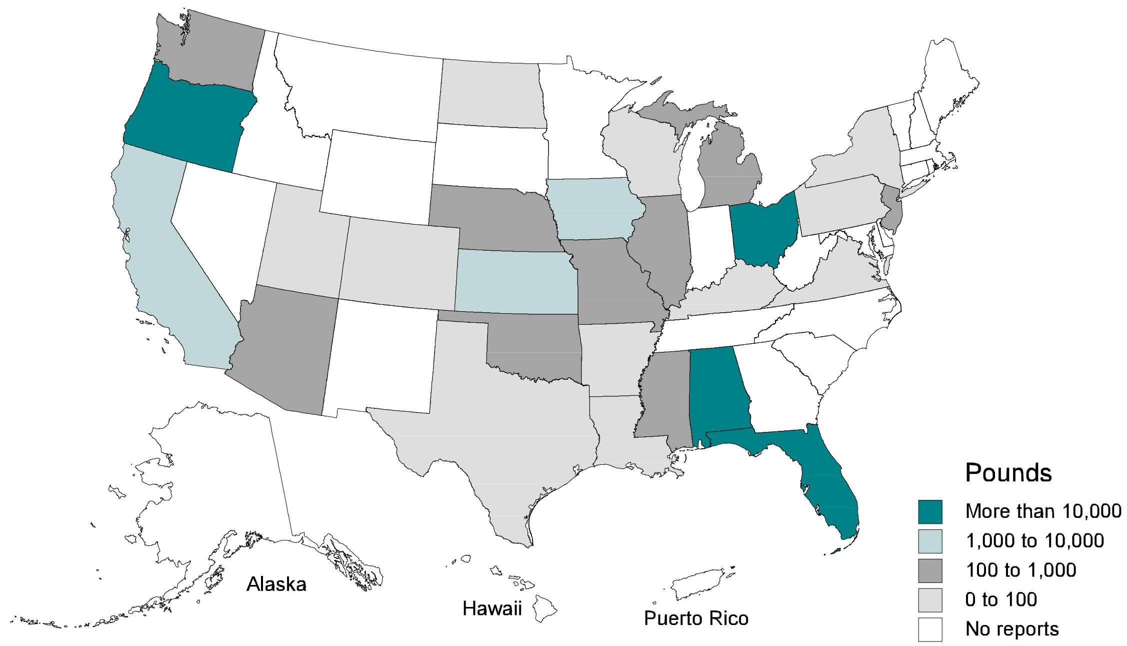
Table 3-35: TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Pesticides

CAS Number	Chemical	Transfers to Recycling	Transfers to Energy Recovery	Transfers to Treatment	Transfers to POTWs: Metals and Metal Compounds	Transfers to POTWs: Non-metal TRI Chemicals	Other Off-site Transfers*	Other Off-site Transfers to Disposal**	Total Transfers for Further Waste Management/ Disposal
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
309-00-2	Aldrin	0.00	0.00	283.30	0.00	0.00	0.00	2.58	285.88
57-74-9	Chlordane	0.00	0.00	4,905.41	0.00	0.00	0.00	828.59	5,734.00
76-44-8	Heptachlor	0.00	0.00	3,773.30	0.00	0.00	0.00	221.87	3,995.17
465-73-6	Isodrin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72-43-5	Methoxychlor	0.00	775.00	430.00	0.00	0.00	0.00	31.75	1,236.75
40487-42-1	Pendimethalin	0.00	0.00	19,602.00	0.00	3.00	0.00	9,555.00	29,160.00
8001-35-2	Toxaphene	0.00	0.00	468.54	0.00	0.00	0.00	176.14	644.68
1582-09-8	Trifluralin	0.00	228.00	97,264.00	0.00	10.00	0.00	2,918.67	100,420.67
	Total	**0.00**	**1,003.00**	**126,726.55**	**0.00**	**13.00**	**0.00**	**13,734.60**	**141,477.15**

Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

* Other Off-site Transfers are transfers reported without a valid waste management code.
** Does not include transfers to POTWs of metals and metal compounds.

Map 3-5: Total On- and Off-site Releases, 2000: Pesticides



The states with the largest quantity released on- and off-site were Florida with 20,402 pounds, Alabama with 19,515 pounds, Ohio with 13,072 pounds and Oregon with 11,820 pounds.

TRI Data by Industry (2-digit SIC Code)

On- and Off-site Releases

Only seven industry sectors reported releases of this group of pesticides in 2000. The hazardous waste/solvent recovery industries reported the largest total releases of any industry sector, 34,846 pounds or 42.3 percent of the total releases (see Table 3-37).

The hazardous waste/solvent recovery industries also reported the largest amounts of on-site land releases to RCRA subtitle C landfills, with 33,375 pounds representing 99.0 percent of the total on-site land releases to RCRA subtitle C landfills in 2000.

The food industry had the second largest total releases, with 20,646 pounds of total releases, most of which were other on-site land releases (that is, other than RCRA subtitle C landfills). These releases by the food industry were 72.2 percent of all other on-site land releases of this group of pesticides in 2000.

The chemical manufacturing industry reported the third largest amount of total releases, with 14,564 pounds. Over 81.2 percent (11,831 pounds) of this was off-site releases (transfers to disposal). These off-site releases by the chemicals industry accounted for 87.2 percent of total off-site releases in 2000.

Waste Management

The hazardous waste/solvent recovery industries reported the largest amount of total production-related waste of pesticides in 2000 (see Table 3-37). With 1.8 million pounds of production-related waste, this industry sector accounted for 68.9 percent of all production-related waste. Almost 1.7 million pounds of pesticides were treated on-site by the hazardous waste/solvent recovery industries, representing 95.6 percent of this industry's total production-related waste. The hazardous waste/solvent recovery industries also reported 43,399 pounds as treated off-site and 33,761 pounds released on- and off-site.

Table 3-36: Summary of TRI Information by State, 2000: Pesticides

		On-site Releases								
				Underground Injection		On-site Land Releases			Off-site Releases	
State	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
	Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Alabama	4	5.10	0.00	0.00	0.00	19,510.00	0.00	19,515.10	0.00	19,515.10
Arizona	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	903.00	903.00
Arkansas	9	25.00	0.00	0.00	0.00	0.00	0.00	25.00	0.00	25.00
California	7	79.00	0.00	0.00	0.00	968.32	0.00	1,047.32	375.00	1,422.32
Colorado	1	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Florida	2	0.00	0.00	0.00	0.00	0.00	20,342.00	20,342.00	0.00	20,342.00
Illinois	7	5.04	0.00	0.00	0.00	0.00	0.00	5.04	407.43	412.47
Iowa	6	1,759.80	0.00	0.00	0.00	0.00	0.00	1,759.80	90.00	1,849.80
Kansas	3	1,660.00	0.00	0.00	0.00	0.00	7,800.00	9,460.00	1.64	9,461.64
Kentucky	7	2.90	0.00	0.00	0.00	0.00	0.00	2.90	27.92	30.82
Louisiana	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Michigan	2	13.00	0.00	0.00	0.00	545.00	0.00	558.00	24.00	582.00
Mississippi	2	16.00	0.00	0.00	0.00	0.00	0.00	16.00	872.00	888.00
Missouri	7	168.24	22.00	0.00	0.00	0.00	1.00	191.24	195.40	386.64
Nebraska	5	12.30	0.00	0.00	0.00	0.00	112.00	124.30	112.00	236.30
New Jersey	8	9.80	302.00	0.00	0.00	332.00	0.00	643.80	0.88	644.68
New York	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
North Dakota	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ohio	18	2,524.96	0.00	0.00	0.00	0.00	0.00	2,524.96	10,528.00	13,052.96
Oklahoma	1	0.00	0.00	0.00	0.00	532.00	0.00	532.00	0.00	532.00
Oregon	5	0.00	0.00	0.00	0.00	11,820.00	0.00	11,820.00	0.00	11,820.00
Pennsylvania	4	0.10	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10
Texas	16	1.18	1.62	3.16	0.00	0.00	0.00	5.96	0.60	6.56
Utah	6	0.11	0.00	0.00	0.00	0.00	0.00	0.11	24.03	24.14
Virginia	1	5.00	5.00	0.00	0.00	0.00	0.00	10.00	0.00	10.00
Washington	3	51.00	0.00	0.00	0.00	0.00	243.00	294.00	0.00	294.00
Wisconsin	2	0.11	0.00	0.00	0.00	0.00	0.00	0.11	2.70	2.81
Total	**138**	**6,339.64**	**330.62**	**3.16**	**0.00**	**33,707.32**	**28,498.00**	**68,878.74**	**13,564.60**	**82,443.34**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Table 3-37: Summary of TRI Information by Industry, 2000: Pesticides

			On-site Releases								
					Underground Injection		On-site Land Releases			Off-site Releases	
SIC Code	Industry	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
20	Food	4	52.00	0.00	0.00	0.00	0.00	20,585.00	20,637.00	9.00	20,646.00
26	Paper	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	Chemicals	33	1,964.00	324.00	0.00	0.00	332.00	113.00	2,733.00	11,830.70	14,563.70
30	Plastics	1	74.00	0.00	0.00	0.00	0.00	0.00	74.00	334.00	408.00
32	Stone/Clay/Glass	4	0.10	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10
39	Miscellaneous	1	2,510.00	0.00	0.00	0.00	0.00	0.00	2,510.00	0.00	2,510.00
	Multiple codes 20-39	1	1,660.00	0.00	0.00	0.00	0.00	7,800.00	9,460.00	0.00	9,460.00
	No codes 20-39	1	5.00	5.00	0.00	0.00	0.00	0.00	10.00	0.00	10.00
	Subtotal Original Industries	**46**	**6,265.10**	**329.00**	**0.00**	**0.00**	**332.00**	**28,498.00**	**35,424.10**	**12,173.70**	**47,597.80**
4953/7389	Hazardous Waste/Solvent Recovery	92	74.54	1.62	3.16	0.00	33,375.32	0.00	33,454.64	1,390.90	34,845.55
	Subtotal for New Industries	**92**	**74.54**	**1.62**	**3.16**	**0.00**	**33,375.32**	**0.00**	**33,454.64**	**1,390.90**	**34,845.55**
	Total	**138**	**6,339.64**	**330.62**	**3.16**	**0.00**	**33,707.32**	**28,498.00**	**68,878.74**	**13,564.60**	**82,443.34**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Table 3-36: Summary of TRI Information by State, 2000: Pesticides (continued)

	Recycled		Energy Recovery		Treated				
State	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	Quantity Released On- and Off-site Pounds	Total Production-related Waste Managed Pounds	Non-production-related Waste Managed Pounds
Alabama	0.00	0.00	0.00	0.00	0.00	57.00	19,515.00	19,572.00	0.00
Arizona	0.00	0.00	0.00	0.00	0.00	903.00	0.00	903.00	0.00
Arkansas	0.00	0.00	0.00	983.00	218,243.00	1,074.00	25.00	220,325.00	0.00
California	2,000.00	0.00	0.00	0.00	0.00	0.25	1,349.32	3,349.57	45.00
Colorado	0.00	0.00	0.00	0.00	0.00	5.00	5.81	10.81	0.00
Florida	0.00	0.00	0.00	0.00	0.00	0.00	20,402.00	20,402.00	0.00
Illinois	0.00	0.00	0.00	0.00	40,762.00	0.00	201.15	40,963.15	0.00
Iowa	0.00	0.00	0.00	0.00	35.00	69,786.00	2,018.00	71,839.00	0.00
Kansas	0.00	0.00	0.00	0.00	58.32	1.64	9,500.00	9,559.96	0.00
Kentucky	0.00	0.00	0.00	0.00	19,222.50	396.30	30.82	19,649.62	0.00
Louisiana	0.00	0.00	0.00	0.00	210.00	40,939.00	0.00	41,149.00	0.00
Michigan	0.00	0.00	0.00	0.00	2.00	0.00	582.00	584.00	0.00
Mississippi	0.00	0.00	0.00	0.00	0.00	0.00	1,129.00	1,129.00	0.00
Missouri	1.00	0.00	0.00	0.00	630,000.00	11,707.00	5,774.60	647,482.60	0.00
Nebraska	0.00	0.00	0.00	0.00	17,173.00	0.00	124.00	17,297.00	0.00
New Jersey	0.00	0.00	0.00	0.00	204,517.00	5,984.00	646.20	211,147.20	0.00
New York	0.00	0.00	0.00	0.00	0.00	50.00	0.00	50.00	0.00
North Dakota	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ohio	9,500.00	0.00	0.00	0.00	520,766.00	9,266.00	13,071.96	552,603.96	0.00
Oklahoma	0.00	0.00	0.00	0.00	0.00	0.00	532.00	532.00	0.00
Oregon	0.00	0.00	0.00	0.00	0.00	1.00	11,820.00	11,821.00	0.00
Pennsylvania	0.00	0.00	1,569.00	0.00	0.00	0.00	0.10	1,569.10	0.00
Texas	0.00	0.00	0.00	0.00	330,235.00	0.00	7.05	330,242.05	0.00
Utah	0.00	0.00	0.00	0.00	331,516.35	0.00	23.02	331,539.37	0.00
Virginia	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	0.00
Washington	0.00	0.00	0.00	0.00	0.00	0.00	294.00	294.00	0.00
Wisconsin	0.00	0.00	0.00	0.00	0.00	2.00	0.71	2.71	0.00
Total	**11,501.00**	**0.00**	**1,569.00**	**983.00**	**2,312,740.17**	**140,172.19**	**87,061.74**	**2,554,027.10**	**45.00**

Note: Data are from Section 8 of Form R.

The chemical manufacturing industry reported the second largest amount of total production-related waste for this group of pesticides, with a total of 753,189 pounds. This was 29.5 percent of total production-related waste of the pesticides in 2000. Most of the chemicals industry's production-related waste (83.7 percent or 630,225 pounds) was treated on-site, and 12.8 percent (96,714 pounds) was treated off-site. The chemicals industry's amount treated off-site represented 69.0 percent of the total amount of pesticides treated off-site in 2000.

Table 3-37: Summary of TRI Information by Industry, 2000: Pesticides (continued)

		Recycled		Energy Recovery		Treated				
SIC Code	Industry	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	Quantity Released On- and Off-site Pounds	Total Production-related Waste Managed Pounds	Non-production-related Waste Managed Pounds
20	Food	0.00	0.00	0.00	0.00	86.00	10.00	20,706.00	20,802.00	0.00
26	Paper	0.00	0.00	0.00	0.00	0.00	50.00	0.00	50.00	0.00
28	Chemicals	6,001.00	0.00	0.00	0.00	630,225.00	96,713.60	20,249.67	753,189.27	45.00
30	Plastics	0.00	0.00	0.00	0.00	0.00	0.00	335.00	335.00	0.00
32	Stone/Clay/Glass	0.00	0.00	1,569.00	0.00	0.00	0.00	0.10	1,569.10	0.00
39	Miscellaneous	5,500.00	0.00	0.00	0.00	0.00	0.00	2,500.00	8,000.00	0.00
	Multiple codes 20-39	0.00	0.00	0.00	0.00	0.00	0.00	9,500.00	9,500.00	0.00
	No codes 20-39	0.00	0.00	0.00	0.00	0.00	0.00	10.00	10.00	0.00
	Subtotal Original Industries	**11,501.00**	**0.00**	**1,569.00**	**0.00**	**630,311.00**	**96,773.60**	**53,300.77**	**793,455.37**	**45.00**
4953/7389	Hazardous Waste/Solvent Recovery	0.00	0.00	0.00	983.00	1,682,429.17	43,398.59	33,760.97	1,760,571.73	0.00
	Subtotal New Industries	**0.00**	**0.00**	**0.00**	**983.00**	**1,682,429.17**	**43,398.59**	**33,760.97**	**1,760,571.73**	**0.00**
	Total	**11,501.00**	**0.00**	**1,569.00**	**983.00**	**2,312,740.17**	**140,172.19**	**87,061.74**	**2,554,027.10**	**45.00**

Note: Data are from Section 8 of Form R.

Table 3-38: Current Year and Projected Quantities of TRI Chemicals in Waste, 2000: Pesticides

Waste Management Activity	Current Year 2000		Projected 2001		Projected 2002	
	Total Pounds	Percent of Total	Total Pounds	Percent of Total	Total Pounds	Percent of Total
Recycled On-site	11,501.00	0.5	11,501.00	0.5	11,501.00	0.5
Recycled Off-site	0.00	0.0	0.00	0.0	0.00	0.0
Energy Recovery On-site	1,569.00	0.1	1,647.00	0.1	1,730.00	0.1
Energy Recovery Off-site	983.00	0.0	755.00	0.0	755.00	0.0
Treated On-site	2,312,740.17	90.6	2,104,605.15	91.4	2,003,688.95	91.1
Treated Off-site	140,172.19	5.5	110,272.36	4.8	106,283.41	4.8
Quantity Released On- and Off-site	87,061.74	3.4	74,672.38	3.2	74,746.09	3.4
Total Production-related Waste Managed	**2,554,027.10**	**100.0**	**2,303,452.89**	**100.0**	**2,198,704.45**	**100.0**
Waste Management Activity	**Projected Change 2000-2001** Percent		**Projected Change 2001-2002** Percent		**Projected Change 2000-2002** Percent	
Recycled On-site	0.0		0.0		0.0	
Recycled Off-site	--		--		--	
Energy Recovery On-site	5.0		5.0		10.3	
Energy Recovery Off-site	-23.2		0.0		-23.2	
Treated On-site	-9.0		-4.8		-13.4	
Treated Off-site	-21.3		-3.6		-24.2	
Quantity Released On- and Off-site	-14.2		0.1		-14.1	
Total Production-related Waste Managed	**-9.8**		**-4.5**		**-13.9**	

Note: Current year and projected amounts are from Section 8 of Form R for 2000.

Projected Quantities of TRI Chemicals Managed in Waste, 2000-2002

TRI facilities expected to decrease their production-related waste of pesticides between 2000 and 2001 by 9.8 percent, from 2.6 million pounds to 2.3 million pounds, with an additional decrease of 4.5 percent to 2.2 million pounds by 2002 (see Table 3-38).

The decrease was projected to occur in amounts treated on- and off-site. Treatment on-site was projected to decrease by 13.4 percent from 2001 to 2002 and treatment off-site by 24.2 percent. The quantity released on- and off-site was projected to decrease by 14.2 percent from 2000 to 2001 but then increase slightly, by 0.1 percent, from 2001 to 2002. On- and off-site releases are the least-desirable outcome under the waste management hierarchy described in **Waste Management** in Chapter 1 (Figure 1-2).

Source Reduction

In 2000, 15 forms were filed reporting source reduction activities for this group of pesticides (see Table 3-39). As noted in **Waste Management** in Chapter 1, source reduction—an activity that prevents the generation of waste—is the preferred waste management option. These 15 forms represented 10.9 percent of all forms submitted for these pesticides in 2000.

Table 3-39: Forms Reporting Source Reduction Activity, by Category, 2000: Pesticides

CAS Number	Chemical	Total Form Rs	Forms Reporting Source Reduction Activity		Category of Source Reduction Activity							
				Percent of All Form Rs	Good Operating Practices	Inventory Control	Spill and Leak Prevention	Raw Materials Modifications	Process Modifications	Cleaning and Degreasing	Surface Preparation and Finishing	Product Modifications
		Number	Number	Percent	Number	Number	Number	Number	Number	Number	Number	Number
309-00-2	Aldrin	11	1	9.1	1	0	0	0	0	0	0	0
57-74-9	Chlordane	21	1	4.8	2	0	0	0	0	0	0	0
76-44-8	Heptachlor	15	1	6.7	2	0	0	0	0	0	0	0
465-73-6	Isodrin	6	0	0.0	0	0	0	0	0	0	0	0
72-43-5	Methoxychlor	20	3	15.0	4	0	0	0	0	0	0	0
40487-42-1	Pendimethalin	18	4	22.2	4	0	0	0	0	0	0	0
8001-35-2	Toxaphene	16	1	6.3	2	0	0	0	0	0	0	0
1582-09-8	Trifluralin	31	4	12.9	5	0	0	0	0	0	0	0
	Total	**138**	**15**	**10.9**	**20**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Note: All source reduction activities on a form are counted in the corresponding category. Totals do not equal the sum of the categories because forms may report more than one source reduction activity.

The only reported type of source reduction activity for the pesticides was good operating practices.

TRI Data for Pesticides Before 2000

Reporting for the group of pesticide PBT chemicals before 2000 was based on the higher TRI thresholds of 25,000 pounds for manufacture or processing of the chemical and 10,000 pounds for otherwise using the chemical. For the reporting year 2000, these thresholds were reduced to 10 pounds for manufacture, processing or otherwise using the pesticides in the manufacturing process. Lowering the threshold, in effect, adds reports by those facilities whose activities were below the higher threshold. Consequently, the amounts for 2000 are not comparable with those for prior years.

Box 3-7 has TRI data reported for pesticide PBT chemicals before 2000.

Box 3-7: TRI Data for Pesticides Before 2000

Following is a brief summary of releases and transfers and total production-related waste for the group of eight pesticides for 1998 and 1999. This table includes reporting by both original and new industries.

TRI Data for Pesticides, 1998-1999

	1998	1999	Change 1998-1999	
	Number	Number	Number	Percent
Forms	58	52	-6	-10.3
	Pounds	Pounds	Pounds	Percent
On-site Releases	131,601	7,759	-123,842	-94.1
Off-site Releases (Transfers to Disposal)	34,026	20,475	-13,551	-39.8
Total On- and Off-site Releases	**165,627**	**28,234**	**-137,393**	**-83.0**
Total Production-related Waste Managed	**1,570,058**	**1,564,559**	**-5,499**	**-0.4**

Two (isodrin and pendimethalin) of the eight pesticide PBT chemicals were added to the TRI list for the 1995 reporting year. The other six have been on the TRI list from the beginning. The following is a summary of releases and transfers and total production-related waste for 1995-1999 for the eight pesticides. This table does not include reporting by new industries for 1998 and 1999 since new industries did not report to TRI before 1998.

TRI Data for Pesticides, 1995-1999

	1995	1998	1999	Change 1995-1999	
	Number	Number	Number	Number	Percent
Forms	32	28	33	1	3.1
	Pounds	Pounds	Pounds	Pounds	Percent
On-site Releases	28,540	12,455	7,693	-20,847	-73.0
Off-site Releases (Transfers to Disposal)	24,490	30,448	20,282	-4,208	-17.2
Total On- and Off-site Releases	**53,030**	**42,903**	**27,975**	**-25,055**	**-47.2**
Total Production-related Waste Managed	**442,920**	**461,798**	**410,349**	**-32,571**	**-7.4**

Other PBT Chemicals

HEXACHLOROBENZENE

Introduction

Hexachlorobenzene (CAS 118-74-1), also known as HCB; HEXA C.B.; phenyl perchloryl; and perchlorobenzene, is an organochlorine compound. It is a white crystalline solid created by the chlorination of benzene. For the rest of this section hexachlorobenzene is referred to by its acronym HCB.

HCB was once used as an agricultural fungicide, but health concerns about the toxicity of HCB led to the cancellation of the registrations of all pesticides that contained HCB as an active ingredient. Its primary use was to treat wheat seeds, onions, and sorghum. As late as 1985 it was used to prevent wheat smut. Although no longer used as an active ingredient in pesticides, HCB is contained as an impurity or formed as a byproduct during the manufacturing of the pesticides ametryn, atrazine cyanazine, dacthal, dienochlor, dipropetryn, lindane, maleic hydrazide, mirex, pentachloronitrobenzene, picloram, prometon, prometryn, propazine, simazine, and terbutryn (EPA, EA, 1999).

Most manufacturers of pesticides containing HCB as an active ingredient canceled their registrations in 1984, with the final manufacturer canceling all registrations for pesticide products containing HCB as an active ingredient in 1985. Under the cancellation, existing inventories of pesticides containing HCB as an active ingredient were allowed to be used until July 1985.

Sources and Uses

A number of manufacturing processes for chlorinated organic compounds generate HCB as a byproduct or impurity. During the manufacture of chlorinated organic chemicals, HCB may be formed by thermal chlorination, oxychlorination, and pyrolysis when carbon and chlorine react at high temperatures. HCB is usually found in the still bottoms generated during product purification or distillation and in air emissions from distillation columns (EPA EA, 1999). HCB may also be found as an impurity in commercial chlorinated solvent products (EPA EA, 1999).

HCB may be produced during the manufacture of chlorine gas from aqueous sodium chloride or potassium chloride by an electrolytic process. The electrolytic process, involving an anode made of powdered graphite with a coal tar pitch binder, leads to the production of a mixture of chlorinated organics that are later removed as a waste byproduct. This waste byproduct, known as "taffy", may contain HCB (EPA EA, 1999).

HCB is also a potential byproduct formed during the production of metallic magnesium when produced via electrolysis with carbon electrodes (EPA EA, 1999). The process leads to the formation of considerable amounts of chlorinated hydrocarbons, including HCB.

The degassing of molten aluminum with hexachloroethylene at aluminum foundries and secondary aluminum smelting plants also produces HCB (EPA EA, 1999). Hydrogen gas from surrounding water vapor dissolves readily in molten aluminum, causing mechanical problems in the aluminum when it is cast. Degassing operations remove the hydrogen gas from the molten aluminum. Gaseous emissions from hexachloroethylene-based aluminum degassing contain high yields of complex organochlorine compounds, including HCB (EPA EA, 1999).

Chemical Characteristics

Persistence and Bioaccumulation

HCB has persistence half-life values in soil of 3 to 6 years and persistence half-life values of 158 to 1,582 days in air. (EPA, PBT Chemicals Final Rule, October 1999).

HCB has a BCF value of 29,600 to 66,000 and BAF values of greater than 2,500,000. (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

HCB can remain in the environment for a long time because it degrades very slowly. When found in an aquatic environment, most of it will remain in particles on the bottom of lakes and rivers due to its low water solubility. In terrestrial environments, HCB binds strongly to soil. High levels of HCB can bioaccumulate in fish, marine mammals, birds, lichens, and animals that eat lichens or fish. It can also bioaccumulate in wheat, grasses, some vegetables, and other plants.

Health and Environmental Effects

Since production of HCB ceased in the 1980s, there are no studies available that evaluate the health effects in humans or animals from dermal exposure to HCB. Therefore, the levels at which HCB might produce health effects from dermal exposure are not known. Reports on oral human exposure and oral studies in animals showed that oral exposure to HCB typically causes porphyria, cutaneous lesions, neurological effects, altered liver enzyme levels, and changes in morphology of the liver. In addition, adverse effects to the kidneys and immune system as well as reproductive and developmental effects have been reported. Several animal studies of HCB show significant disruption to the endocrine system, especially reductions in thyroid gland activity and enlarged thyroids. Further, animal studies also show that oral exposure to HCB can cause cancer of the liver, kidney, lungs, lymphatic system, blood, and thyroid (ATSDR, September 1997).

A study of people in Turkey who ate bread accidentally contaminated with HCB showed that exposure can cause red-colored urine, skin sores, change in skin color, arthritis, and problems of the liver, nervous system, and stomach (ATSDR, September 1997). In addition, laboratory experiments show that ingestion of HCB over an extended period can damage the liver, thyroid, nervous system, bones, kidneys, blood, and immune and endocrine systems. Increased rates of liver, kidney and thyroid cancer were also observed in laboratory experiments.

Efforts to Reduce Pollution from the Chemical

EPA has undertaken several measures addressing HCB. EPA has recommended that there should be no more than 0.05 milligrams of HCB per liter of water (0.05 mg/L) in water that children drink, and no more than 0.2 mg/L in water that adults drink (ATSDR, September 1997). In addition, spills or accidental releases into the environment of 10 or more pounds of HCB must be reported to EPA under RCRA and CERCLA (ATSDR, September, 1997).

OCTACHLOROSTYRENE

Introduction

Octachlorostyrene (OCS) (CAS 29082-74-4) is a polychlorinated styrene that is an unwanted byproduct of chlorine production, chlorination reactions, and metal product/finishing operations such as the production of metallic magnesium and dry etching of aluminum. OCS may also be formed by the high-temperature incineration of chlorinated hydrocarbons (EPA EA, 1999). OCS is not a commercial product, and no commercial uses are known.

Sources and Uses

Industrial processes that may produce OCS as a byproduct include the following:

- Radical initiated chloralkene polymerization, a process involving aromatic radicals, vinyl or styrene monomers, and chlorine atom sources;
- Electrolysis of chloride salts in processes using graphite or carbon anodes at temperatures greater than 275ºC. This process may be used in the production of chlorine, aluminum, sodium metal, tantalum metal, and niobium metal;
- Manufacture of metallic magnesium using carbon electrodes;

- Fused salt electrolysis, a process used to produce sodium from sodium chloride;
- Aluminum production that utilizes a smelting process created by Alcoa in 1976, which incorporates alumina, carbon, chlorine, and a carbon electrode at high temperatures;
- Incineration of chlorine-containing plastics and organic chemicals (EPA EA, 1999);
- Degassing of molten aluminum with hexachloroethane (EPA EA, 1999); and
- Production of perchloroethylene and carbon tetrachloride using the Stauffer or Scientific Design processes (EPA EA, 1999).

Historically, OCS was generated in the manufacture of chlorine from aqueous sodium chloride or potassium chloride by an electrolytic process. The electrolytic process, involving an anode made of powdered graphite with a coal tar pitch binder, leads to the production of a mixture of chlorinated organics that are later removed as a waste byproduct. This waste byproduct, known as "taffy", may contain OCS. The improper disposal of the taffy may release OCS into the environment (EPA EA, 1999).

OCS has been identified as a byproduct from the manufacture of carbon tetrachloride and perchloroethylene. OCS is also a potential byproduct of the production of metallic magnesium. The process involves electrolyzing magnesium chloride to metallic magnesium and chlorine using a carbon electrode. The process leads to the formation of considerable amounts of chlorinated hydrocarbons, including OCS (EPA EA, 1999).

OCS is also produced during degassing of molten aluminum with hexochloroethane (EPA EA, 1999) at aluminum foundries and secondary smelting plants. Hydrogen gas from the surrounding water vapor is readily dissolved in molten aluminum and causes deficient mechanical properties in the resulting aluminum castings. Degassing operations remove the hydrogen gas from the molten aluminum, but emissions from this process have demonstrated high yields of complex organochlorine compounds, including OCS (EPA EA, 1999).

Chemical Characteristics

Persistence and Bioaccumulation

OCS has persistence half-life values in soil of 3 to 6 years and persistence half-life values in air of 1 to 10 hours (EPA, PBT Chemicals Final Rule, October 1999).

OCS has a BCF value of 33,113 and BAF values of greater than 117,000,000 (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

Compared to other PBT chemicals, little is known about the physical-chemical properties of OCS. Due to its low water solubility, OCS rapidly separates from water and binds to sediments and suspended solids. OCS is extremely persistent, and has a high bioaccumulation potential.

Health and Environmental Effects

Toxicity studies in rats showed that OCS caused adverse liver, thyroid, and kidney effects. The studies also showed statistically significant increases in organ weights (e.g., in the liver and kidney), indicating that OCS causes serious organ damage and impaired organ functions. The results of aquatic toxicity studies indicate that OCS is toxic at relatively low concentrations and thus is highly toxic to aquatic organisms (EPA, PBT Chemicals Proposed Rule, January 1999).

Few studies addressing potential human toxicological effects exist because OCS was never an intentionally produced product for which such studies would be commissioned. However, because OCS is structurally similar to HCB and hexachlorobutadiene, it can be assumed that OCS will be similarly toxic and will affect human and environmental health in a similar manner.

OCS may have the potential to interfere with metabolism in fish and to inhibit photosynthesis in algae. In laboratory animals, adverse affects were observed in the kidney, liver and thyroid. OCS may also promote mutagenicity and carcinogenicity, in addition to acting as an endocrine disruptor.

Efforts to Reduce Pollution from the Chemical

EPA has taken numerous steps to regulate and reduce pollution from OCS. EPA has developed a strategic approach to managing OCS that focuses on the development of a more complete fundamental understanding of OCS sources and sinks, and the quantification of OCS released to the environment. In addition, under the Great Lakes Water Quality Guidance, EPA determined that OCS was a Bioaccumulative Chemical of Concern and has developed methodologies for the Great Lakes States and Tribes to adopt water quality standards and enforceable controls on discharges of pollutants. Under the Clean Water Act, OCS is listed as one of the 29 high priority chemicals for development or revision of water quality criteria due to its bioaccumulation potential and toxicity. While solid wastes and air emissions of OCS are not regulated specifically, regulations governing other chlorinated hydrocarbons, such as PCDD/PCDF and HCB, with which OCS is co-generated, have the effect of governing OCS as well. In addition, individual states have recommended ambient water quality values for OCS for drinking water intake and for fish consumption. Furthermore, remediation of sites contaminated with OCS has been successful in several locations, including landfills in the Niagara Falls area.

PENTACHLOROBENZENE

Introduction

Pentachlorobenzene (CAS 608-93-5) is formed by the chlorination of benzene. Pentachlorobenzene is not used as an end product. It is made as an intermediate in the production of the fungicide pentachloronitrobenzene (quintozene) and as an impurity remaining in the end product. Quintozene has been commercially produced since the 1930s and is also referred to as PCNB and PkhNB. It has also been marketed under the following trade names: Avicol, Earthcide, Folosan, Kobu, Kobutol, Pentagen, RTU, PCNB, Terrachlor, Terrazan and Tri-PCNB (EPA EA, 1999). It is a white or colorless crystalline solid with a characteristic pleasant odor.

Sources and Uses

There are no known natural sources of pentachlorobenzene. Pentachlorobenzene is found in the quintozene process waste stream as an unreacted intermediate and in the final product as an impurity. Quintozene is used as a fungicide for seed treatment, soil application, and as a slime inhibitor in industrial waters.

Pentachlorobenzene may also be produced whenever organic compounds are burned in the presence of a chlorine source. Pentachlorobenzene may be produced in small quantities in medical waste incinerators, cement kilns, municipal waste and sewage sludge incinerators, and secondary copper production.

In addition, pentachlorobenzene is present in dielectric fluids, both those currently in use and in those in storage and destined for disposal by destruction.

Chemical Characteristics

Persistence and Bioaccumulation

Pentachlorobenzene has persistence half-life values in soil of 194 days to more than 22 years and persistence half-life values in air of 46 to 460 days (EPA, PBT Chemicals Final Rule, October 1999).

Pentachlorobenzene has a BCF value of 8,318 and BAF values of greater than 640,000. (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

Since pentachlorobenzene is created as a by-product or contaminant during the production of other chlorinated organic substances, it can enter the environment from releases of these compounds during storage, use, transport or disposal.

If released to the soil, it will bind strongly to soil and will not significantly biodegrade. If released to water, pentachlorobenzene will bind strongly to bottom sediments or particulate matter in the water column and evaporates with an estimated half-life of 6.5 hours from a river under average conditions (Spectrum Laboratories, November 2001). It does not significantly biodegrade in water and it bioaccumulates in aquatic and terrestrial organisms. If released to the atmosphere, pentachlorobenzene may bind to particulate matter and be transported over long distances before it is deposited to the earth's surface. It may be subject to significant photodegradation.

Health and Environmental Effects

Laboratory feeding studies on rats indicate that oral exposure to pentachlorobenzene may have serious toxic effects to the kidney and liver, as well as serious hematological effects and developmental effects. The studies show statistically significant increases in organ weights, serious damage to organs and impaired organ functions. Ecotoxicity studies on fish, algae, shrimp, and daphnids indicate acute toxicity values associated with pentachlorobenzene. This indicates that pentachlorobenzene is toxic at relatively low concentrations and thus is highly toxic to aquatic organisms (EPA, PBT Chemicals Proposed Rule, January 1999).

Laboratory experiments demonstrate toxic effects on the reproductive system and the central nervous system. Bioaccumulation occurs in both terrestrial and aquatic organisms.

Human exposure to pentachlorobenzene results from consumption of contaminated drinking water or from food, and inhalation of contaminated air. Pentachlorobenzene may adversely affect the kidneys and liver.

Efforts to Reduce Pollution from the Chemical

EPA has taken steps to regulate and reduce pollution from pentachlorobenzene. It has been included on the RCRA Waste Minimization PBT Chemical List. In Michigan, as in several other Great Lakes states, pentachlorobenzene has been included in a state pollution prevention action plan.

TETRABROMOBISPHENOL A

Introduction

Tetrabromobisphenol A (C6H2Br2OH)2C(CH3)2 (CAS 79-94-7), otherwise known as TBBPA, is a white, crystalline powder that is soluble in methanol and ether. TBBPA is a brominated flame retardant and is often used in plastics and engineering resins for printed circuit boards and computer equipment (EPA EA, 1999).

Sources and Uses

TBBPA is used as a flame retardant. It is used in polymers, such as acrylonitrile-butadiene-styrene (ABS), epoxy and polycarbonate resins, high-impact polystyrene, phenolic resins, adhesives, unsaturated polyester resins, thermoplastic polyesters, and as a replacement for octa-diphenyl-oxide in styrenics.

TBBPA is primarily used as a reactive flame retardant and is often used in electronic equipment, particularly printed circuit boards (EPA EA, 1999). In this form, it is covalently bound to a polymer backbone to produce an oligomer (a polymer that consists of two, three, or four monomers) that is flame retardant When used as an additive flame retardant, TBBPA is mixed with various polymers, but does not react chemically with them. In this form it is used in televisions, VCRs, computer wire and cable, automotive components, TV cabinets, structural cases for electrical and electronic devices, and other thermoplastics (EPA EA, 1999). In these applications TBBPA retains its chemical identity.

Chemical Characteristics

Persistence and Bioaccumulation

TBBPA has persistence half-life values in soil of 44 to 179 days, persistence half-life values in water of 48 to 84 days, and persistence half-life values in air of 1 to 9 days (EPA, PBT Chemicals Final Rule, October 1999).

TBBPA has a BCF values of 780, 1,200, and 3,200. (EPA, PBT Chemicals Final Rule, October 1999).

Environmental Fate and Transport

The majority of objects treated with TBBPA are disposed of in landfills or incinerators. Because of its low water solubility, TBBPA binds to sediment and organic matter in the soil. In aquatic environments, TBBPA binds to bottom sediment or particulate matter in the water column. In soil and aquatic systems, TBBPA is partly degraded under both aerobic and anaerobic conditions (International Programme on Chemical Safety, 1995).

Health and Environmental Effects

Ecotoxicity studies on fish, daphnids, shrimp, oysters, and algae have shown acute toxicity values for TBBPA. The values indicate that TBBPA is toxic at relatively low concentrations and thus is highly toxic to aquatic organisms (EPA, PBT Chemicals Proposed Rule, January 1999).

Laboratory studies have not indicated extremely high toxicity, although decreased body weight, increased spleen weight, and reduced concentration of red blood cells, serum proteins, and serum triglyceride have been observed (International Programme on Chemical Safety, 1995). Limited studies, especially those with human subjects, have been conducted to evaluate the chemical's health effects.

Efforts to Reduce Pollution from the Chemical

Currently, there are very few initiatives to reduce pollution from TBBPA. However, it is recognized that in order to reduce pollution from TBBPA, it must be used correctly and effluents containing TBBPA must be addressed appropriately. In addition, disposal of discarded TBBPA wastes and TBBPA-containing products must be monitored to minimize environmental contamination with this substance and its breakdown products. Incineration of TBBPA-containing materials must take place in equipment with appropriate pollution prevention controls (International Programme on Chemical Safety, 1995).

2000 TRI DATA FOR OTHER PBT CHEMICALS

On-site and Off-site Releases

As shown in Table 3-40, there were 172 TRI forms submitted for 2000 for these PBT chemicals: hexachlorobenzene, octachlorostyrene, pentachlorobenzene and tetrabromobisphenol A (TBBPA). On- and off-site releases for these PBT chemicals totaled 838,914 pounds. Tetrabromobisphenol A had the largest releases of this group, with 797,476 pounds or 95.1 percent of the total releases for these PBT chemicals. Releases of hexachlorobenzene, the chemical with the most number of forms and the second largest releases of these PBT chemicals, were 37,527 pounds (4.5 percent of the total). Pentachlorobenzene followed with 3,326 pounds and octachlorostyrene had 585 pounds.

Off-site releases (transfers to disposal) were the largest type of release for these PBT chemicals, accounting for 65.7 percent of total releases, or 551,362 pounds (see Figure 3-16). Other on-site land releases (that is, other than RCRA subtitle C landfills) were the second largest type of release, accounting for 24.5 percent of total releases or 205,422 pounds. (Types of on-site land releases are described in Box 1-4 in Chapter 1.) Air emissions totaled 63,976 pounds or 7.6 percent of total releases for these PBT chemicals. Surface water discharges and underground injection of these PBT chemicals totaled less than 600 pounds.

For tetrabromobisphenol A (TBBPA), off-site releases were 537,549 pounds, representing 67.4 percent of the total releases for this chemical. Another 197,529 pounds or 24.8 percent were other on-site land releases (that is, other than RCRA subtitle C landfills) and 62,387 pounds or 7.8 percent were air emissions.

Hexachlorobenzene's releases of 37,527 pounds were divided between 16,955 pounds of on-site land releases to RCRA subtitle C landfills (45.2 percent of the total releases for the chemical), 13,021 pounds of off-site releases (transfers to disposal) (34.7 percent of this chemical's total releases total), and 5,745 pounds of other on-site land releases (15.3 percent of the total releases for the chemical).

Pentachlorobenzene's releases were also mainly of these types of releases, with 2,000 pounds of other on-site land releases (that is, other than RCRA subtitle C landfills) representing 60.1 percent of the chemical's total releases, 623 pounds to RCRA subtitle C landfills (18.7 percent of the chemical's total releases) and 355 pounds of off-site releases (transfers to disposal) (10.7 percent of the chemical's total releases).

Three-quarters (437 pounds out of 535 pounds) of the total releases of octachlorostyrene were off-site releases (transfers to disposal). The other releases of octachlorostyrene were other on-site land releases (that is, other than RCRA subtitle C landfills).

Waste Management Data

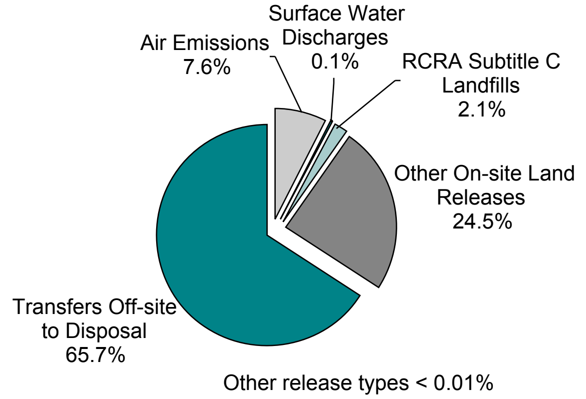
Quantities of TRI Chemicals in Waste

Production-related waste of these PBT chemicals totaled 7.6 million pounds in 2000, as shown in Table 3-41. Much (6.5 million pounds or 85.7 percent) of the total production-related waste was treated on-site (see Figure 3-17). Another 11.1 percent (839,475 pounds) was released on- and off-site.

Hexachlorobenzene accounted for 6.4 million pounds or 84.8 percent of the production-related waste of these PBT chemicals. Most was treated on-site. The 6.2 million pounds of hexachlorobenzene treated on-site represented 95.6 percent of total production-related waste of hexachlorobenzene in 2000.

There were 804,166 pounds of production-related

Figure 3-16: Distribution of TRI On-site and Off-site Releases, 2000: Other PBT Chemicals



Note: **On-site Releases** are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Table 3-40: TRI On-site and Off-site Releases, 2000: Other PBT Chemicals

			On-site Releases							Off-site Releases	
					Underground Injection		On-site Land Releases				
CAS Number	Chemical	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
118-74-1	Hexachlorobenzene	100	1,426.24	331.44	48.37	0.02	16,955.00	5,745.20	24,506.26	13,021.04	37,527.30
29082-74-4	Octachlorostyrene	4	0.00	0.00	0.00	0.00	0.00	148.30	148.30	436.90	585.20
608-93-5	Pentachlorobenzene	20	162.54	173.85	11.90	0.00	623.20	1,999.60	2,971.09	355.00	3,326.09
79-94-7	Tetrabromobisphenol A	48	62,387.41	10.00	0.00	0.00	0.00	197,529.00	259,926.41	537,549.30	797,475.71
	Total	**172**	**63,976.18**	**515.29**	**60.27**	**0.02**	**17,578.20**	**205,422.10**	**287,552.06**	**551,362.24**	**838,914.30**

Note: **On-site Releases** are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

waste of tetrabromobisphenol A (TBBPA) reported for 2000. Almost 97.9 percent (787,143 pounds) of this was released on- and off-site.

The total production-related waste of pentachlorobenzene was 347,425 pounds, with 342,267 pounds treated on-site. On-site treatment accounted for 98.5 percent of total production-related waste of pentachlorobenzene in 2000.

There were 604 pounds of production-related waste of octachlorostyrene reported for 2000. Most (585 pounds) of it was released on- and off-site.

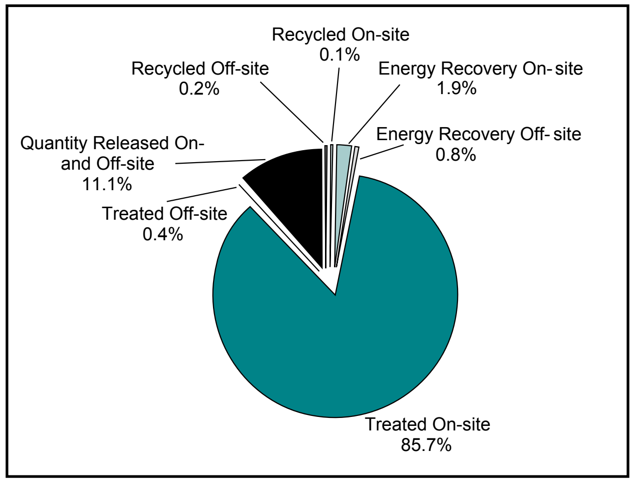
Transfers Off-site for Further Waste Management/Disposal

Transfers off-site for further waste management and disposal of these PBT chemicals totaled almost 679,581 pounds in 2000 (see Table 3-42). Transfers to disposal accounted for 82.7 percent of the transfers for further waste management and disposal (see Figure 3-18). Transfers to energy recovery accounted for 8.6 percent and transfers to treatment for 6.6 percent.

Transfers off-site for further waste management and disposal of tetrabromobisphenol A (TBBPA) totaled 546,096 pounds for 2000, over 98.4 percent of which was off-site transfers to disposal.

For hexachlorobenzene, transfers off-site for further waste management and disposal were 130,882 pounds. Such transfers consisted of 56,586 pounds (43.2 percent) of transfers to energy recovery, 36,956 pounds (28.2 percent) of transfers to treatment, 23,908 pounds (18.3 percent) of other transfers to disposal, and 13,421 pounds (10.3 percent) of transfers to recycling.

Figure 3-17: Quantities of TRI Chemicals in Waste, 2000: Other PBT Chemicals



Note: Data are from Section 8 of Form R.

Transfers off-site for further waste management and disposal of pentachlorobenzene totaled 2,147 pounds with 64.8 percent as transfers to treatment. The 456 pounds of transfers off-site for further waste management and disposal of octachlorostyrene were mostly (95.8 percent) other transfers to disposal.

TRI Data by State

Facilities in Louisiana and Texas, with 15 forms each, submitted the largest number of forms in 2000 for these PBT chemicals. Two states, Alabama and California, each had 12 forms. All other states had less than 9 forms.

Table 3-41: Quantities of TRI Chemicals in Waste Managed, 2000: Other PBT Chemicals

CAS Number	Chemical	Recycled		Energy Recovery		Treated		Quantity Released On- and Off-site	Total Production-related Waste Managed	Non-production-related Waste Managed
		On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	Pounds	Pounds	Pounds
118-74-1	Hexachlorobenzene	6,000.50	12,039.00	140,662.00	56,585.00	6,154,926.17	19,461.15	48,420.58	6,438,094.40	21,752.30
29082-74-4	Octachlorostyrene	0.00	0.00	0.00	0.00	19.00	0.00	585.20	604.20	0.00
608-93-5	Pentachlorobenzene	40.00	401.00	0.00	0.00	342,267.00	1,390.81	3,326.28	347,425.09	2.35
79-94-7	Tetrabromobisphenol A	565.00	10.00	0.00	1,849.00	6,962.00	7,637.00	787,143.11	804,166.11	0.00
	Total	**6,605.50**	**12,450.00**	**140,662.00**	**58,434.00**	**6,504,174.17**	**28,488.96**	**839,475.17**	**7,590,289.80**	**21,754.65**

Note: Data are from Section 8 of Form R.

On- and Off-site Releases

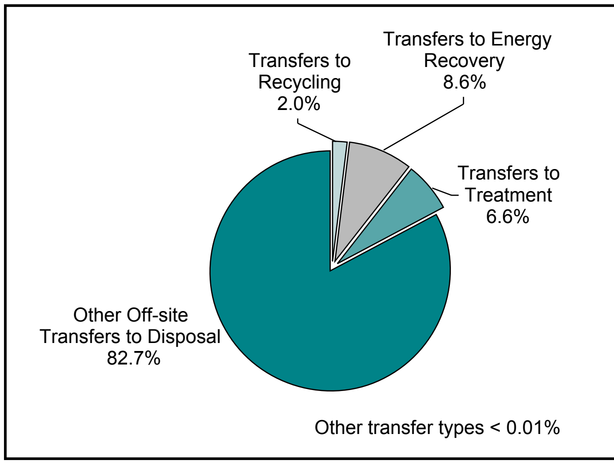
In 2000, facilities in Arkansas reported the largest total on- and off-site releases of these PBT chemicals (see Table 3-43). They reported a total of 749,534 pounds, or 89.3 percent of the total for 2000. South Carolina reported the second largest amount with 20,747 pounds, which was 2.5 percent of the total. Three other states, New York, Pennsylvania, and Louisiana, each had over 10,000 pounds of total releases of these PBT chemicals.

Arkansas' releases consisted of off-site releases (transfers to disposal), other on-site land releases (that is, other than RCRA subtitle C landfills), and air emissions. Off-site releases from Arkansas facilities represented 67.6 percent of total releases in Arkansas, other on-site land releases were 24.8 percent, and air emissions were 7.6 percent.

South Carolina facilities reported 20,747 pounds of total releases, over half of which was off-site releases (transfers to disposal of 10,712 pounds) and almost half was other on-site land releases (land releases to other than RCRA subtitle C landfills of 10,035 pounds).

As shown in Map 3-6, releases of these PBT chemicals were concentrated in Arkansas with 749,534 pounds. Four other states, South Carolina, New York, Pennsylvania and Louisiana, reported more than 10,000 pounds but less than 25,000 pounds of total releases.

Figure 3-18: Distribution of TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Other PBT Chemicals



Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

Waste Management Data

The states with the largest quantity of total production-related waste of these PBT chemicals in 2000 were Louisiana and Texas (see Table 3-43). Louisiana reported 3.1 million pounds of total production-related waste and accounted for 41.3 percent of the total for these PBT chemicals. Texas reported 3.0 million pounds and accounted for 39.8 percent of the total. Arkansas ranked third with 801,611 pounds (10.6 percent of the total).

Both Louisiana and Texas reported most of their production-related waste of these PBT chemicals as

Table 3-42: TRI Transfers Off-site for Further Waste Management/Disposal, 2000: Other PBT Chemicals

CAS Number	Chemical	Transfers to Recycling	Transfers to Energy Recovery	Transfers to Treatment	Transfers to POTWs: Metals and Metal Compounds	Transfers to POTWs: Non-metal TRI Chemicals	Other Off-site Transfers*	Other Off-site Transfers to Disposal**	Total Transfers for Further Waste Management/ Disposal
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
118-74-1	Hexachlorobenzene	13,421.00	56,586.00	36,956.28	0.00	10.66	0.00	23,908.04	130,881.98
29082-74-4	Octachlorostyrene	0.00	0.00	19.00	0.00	0.00	0.00	436.90	455.90
608-93-5	Pentachlorobenzene	401.00	0.00	1,390.81	0.00	0.00	0.00	355.00	2,146.81
79-94-7	Tetrabromobisphenol A	0.00	1,829.00	6,716.79	0.00	1.00	0.00	537,549.30	546,096.09
	Total	**13,822.00**	**58,415.00**	**45,082.88**	**0.00**	**11.66**	**0.00**	**562,249.24**	**679,580.78**

Note: Total Transfers Off-site for Further Management/Disposal are from Section 6 of Form R.

* Other Off-site Transfers are transfers reported without a valid waste management code.
** Does not include transfers to POTWs of metals and metal compounds.

Table 3-43: Summary of TRI Information by State, 2000: Other PBT Chemicals

State	Total Forms	On-site Releases							Off-site Releases	
				Underground Injection		On-site Land Releases				
	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
	Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Alabama	12	1,136.04	0.00	0.00	0.00	1,349.00	0.00	2,485.04	22.00	2,507.04
Arizona	2	2.00	0.00	0.00	0.00	0.00	0.00	2.00	268.00	270.00
Arkansas	8	57,227.00	0.00	0.00	0.00	0.00	185,598.00	242,825.00	506,709.00	749,534.00
California	12	158.51	0.01	0.00	0.00	610.00	0.00	768.52	399.00	1,167.52
Colorado	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Connecticut	3	6.30	0.00	0.00	0.00	0.00	0.00	6.30	263.40	269.70
Delaware	6	2.10	58.50	0.00	0.00	0.00	0.00	60.60	1,943.90	2,004.50
Florida	2	12.00	0.00	0.00	0.00	0.00	0.00	12.00	601.00	613.00
Georgia	3	15.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	15.00
Illinois	8	285.00	0.00	0.47	0.00	0.00	0.00	285.47	5.00	290.47
Indiana	4	250.10	10.00	0.00	0.00	0.00	0.00	260.10	1,200.00	1,460.10
Iowa	2	60.00	0.00	0.00	0.00	0.00	0.00	60.00	0.00	60.00
Kansas	1	0.00	0.00	8.00	0.00	0.00	0.00	8.00	0.00	8.00
Kentucky	3	0.11	0.00	0.00	0.00	0.00	0.00	0.11	0.18	0.29
Louisiana	15	350.45	18.21	0.00	0.00	11,000.00	42.90	11,411.56	510.50	11,922.06
Maryland	2	0.00	0.70	0.00	0.00	0.00	139.30	140.00	0.00	140.00
Massachusetts	1	0.00	0.00	0.00	0.00	0.00	315.00	315.00	315.00	630.00
Michigan	5	76.20	0.00	0.00	0.00	2,029.00	0.00	2,105.20	116.00	2,221.20
Minnesota	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mississippi	6	1.40	86.20	23.80	0.00	0.00	4,263.90	4,375.30	0.00	4,375.30
Missouri	2	16.00	0.00	0.00	0.00	0.00	0.00	16.00	0.00	16.00
Montana	1	10.80	0.00	0.00	0.00	0.00	0.00	10.80	0.00	10.80
Nebraska	1	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
New Hampshire	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
New Jersey	4	124.88	12.00	0.00	0.00	0.00	0.00	136.88	3.00	139.88
New York	5	60.52	0.30	0.00	0.00	0.00	0.00	60.82	14,490.70	14,551.52
North Carolina	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ohio	7	13.57	0.00	0.00	0.00	0.00	0.00	13.57	673.20	686.77
Oregon	6	0.00	0.00	0.00	0.00	2,336.00	0.00	2,336.00	32.80	2,368.80
Pennsylvania	6	2,790.31	0.07	0.00	0.00	0.00	0.00	2,790.38	9,769.00	12,559.38
South Carolina	4	0.00	0.00	0.00	0.00	0.00	10,035.00	10,035.00	10,712.00	20,747.00
Tennessee	7	88.40	277.00	0.00	0.00	0.00	2,836.00	3,201.40	0.00	3,201.40
Texas	15	357.50	52.30	28.00	0.02	254.20	0.00	692.02	1,208.00	1,900.02
Utah	4	0.00	0.00	0.00	0.00	0.00	611.00	611.00	75.56	686.56
Washington	5	930.00	0.00	0.00	0.00	0.00	0.00	930.00	464.00	1,394.00
West Virginia	1	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Wisconsin	1	0.00	0.00	0.00	0.00	0.00	1,581.00	1,581.00	1,581.00	3,162.00
Total	**172**	**63,976.18**	**515.29**	**60.27**	**0.02**	**17,578.20**	**205,422.10**	**287,552.06**	**551,362.24**	**838,914.30**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

treated on-site. Over 3.0 million pounds (96.0 percent) of Louisiana's production-related waste was treated on-site, and almost 3.0 million pounds (99.0 percent) of production-related waste in Texas was.

Arkansas reported the largest quantity released on- and off-site, with 751,969 pounds, which was 93.8 percent of total production-related waste for Arkansas in 2000 for these PBT chemicals.

TRI Data by Industry (2-digit SIC Code)

On- and Off-site Releases

Only nine industry sectors reported releases of these PBT chemicals in 2000. The chemical manufacturing sector reported the largest total releases of any industry sector, with 765,445 pounds or 91.2 percent of the total releases (see Table 3-44). Two-thirds (512,291 pounds) of the releases for the chemicals industry were off-site releases (transfers to disposal). One-quarter (192,880 pounds) of the releases for the chemicals industry were other on-site land releases (that is, other than RCRA subtitle C landfills). Almost 59,476 pounds of air emissions of these PBT chemicals were reported by the chemicals industry, accounting for 7.8 percent of total releases for this industry.

Table 3-43: Summary of TRI Information by State, 2000: Other PBT Chemicals (continued)

State	Recycled		Energy Recovery		Treated		Quantity Released On- and Off-site	Total Production-related Waste Managed	Non-production-related Waste Managed
	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	Pounds	Pounds	Pounds
Alabama	0.10	0.00	0.00	10.10	0.00	973.20	2,505.00	3,488.40	0.30
Arizona	0.00	0.00	0.00	345.00	0.00	1,500.00	270.00	2,115.00	0.00
Arkansas	0.00	0.00	11,600.00	12.00	36,382.00	1,648.00	751,969.22	801,611.22	0.00
California	6,000.00	0.00	0.00	56,527.00	2,100.00	192.00	1,152.52	65,971.52	0.00
Colorado	0.00	1,300.00	0.00	0.00	0.00	0.00	0.00	1,300.00	0.00
Connecticut	565.00	10.00	0.00	10.00	0.00	10.00	267.40	862.40	1.00
Delaware	40.00	0.00	0.00	0.00	0.00	0.00	2,004.50	2,044.50	0.00
Florida	0.00	0.00	0.00	0.00	0.00	1,964.00	613.00	2,577.00	0.00
Georgia	0.30	0.00	0.00	0.00	2.00	0.00	15.00	17.30	0.00
Illinois	0.00	0.00	0.00	109.00	975.00	98.00	290.47	1,472.47	0.00
Indiana	0.00	0.00	17,913.00	46.90	90.00	0.00	1,544.10	19,594.00	0.00
Iowa	0.00	0.00	0.00	0.00	0.00	1.00	60.00	61.00	0.00
Kansas	0.00	0.00	0.00	0.00	0.00	22.00	8.00	30.00	0.00
Kentucky	0.00	2.00	0.00	0.00	893.30	16.00	0.29	911.59	0.00
Louisiana	0.10	0.00	110,000.00	0.00	3,008,256.00	4,232.92	11,419.05	3,133,908.07	12.55
Maryland	0.00	0.00	0.00	0.00	0.00	0.00	140.00	140.00	0.00
Massachusetts	0.00	0.00	0.00	0.00	0.00	0.00	315.00	315.00	0.00
Michigan	0.00	0.00	0.00	0.00	81.00	18.02	2,220.90	2,319.92	0.00
Minnesota	0.00	0.00	0.00	0.00	7.00	5.00	0.00	12.00	0.00
Mississippi	0.00	0.00	0.00	0.00	0.00	0.20	4,375.30	4,375.50	0.00
Missouri	0.00	0.00	0.00	0.00	0.00	640.00	16.00	656.00	0.00
Montana	0.00	0.00	0.00	0.00	0.00	0.00	10.80	10.80	0.00
Nebraska	0.00	0.00	0.00	0.00	8,327.00	0.00	1.00	8,328.00	0.00
New Hampshire	0.00	0.00	0.00	0.00	0.00	2,988.00	0.00	2,988.00	0.00
New Jersey	0.00	0.00	0.00	0.00	102,389.00	2,984.00	138.88	105,511.88	0.00
New York	0.00	0.00	0.00	1,374.00	226.00	0.00	14,569.72	16,169.72	21,700.00
North Carolina	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.20	0.00
Ohio	0.00	0.00	0.00	0.00	236,061.00	3.00	691.77	236,755.77	0.00
Oregon	0.00	0.00	0.00	0.00	0.00	66.92	2,368.80	2,435.72	0.00
Pennsylvania	0.00	0.00	0.00	0.00	603.00	107.00	12,549.00	13,259.00	0.00
South Carolina	0.00	0.00	0.00	0.00	0.00	0.10	10,712.00	10,712.10	0.00
Tennessee	0.00	0.00	0.00	0.00	113,272.00	4,832.00	3,201.40	121,305.40	0.00
Texas	0.00	11,138.00	1,149.00	0.00	2,991,094.00	5,572.40	12,788.40	3,021,741.80	40.80
Utah	0.00	0.00	0.00	0.00	3,415.87	210.00	686.56	4,312.43	0.00
Washington	0.00	0.00	0.00	0.00	0.00	405.10	989.00	1,394.10	0.00
West Virginia	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00
Wisconsin	0.00	0.00	0.00	0.00	0.00	0.00	1,581.00	1,581.00	0.00
Total	**6,605.50**	**12,450.00**	**140,662.00**	**58,434.00**	**6,504,174.17**	**28,488.96**	**839,475.17**	**7,590,289.80**	**21,754.65**

Note: Data are from Section 8 of Form R.

The electrical equipment industry had the second largest total releases, with 27,850 pounds of total releases. Off-site releases (transfer to disposal) accounted for 57.1 percent (15,915 pounds) of total releases of the electrical equipment industry. This sector also reported 11,931 pounds of other on-site land releases (that is, other than RCRA subtitle C landfills), representing 42.8 percent of total releases of the electrical equipment industry.

The hazardous waste/solvent recovery industries reported the third largest amount of total releases, with 17,751 pounds, and the largest on-site land releases to RCRA subtitle C landfills, with 17,324 pounds. On-site land releases to RCRA subtitle C landfills accounted for 97.6 percent of releases to RCRA subtitle C landfills of these PBT chemicals by the hazardous waste/solvent recovery industries in 2000.

Waste Management

The chemical manufacturing industry reported the largest amount of total production-related waste of these PBT chemicals in 2000 (see Table 3-44). With 7.0 million pounds of production-related waste, this industry sector accounted for 91.8 percent of all production-related waste of these PBT chemicals.

Map 3-6: Total On- and Off-site Releases, 2000: Other PBT Chemicals

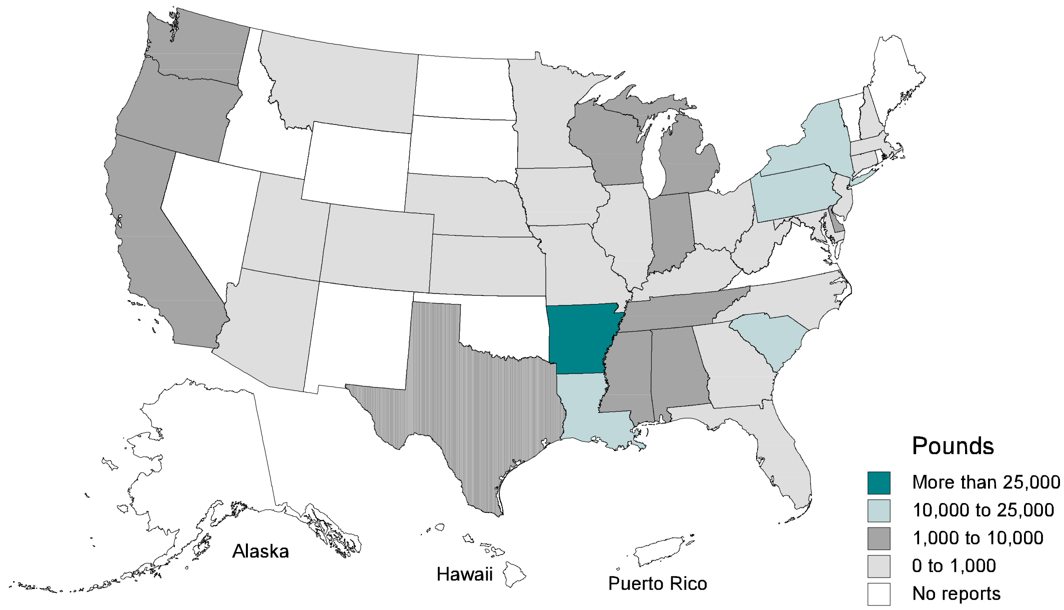


Table 3-44: Summary of TRI Information by Industry, 2000: Other PBT Chemicals

			On-site Releases							Off-site Releases	
					Underground Injection		On-site Land Releases				
SIC Code	Industry	Total Forms	Total Air Emissions	Surface Water Discharges	Class I Wells	Class II-V Wells	RCRA Subtitle C Landfills	Other On-site Land Releases	Total On-site Releases	Transfers Off-site to Disposal	Total On- and Off-site Releases
		Number	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
24	Lumber	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	Chemicals	71	59,475.76	511.85	32.27	0.02	254.20	192,880.10	253,154.20	512,291.00	765,445.20
30	Plastics	13	2,893.40	0.00	0.00	0.00	0.00	0.00	2,893.40	12,666.70	15,560.10
32	Stone/Clay/Glass	2	1.10	0.00	0.00	0.00	0.00	0.00	1.10	0.00	1.10
33	Primary Metals	6	243.00	0.00	0.00	0.00	0.00	611.00	854.00	32.80	886.80
36	Electrical Equip.	8	4.31	0.00	0.00	0.00	0.00	11,931.00	11,935.31	15,915.00	27,850.31
37	Transportation Equip.	4	933.50	0.00	0.00	0.00	0.00	0.00	933.50	464.00	1,397.50
	Multiple codes 20-39	8	164.50	0.00	0.00	0.00	0.00	0.00	164.50	0.00	164.50
	No codes 20-39	2	71.00	0.00	0.00	0.00	0.00	0.00	71.00	0.00	71.00
	Subtotal Original Industries	**137**	**63,786.56**	**511.85**	**32.27**	**0.02**	**254.20**	**205,422.10**	**270,007.00**	**541,369.50**	**811,376.50**
491/493	Electric Utilities	10	131.48	0.08	0.00	0.00	0.00	0.00	131.56	9,655.00	9,786.56
4953/7389	Hazardous Waste/Solvent Recovery	25	58.14	3.36	28.00	0.00	17,324.00	0.00	17,413.50	337.74	17,751.24
	Subtotal for New Industries	**35**	**189.62**	**3.44**	**28.00**	**0.00**	**17,324.00**	**0.00**	**17,545.06**	**9,992.74**	**27,537.80**
	Total	**172**	**63,976.18**	**515.29**	**60.27**	**0.02**	**17,578.20**	**205,422.10**	**287,552.06**	**551,362.24**	**838,914.30**

Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Most of the chemicals industry's production-related waste (85.9 percent or 6.0 million pounds) was treated on-site and 11.2 percent (778,311 pounds) was released on- and off-site.

The hazardous waste/solvent recovery industries had the second largest total production-related waste of these PBT chemicals in 2000, with 540,803 pounds. Over 96.3 percent (520,956 pounds) of the hazardous waste/solvent recovery industries' production-related waste was treated on-site. The quantity released on- and off-site accounted for 3.3 percent (17,760 pounds) of these industries' production-related waste.

Three other industry sectors reported about 20,000 pounds of these PBT chemicals in 2000. The stone/clay/glass sector reported 29,561 pounds, mostly as energy recovery on-site. The plastics industry reported 19,394 pounds, primarily released on- and off-site. The electrical equipment industry reported 17,641 pounds, also primarily released on- and off-site.

Projected Quantities of TRI Chemicals Managed in Waste, 2000-2002

TRI facilities expected to decrease their production-related waste of these PBT chemicals between 2000 and 2002 by 1.5 percent, from 7.6 million pounds to 7.5 million pounds (see Table 3-45). The projected decrease was expected to occur primarily from 2000 to 2001, with a 0.9 percent decrease and a projected decrease of 0.6 percent from 2001 to 2002.

The decrease was projected to occur in most types of waste management activity. Treatment on-site (the activity with the largest amounts) was projected to decrease by 1.5 percent from 2000 to 2002. The quantity released on- and off-site (the activity with the second largest amounts) was projected to increase from 2000 to 2002. The expected increase was 0.7 percent. On- and off-site releases are the least-desirable outcome under the waste management hierarchy described in Waste Management in Chapter 1 (Figure 1-2).

Source Reduction

In 2000, 19 forms were filed reporting source reduction activities for these PBT chemicals (see Table 3-46). As noted in Waste Management in Chapter 1, source reduction—an activity that prevents the generation of waste—is the preferred waste management option. These 19 forms represented 11.0 percent of all forms submitted for these these PBT chemicals in 2000.

Table 3-44: Summary of TRI Information by Industry, 2000: Other PBT Chemicals (continued)

		Recycled		Energy Recovery		Treated				
SIC Code	Industry	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	On-site Pounds	Off-site Pounds	Quantity Released On- and Off-site Pounds	Total Production-related Waste Managed Pounds	Non-production-related Waste Managed Pounds
24	Lumber	0.50	0.00	0.00	0.10	0.00	1.00	0.10	1.70	0.30
28	Chemicals	6,040.00	12,440.00	111,149.00	56,537.00	5,983,205.00	20,984.34	778,310.89	6,968,666.23	21,754.35
30	Plastics	565.00	0.00	0.00	0.00	1.00	3,232.00	15,595.80	19,393.80	0.00
32	Stone/Clay/Glass	0.00	0.00	29,513.00	46.90	0.00	0.00	1.32	29,561.22	0.00
33	Primary Metals	0.00	0.00	0.00	0.00	0.00	276.62	886.80	1,163.42	0.00
36	Electrical Equip.	0.00	0.00	0.00	1,719.00	3.00	0.00	15,919.31	17,641.31	0.00
37	Transportation Equip.	0.00	10.00	0.00	10.00	0.00	415.00	990.00	1,425.00	0.00
	Multiple codes 20-39	0.00	0.00	0.00	109.00	9.00	1,505.00	164.50	1,787.50	0.00
	No codes 20-39	0.00	0.00	0.00	0.00	0.00	0.00	71.00	71.00	0.00
	Subtotal New Industries	**6,605.50**	**12,450.00**	**140,662.00**	**58,422.00**	**5,983,218.00**	**26,413.96**	**811,939.72**	**7,039,711.18**	**21,754.65**
491/493	Electric Utilities	0.00	0.00	0.00	0.00	0.00	0.00	9,775.88	9,775.88	0.00
4953/7389	Hazardous Waste/Solvent Recovery	0.00	0.00	0.00	12.00	520,956.17	2,075.00	17,759.58	540,802.75	0.00
	Subtotal New Industries	**0.00**	**0.00**	**0.00**	**12.00**	**520,956.17**	**2,075.00**	**27,535.46**	**550,578.63**	**0.00**
	Total	**6,605.50**	**12,450.00**	**140,662.00**	**58,434.00**	**6,504,174.17**	**28,488.96**	**839,475.17**	**7,590,289.80**	**21,754.65**

Note: Data are from Section 8 of Form R.

Table 3-45: Current Year and Projected Quantities of TRI Chemicals in Waste, 2000: Other PBT Chemicals

Waste Management Activity	Current Year 2000		Projected 2001		Projected 2002	
	Total Pounds	Percent of Total	Total Pounds	Percent of Total	Total Pounds	Percent of Total
Recycled On-site	6,605.50	0.1	7,382.80	0.1	7,808.80	0.1
Recycled Off-site	12,450.00	0.2	10,472.00	0.1	10,742.00	0.1
Energy Recovery On-site	140,662.00	1.9	137,800.00	1.8	137,800.00	1.8
Energy Recovery Off-site	58,434.00	0.8	46,818.10	0.6	46,821.10	0.6
Treated On-site	6,504,174.17	85.7	6,454,479.87	85.8	6,403,432.87	85.6
Treated Off-site	28,488.96	0.4	25,621.42	0.3	26,970.42	0.4
Quantity Released On- and Off-site	839,475.17	11.1	843,081.87	11.2	845,679.76	11.3
Total Production-related Waste Managed	**7,590,289.80**	**100.0**	**7,525,656.06**	**100.0**	**7,479,254.95**	**100.0**
Waste Management Activity	**Projected Change 2000-2001**		**Projected Change 2001-2002**		**Projected Change 2000-2002**	
	Percent		Percent		Percent	
Recycled On-site	11.8		5.8		18.2	
Recycled Off-site	-15.9		2.6		-13.7	
Energy Recovery On-site	-2.0		0.0		-2.0	
Energy Recovery Off-site	-19.9		0.0		-19.9	
Treated On-site	-0.8		-0.8		-1.5	
Treated Off-site	-10.1		5.3		-5.3	
Quantity Released On- and Off-site	0.4		0.3		0.7	
Total Production-related Waste Managed	**-0.9**		**-0.6**		**-1.5**	

Note: Current year and projected amounts are from Section 8 of Form R for 2000.

The most frequently reported source reduction activity for these PBT chemicals was good operating practices, with 10 forms. Other source reduction activities included process modifications (listed on 7 forms), raw materials modifications (on 5 forms), and spill and leak prevention (on 4 forms).

Table 3-46: Forms Reporting Source Reduction Activity, by Category, 2000: Other PBT Chemicals

CAS Number	Chemical	Total Form Rs	Forms Reporting Source Reduction Activity		Category of Source Reduction Activity							
				Percent of All Form Rs	Good Operating Practices	Inventory Control	Spill and Leak Prevention	Raw Materials Modifications	Process Modifications	Cleaning and Degreasing	Surface Preparation and Finishing	Product Modifications
		Number	Number	Percent	Number	Number	Number	Number	Number	Number	Number	Number
118-74-1	Hexachlorobenzene	100	12	12.0	5	2	3	1	4	0	1	0
29082-74-4	Octachlorostyrene	4	0	0.0	0	0	0	0	0	0	0	0
608-93-5	Pentachlorobenzene	20	0	0.0	0	0	0	0	0	0	0	0
79-94-7	Tetrabromobisphenol A	48	7	14.6	5	0	1	4	3	0	0	1
	Total	**172**	**19**	**11.0**	**10**	**2**	**4**	**5**	**7**	**0**	**1**	**1**

Note: All source reduction activities on a form are counted in the corresponding category. Totals do not equal the sum of the categories because forms may report more than one source reduction activity.

TRI Data for Hexachlorobenzene Before 2000

Of these PBT chemicals, only hexachlorobenzene was on the TRI list before 2000. Reporting for hexachlorobenzene before 2000 was based on the higher TRI thresholds of 25,000 pounds for manufacture or processing of the chemical and 10,000 pounds for otherwise using the chemical. For the reporting year 2000, these thresholds were reduced to 10 pounds for manufacture, processing or otherwise using hexachlorobenzene. Lowering the threshold, in effect, adds reports by those facilities whose activities were below the higher threshold. Consequently, the amounts for 2000 are not comparable with those for prior years.

Box 3-8 has TRI data reported for hexachlorobenzene before 2000.

Box 3-8: TRI Data for Hexachlorobenzene Before 2000

Following is a brief summary of releases and transfers and total production-related waste for hexachlorobenzene for 1998 and 1999. This table includes reporting by both original and new industries.

TRI Data for Hexachlorobenzene, 1998-1999

	1998	**1999**	**Change 1998-1999**	
	Number	Number	Number	Percent
Forms	17	20	3	17.6
	Pounds	Pounds	Pounds	Percent
On-site Releases	486	13,602	13,116	2,698.8
Off-site Releases (Transfers to Disposal)	13,328	1,506	-11,822	-88.7
Total On- and Off-site Releases	**13,814**	**15,108**	**1,294**	**9.4**
Total Production-related Waste Managed	**1,872,471**	**5,852,454**	**3,979,983**	**212.6**

Hexachlorobenzene have been on the TRI chemical list since the beginning of TRI. The following is a summary of releases and transfers for 1988-1999. This table does not include reporting by new industries for 1998 and 1999 since new industries did not report to TRI before 1998.

TRI Data for Hexachlorobenzene, 1988-1999

	1988	**1995**	**1998**	**1999**	**Change 1988-1999**	
	Number	Number	Number	Number	Number	Percent
Forms	9	9	12	14	5	55.6
	Pounds	Pounds	Pounds	Pounds	Pounds	Percent
On-site Releases	4,459	7,504	471	590	-3,869	-86.8
Off-site Releases (Transfers to Disposal)	443,541	6,975	13,251	13,550	-429,991	-96.9
Total On- and Off-site Releases	**448,000**	**14,479**	**13,722**	**14,140**	**-433,860**	**-96.8**

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